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INTERNATIONAL ASPECTS OF RECONSTRUCTION

BEFORE the United States entered the War, the question of Anglo-American co-operation after the War and the implications of the fifth article of the Atlantic Charter were under discussion, and attempts were being made to face the more obvious difficulties which will confront the world in the years to come. Speeches by Mr. Attlee and Mr. Eden, as well as by Mr. Sumner Welles, revealed agreement not only on ultimate purpose but also on some of the measures by which those purposes should be pursued. Mr. Eden's broadcast following his visit to Moscow showed that the confidence entertained that the Soviet Government will fully support those purposes and measures is well founded. Moreover, the announcement made by President Roosevelt during Mr. Churchill's visit to Washington that all barriers to the full pooling of reserves between Canada and the United States would be removed, in accordance with the recommendations of the Joint War Production Committee of Canada and the United States, indicates that unity of command in the military, naval and air operations is being accompanied by equal unity in the economic sphere.

The tendency to unity has thus been greatly accelerated by Japanese aggression, and the disturbance in the economic sphere arising out of the immediate Japanese gains in Thailand, Malaya, the Philippines and Borneo raises problems in the sphere of production and war economy no less difficult than those offered to war strategy and tactics in the military or naval sphere. Only concerted economic policy can enable the available resources of the free nations to be devoted to the maximum production essential for the overthrow of the aggressor nations. The effort and sacrifices required of every citizen in the nations linked together in the defence of freedom must be inspired by a common policy, just as the efforts of the armed forces must be guided by a grand strategy.

The Washington and Moscow conferences have clearly laid the foundations for such a policy in the prosecution of the War, and there are equally clear indications that concerted measures and policy will not be laid aside immediately the War comes to an end. There may be differences of opinion as to the extent to which effort can at present be devoted to planning while the war effort has still to reach its peak, but Mr. Churchill's speech to Congress shows that the lessons of twenty-five years ago are impressed on the minds of our leaders ; that it is no empty hope, in the words of his peroration, that "the British and American peoples will for their own safety and for the good of all walk together in majesty, in justice and in peace". The urgent needs of war are fashioning habits and weapons of co-operation that it would be the height of folly to destroy before we have determined how far or with what modifications they might equally serve the purposes of peace.

Much indeed has happened to give impetus to Anglo-American co-operation since Mr. Harold Butler wrote so wisely and presciently of it in his brilliant book "The Lost Peace". Our hopes both of economic revival and of a stable peace rest largely on the assumption by the English-speaking countries of their responsibilities for leadership in a bold and broad spirit. Such leadership, in which constructive statesmanship, stimulated by the strong social consciousness manifest in both countries and in the Dominions, with as general objective not only the restoration of economic stability but also the progressive improvement of standards throughout the Continent, may well prove the surest way of consolidating our friendship and understanding with the Soviet Government, and of enlisting a degree of willing co-operation from the neutral as well as Allied Governments which would not be obtained by any political appeal.

Given both the general objective and the broad lines of policy, there are still many difficult problems to be resolved before even at the end of hostilities effective action in their furtherance is possible. There is the problem of the future of Germany inherent in the realization of such a common primary aim as that of ensuring that German aggression shall never endanger the peace of the world. There is the related problem of the basis of a system of collective security on which Mr. Butler writes succinctly and sagely. There are all the immense problems of restarting the economic life of the world, the planning of post-war industry, the reconstruction of world trade and the like, with the further complications in the way of supplies and diversion or redistribution of industrial activity which the outbreak of war in the Far East has already necessitated.

If we are not to be overwhelmed by the magnitude of so stupendous a task or engulfed in non-essentials and irrelevances, the clear recognition of ultimate objectives and of fundamental principles is essential. Only so can we keep a sense of perspective when we come to the discussion of particular intricate problems, as Prof. J. B. Condliffe has done in a recent admirable analysis of the reconstruction of world trade*. In its absence, a certain air of unreality is attached to some of the discussions on the machinery of international organization like federal union. Mr. Butler suggests that the British and American peoples will go farther and faster along the road together if they keep their national identities, than if they try to merge them in a common government, which would not be palatable to either. What matters most is in fact not the form of the machinery or organization but the spirit in which it is used. The machinery can be modified or shaped to reach the desired purpose, given the spirit and the will, but in their absence any machinery may be wrecked or left idle. That, as Mr. Butler sees it, is essentially the lesson of the last peace. For lack of will and lack of vision, organization which might have served the peace was never really used, and unless we can bring to the service of the new order of security and peace something which will inspire the coming generations with the same enthusiasm and the same spirit of sacrifice that the defence of freedom now evokes in the youth of so many lands in war, that new order will not be durable. In the great tasks ahead of us we have to enlist all the idealism and devotion of the best men and women in the world. As Mr. Butler reminds us, love and charity are the only foundations upon which a real civilization can be built, and a real and lasting peace will come only when the notion of service is expanded beyond national boundaries and foreign policy is guided by Oliver Cromwell's maxim: "God has not brought us hither where we are but to consider the work we may do in the world as well as at home".

From such a constructive idealism our plans and our lines of advance must start. With it must go the readiness to learn the lessons of the past and to shape new methods if the old or traditional ones are inadequate to our purpose. The sober realism that tempers Mr. Butler's judgment on the lost peace must guide our handling of the reconstruction that will begin when the War ends, and of the planning and preparation that must already be put in hand. We cannot postpone this realistic attempt to organize the economic and political life of the world on broader, more international lines. We can avoid the mistake of thinking of the world in nineteenth-century terms, which did so much to lose the last peace, and we can profit from the failure of our first experience in organizing the world for peace by reading its lessons aright.

Fortunately, much of our experience in the War itself is forcing us to recognize not merely the economic unification of the world under the pressure of technical progress but also the political consequences, just as organization being established to serve immediate war purposes is equally apt to serve those of economic relief after the War. We should recognize further not only that some new form of international organization is indispensable if war is to be banished, but also with that the extent to which our civilization still owes its vitality, its culture and its rich diversity to the national ideal. Sound opinions on vital aspects of post-war policy must, as an admirable report of the Committee on Reconstruction produced by the Royal Institute of International Affairs, issued for private circulation, points out, be based on accurate information, and much in the programme of inquiries suggested by the committee is relevant to the winning of the War. No policy based on reason can be consistently and effectively applied in the absence of a certain degree of unity and steadiness in the public mind.

It is the function of the discussions and inquiries proceeding to contribute to the formation of sound public opinion as well as to the maintenance of moral and the provision of a basis for policy and action at the right time. In all this, preservation of a sane balance is a first essential. A sane balance between town and country is a prime requirement in national policy and stability. Social equilibrium is the first requisite of political stability, and ultimately the political, economic and social security of nations depends mainly on the extent to which the conjugation of their national policies is calculated to prevent international disorder and secure economic

* The Reconstruction of World Trade. By Prof. J. B. Condliffe. Pp. 427. (London: George Allen and Unwin, Ltd., 1941.) 12*s*. 6*d*. net.

stability. The reconciliation of both national and international needs under the stress of war is being effected under our eyes. It will issue in a durable peace when men, as in science itself, are the servants of some purpose capable of satisfying their spiritual instincts and setting them on a new adventure in the quest of higher things.

DOMINATION OR RELATIONSHIP?

The Impulse to Dominate
By D. W. Harding. Pp. 256. (London: George Allen and Unwin, Ltd., 1941.) 7*s.* 6*d.* net.

ANY serious attempt to survey the psychological causes of war is noteworthy. But a work which leads logically and inevitably to the conclusion that war is inherent in our social pattern, relying as this essentially does upon dominative and prestige values, must challenge our best attention. In D. W. Harding's book, the author traces our individual failure in responsibility to two main problems. On one hand we need to become aware of certain unconscious tendencies which have fostered, and still maintain, the relation of domination or submission as the evolutionary ground-pattern in the development of our social and international relationships. On the other hand, the extreme complexity of the political issues of the great modern States makes it well-nigh impossible for the inexpert citizen, however intelligent, to participate responsibly in the crucial decisions of statesmanship. Since little can be done to reduce the latter factor to manageable proportions, the author wisely focuses attention upon those unconscious tendencies which can be largely modified through the cultivation of psychological responsibility.

Without minimizing the contribution which Freud and his followers have made in reducing the cause of war to the existence of infantile aggression and sadism, the author trims the balance by bringing into relief the basic dominative pattern which pervades our whole social atmosphere and which, therefore, must be regarded as a *representation collective* (Lévy-Bruhl), namely, an emotional preconception which everybody acts upon but nobody thinks.

Inasmuch as the author has called his work "The Impulse to Dominate", one could have wished for more enlightenment on the immense biological tail which civilized man has to draw after him in the realm of these archaic instincts. The general relation of the impulse to dominate to an underlying sense of insecurity is correctly stressed, but the perspective whereby this civilized mechanism is seen to derive its original dynamism from the primordial state whence, through the creation of communal solidarity, precarious solitariness was converted into a status of biological power and superiority, is strangely omitted. The author discusses Perry's anthropological evidence in support of the theory that violence is a cultural product and not, therefore, indigenous to our fundamental instinctual make-up. But Perry's contention that aggressiveness is a kind of diffusional accident is shown to be psychologically untenable, since it is impossible to believe that human beings could have built up a fundamental social structure which had no relation to their basal instincts. The fact that certain primitive tribes make violence their primary concern, while others, like the Eskimo, have produced an effective cultural breakwater against aggression, merely illustrates the difference of attitude with which the primitive mind has become adapted to a vital social problem. Perry's anthropological evidence is none the less significant. If the Eskimo have succeeded in creating a non-aggressive social pattern by a peculiar sense for communal responsibility, it is surely possible for us in the face of immediate necessity to cultivate the integrative pattern of relationship instead of the dominative. This fundamental change in attitude comes into the realm of the feasible, when it is borne in mind that the impulse to dominate is countered by its opposite, which might be called communal solidarity, or relatedness. When the one hypothesis leads us to the very brink of chaos, it is conceivable that a human migration towards the other pole will eventually create a sense of community among men in which the bare threat of domination will evoke instant response like that of the fire-alarm. The nation-wide discipline of fire-watching could even be regarded as a first step towards the development of a general attitude of responsibility in regard to the latent archaic potentialities in human nature. The author's insistence throughout the book upon the superiority of the integrative type of relation—based essentially upon a living feeling for human individuality—is supported by psycho-therapeutic experience. It is indeed in the cultivation of a relation of candour between patient and doctor, in which the distinctivenes and totality of the personality are unreservedly accepted, that the healing value lies.

From the psychological point of view, the only criticism of Harding's work that can be made (though a significant one) is the omission of any reference to the general dynamic determinants which are comprised in the various national myths. The myth of a people is more than a poetic heirloom. It is an incalculable storehouse of explosive energy, as we have seen to our cost in the resurgence of the tribal myth in Germany and Japan. The term 'pattern' is altogether too static and thin to comprehend the stupendous reserves of energy-potential which are evoked from the racial unconscious in times of national crisis. This omission is all the more singular inasmuch as the author's somewhat discursive review of the various regressive social phenomena of war-time, such as acquiescence, credulity, sadism, cruelty and sexual interest, demands just this comprehensive conception of the activation of the archaic unconscious to bring the total picture into a comprehensive focus. In point of fact, it was the abundance of similar evidence of archaistic social tendencies which led Jung in the first place to postulate the existence of a general unconscious. The author perceives the psychological inadequacy of the attempt to explain the war-time psyche from analysable factors in the personal unconscious, but he apparently recoils from the wider conception which could alone make it intelligible. The path which Trotter blazed during the War of 1914–18 in his "Instincts of the Herd in Peace and War" served us well for a time; but, since Trotter wrote, psychology has placed valuable tools in our hands which cannot be ignored.

Harding's work is compact and readable. If it has suffered from the exigencies of war-time economy, this necessary circumscription will make the book accessible to a larger public. It is a work that merits wide acceptance.

H. G. BAYNES.

THE ENDOCRINE ORGANS IN HEALTH AND DISEASE

Essentials of Endocrinology

By Dr. Arthur Grollman. Pp. xvi+480. (Philadelphia, London and Montreal: J. B. Lippincott Company, 1941.) 36*s*.

NO science has developed more rapidly in recent years than that of endocrinology. This has been partly due to its great practical importance in relation to the study of disease, and it is noteworthy that many of the more important discoveries in this branch of science have had their origin in clinical observation. As Dr. Grollman points out, it is impossible to dissociate experimental from clinical endocrinology. Moreover, the latter can now be placed on a scientifically sound basis, for the organism is continually performing natural experiments the results of which can be followed up and correlated with other observed facts in such a way that conclusions of lasting value can be formed. It is the purpose of Dr. Grollman's book to bring together in one volume the results of all these observations and experiments for the average medical reader. At the same time, there is much in the work that makes a strong appeal to the general biologist.

The book is divided into five main parts. The first of these deals with the endocrine glands of the cranial cavity and more particularly with the hypophysis, which is a compound gland of great importance but not necessarily the 'master gland' of the endocrine system as some authors have conceived it to be. It is pointed out that certain disorders of hypothalamic origin have often been ascribed to the pituitary. Thus the well-known 'fat boy' condition may be hypothalamic. Nevertheless, the fact that stimuli of various sorts applied to the hypothalamus may affect the functions of the anterior pituitary, both positively and negatively, is evidence that hypothalamic lesions or defects may very often make themselves evident by interfering with pituitary function. In this part of the book the diseases ascribed to pituitary influence are well described and illustrated.

The second part deals with the branchiogenic organs and contains admirable accounts of the thyroid and parathyroid glands and the diseases arising from their dysfunction. The thymus is also included in this part, and after carefully considering the evidence, the author comes to the conclusion that none of the theories which have been put forward to explain its function are based on adequate experimental data or any plausible foundation. Some of the experimental evidence is contradictory as, for example, the claim that irradiation of the thymus in rats causes testicular atrophy, and the conclusion of Noel Paton that thymectomy tends to produce testicular hypertrophy.

Part 3 of the book is upon the endocrine organs of the abdominal cavity, namely, the 'islet' tissue of the pancreas and the medulla and cortex of the supra-renal. The pathology of these organs and their relationship to other organs and structures are well described, and much useful information is given concerning the treatment of the diseases connected with these organs. In dealing with the adrenals, there is a short account of their comparative anatomy throughout the vertebrates, but there is no mention of Swale Vincent, to whom much of our knowledge was due.

The fourth part, which concerns the reproductive system, is the least satisfactory in the book. Heape's original terminology used in describing the phases of the œstrous cycle is adopted with some modifications, but his name is not mentioned and the modifications do not make for increased accuracy. Thus, the anœstrum and diœstrum are not identical, and the latter is scarcely a period of rest since it is actually an abbreviated pseudo-pregnancy occurring only in polyœstrous mammals, and the distinction between these and monœstrous animals is not made. Ovulation does not necessarily depend upon coition in the cat, since many cats ovulate spontaneously during heat and are polyœstrous. Besides the rabbit and the ferret, the thirteen-lined ground squirrel (among rodents) does not ovulate without previously copulating, as shown by Foster. Moreover, among primates, both man and monkeys, there may be non-ovulatory diœstrous cycles and there is evidence that occasionally in women coition may induce ovulation. There is no such thing as a diœstrous period in the dog. Animals, such as most ruminants in temperate countries, which experience œstrus in autumn, usually bring forth in late winter or spring without any postponement of the development of the embryo. There is no evidence of a physiological law that the right and left ovaries of mammals produce ripe follicles which discharge their eggs alternately, but as a matter of actual fact this happens more frequently than not in the cow as recorded by Hammond and in the mare as observed by Day, and so probably may happen in other mammals. The placental theory of parturition does not explain the phenomena of pseudo-parturition as seen in the bitch, the rabbit and the marsupial cat. The absence of any account of behaviour cycles in relation to recurrent sexual phenomena is a noticeable omission.

The work concludes with a short fifth part on hormones produced from primarily non-endocrine organs, with notes on invertebrate and plant hormones.

About the general usefulness of the book there can be no question. F. H. A. MARSHALL.

SCIENTIFIC CHILD-STUDY

Child Psychology

Child Development and Modern Education. Edited by Charles E. Skinner and Philip Lawrence Harriman, with the collaboration of Amy F. Arey, Lawrence Augustus Averill, Lorin E. Bixler, Elden A. Bond, John W. Charles, Lester D. Crow, Raleigh M. Drake, Clyde Hissong, Clarence E. Ragsdale, Gladys Risden, J. J. Smith, Brian E. Tomlinson. Pp. xii+522. (New York: The Macmillan Company, 1941.) 12*s*. 6*d*. net.

THE dominant note of this book, and the justification of review in the pages of NATURE, is its claim, consistently maintained throughout, to adhere to a strictly scientific treatment of its subject. Poets and philosophers long held the field in the treatment of childhood, but since Darwin's time the man of science has joined them. Even the man of science has sometimes succumbed to points of view that could scarcely be called scientific, and the progress of child psychology has been from armchair speculation to the careful experimentation which is the sole concern of the writers of this book. They have written for a wide though a definite public—for parents, students of education, members of administrative staffs in schools, institutions and children's hospitals, and "those public-spirited citizens who may like to keep abreast of developments in this field". More especially, their purpose has been to meet the needs of teachers' colleges and university departments of education. No important aspect of child development has been omitted, not even the religious aspect. Some readers may in fact think that the scientific spirit is upheld to the point of quaintness when they read that "religious education can give human life dignity and worth through God-orientation".

As the title-page emphatically shows, the book is of highly composite authorship, there being no fewer than fourteen contributors. In this respect it differs from other recent and highly approved American books on the same subject, notably those of F. D. Brooks and Ruth Strang. The writers were carefully chosen for the specific contribution each was able to make. All of them have established connexions with leading institutions of higher education, and all of them are deemed to be qualified, by training and experience, to speak with authority. Equal care has been taken to prevent overlapping, and in an appendix the threads are pulled together by means of a full outline of the contents of the book. Extensive bibliographies enhance its value as a student's manual. By way of comparison with the well-known treatises of A. Gesell, J. Piaget and Susan Isaacs, it may be added that each of these is the work of one hand, and that each of them is in the main the result of original observation and experiment.

The range of topics covered by the book is so wide that it is only possible here to attempt a representative selection. On the vexed question of human instinct, for example, the authors are, on experimental grounds, led to a position which is neither that of the psychologist who made a list of fifteen hundred, nor that of the psychologist who found none at all. To maintain, says one of them, as McDougall does, that the human mind has a number of inherited tendencies that are the essential motivators of human striving has strong appeal to many even though others find the evidence unconvincing. It may be added that a general acceptance of McDougall's position seems to have led to fruitful results in the realm of applied psychology. On the subject of intelligence tests justifiably high claims are made for the brilliant work done by American psychologists, but with the equally justifiable warning that "unfounded generalizations, dogmatic assumptions, and unscientific attitudes have done much to destroy confidence in intelligence tests as they are now used and interpreted". The chapter on children's learning contains needed criticism of the half-truth that practice makes perfect: mere hammering away with no motive except to please parent or teacher yields little benefit, and we should never lose sight of the fact that learning often takes place with great suddenness—which is again a question of motive. There is an excellent chapter on the play life of children, but how odd it seems to anyone who has followed American studies in education produced during the past half-century to find that poor old Froebel is now not even mentioned! Odd, but no doubt inevitable, for though Froebel may have been in the main essentially sound, his writings cannot bear the test of scientific scrutiny.

This book on child study has been produced by a strong team of contributors, and it has features which differentiate it from other comparable books. It should take its place as a standard work on the subject. That it is addressed primarily by Americans to Americans is, at this time of day, a good reason why it should be well received on the other side of the Atlantic.

T. RAYMONT.

ENGINEERING DESIGN

Practical Design of Simple Steel Structures

Vol. 2: Girders, Columns, Trusses, Bridges, etc.: a Text-Book suitable for Civil Engineers, Structural Engineers, Road and Railway Engineers, and Students at Universities and Technical Colleges. By Dr. David S. Stewart. Second edition. Pp. xiii+289+11 plates. (London: Constable and Co., Ltd., 1940.) 16*s*. net.

Machine Design Drawing Room Problems

By Prof. C. D. Albert. Third edition. Pp. xi+441. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 21*s*. net.

IN its second edition, Stewart's "Practical Design"—one of the series edited by Prof. Moncur and known as the "Glasgow Text-Books"—has been largely revised and rewritten to bring it into conformity with recent specifications. A substantial part consists of the detailed calculations necessary in the complete design of girders, columns, trusses, portals and bridges, and here an innovation has been introduced by arranging the figuring and the explanatory notes on opposite pages. This permits the calculations to be followed through consecutively and gives the young designer a guide to the proper method of setting out his own calculations in an orderly and logical sequence.

The book exhibits the dual purpose of developing the principles and applications of structural theory and of inculcating in the reader's mind the importance of the successive steps in the working up of a complete design. Against the risk of mere calculations being regarded too dogmatically, the author maintains a just proportion as between theory, practical knowledge and mathematical processes.

Prof. Albert's book treats of quite a distinct branch of engineering design, but it is evident that it too has been written from the point of view that practical knowledge is of the highest importance in design. It requires a sufficient knowledge of kinematics, mechanics and drawing, and offers, in conjunction with a parallel lecture course, the complete material for a practical course of instruction in machine design. The examples with which it deals include a number of unusual problems such as an arbor press, the frame of a punching machine, and a thrustor brake and thus afford a welcome change. The designs of these and other examples are fully worked out from initial specifications set out in much the same terms as they would be received in the drawing office and so present the method by which each problem is reduced to its elements and then worked up into the complete design. The latter part of the book forms a store of valuable data essential to the designer of machines and, for this alone, many will find it an almost indispensable item of drawing office equipment.

GALILEO GALILEI, 1564–1642

By PROF. H. C. PLUMMER, F.R.S.

IF there is something noteworthy in every tercentenary, in the conjunction of two such events in a single year there is something far more remarkable. The death of Galileo and the birth of Newton are important enough when considered separately. A great man has played his part and leaves the stage ; or another enters on a career no less brilliant. Both episodes are impressive ; that one followed the other within a space of twelve months adds to the significance of both. The two lives cover the whole of the seventeenth century and by themselves make it illustrious. The period between the birth of Galileo and the death of Newton was longer—no less than 163 years—running from the year which also saw the birth of Shakespeare in the reign of the Tudor Queen Elizabeth to the death of the first Hanoverian king. If that were all, it would be nothing extraordinary ; old Parr himself, who is reputed to have joined the reigns of Richard III and Charles I, covered nearly as long a span in a single life. But the age of Galileo and Newton was marked by an altogether unusual development of the human mind, and though this growth was far from being the work of two men, none contributed more powerfully to decide the extent and direction of its course than these two.

At the end of the sixteenth century, when Galileo was receiving his own careful and liberal education, the state of abstract science must naturally seem backward in comparison with what it became a comparatively few years later. There is indeed a manifest difference of scientific outlook between this and the following century, when the Paris Academy of Sciences and the Royal Society came into existence. Scientific method is applied with greater assurance, superstition is less evident and in fact the modern spirit has visibly grown in strength. Something of the change can be attributed to men like Francis Bacon, but more to Galileo and the abler among his contemporaries and followers.

Not that science, as distinct from medical knowledge, had failed to make considerable strides in Europe. After the deluge in which Greek culture had been overwhelmed, the scientific tradition passed into the keeping of the Arabs, to return to Europe about the thirteenth century. The subjects of serious interest were few, and chief among them was always astronomy. Indeed, a knowledge of this science had never been altogether lost ; the Venerable Bede had some familiarity with it, owing to the importance of the ecclesiastical calendar with its lunar and solar elements. But the Alfonsine Tables, which with modifications supplied Europe with astronomical ephemerides for about three centuries, were based on the Ptolemaic tradition preserved by the Arabs. The first attempt to understand the Ptolemaic system properly was made by Peurbach and Regiomontanus in the fifteenth century, and it was then that systematic astronomical observations were initiated. The next century saw the real advance made by Copernicus, though to Tycho Brahe's persistent observations astronomy owes an even greater debt for precept and example. From this point the main thread of astronomy passed through the hands of Kepler on the way to Newton, but the influence of Galileo, though less direct and less obvious, was no less important.

Like other sciences, astronomy was cultivated not merely because it appealed to intellectual curiosity but also because it satisfied human needs, first by supplying the data for astrology and later providing for the purposes of navigation. It owed its pre-eminence to its dependence on observation ; for though the art of observing developed with painful slowness from a primitive state, and the necessity of continuous application was realized as slowly, the case of those sciences which depended on experiment was far worse. Some knowledge of optics had been preserved by the Arabs, and with astronomy returned to the ambit of European culture. But it was of a geometrical kind, and it is symptomatic of its slow development on the experimental side that in 1600 the law of refraction was still unknown and was not discovered even by Kepler a few years later. A theory of sound was widely cultivated as part of the art of music, in which Galileo inherited great skill from his father, Vincenzo Galilei. After Gilbert's work, progress in electricity and magnetism was to prove slow and intermittent. In fact, natural philosophy was far from covering the whole extent of physics in Elizabethan days and for some time after. But chemistry was still more backward, though preserved among the lore of the Arabs and valued as alchemy ; even Newton, who made extensive researches in the subject, was mainly interested in the transmutation of metals.

Thus in Galileo's day, while the observational science of astronomy was beginning to advance by appropriate method, the experimental sciences lagged behind largely because the conditions for success were not understood. Quite naturally the change is first seen in optics. Galileo did not invent the telescope, but the barest hint of its possibility set him to work with his own hands ; and his example was followed. It is noteworthy that Galileo, Huygens, Newton, Descartes apparently and Spinoza certainly, were all practical opticians, who made lenses with their own hands. Here also is another change. Tycho Brahe, Galileo, Huygens, Boyle and Newton, who were distinguished by manual dexterity and a genuine taste for manipulation, were all far removed by birth from the artisan class. It was necessary to clear such occupations from social and intellectual prejudices alike, and the example set by Galileo in this direction was the more effective because his lectures as professor at Padua attracted an audience of the most distinguished.

As an astronomer, Galileo by the introduction of the telescope created a new type, in which he was to be followed by Huygens and surpassed by the first Cassini. He was not a painstaking observer like Tycho, and he was not a profound analyst like Kepler. But among other things he discovered the four principal satellites of Jupiter and the peculiar character of Saturn, the structure of the galaxy, and from observations of the solar spots he determined the rotation of the sun. Such achievements naturally brought fame and fanned his own vivid scientific imagination. The results were not altogether fortunate. They roused the implacable hostility of the fundamentalists, and it was not in Galileo's nature to adopt a conciliatory tone. He was a master of the satirical style and he used it with incisive effect.

The issue has been often misrepresented as concerned with the Copernican doctrine. But by 1616, when the "De Revolutionibus" was placed on the Index and Galileo received his first warning, astronomy had outgrown that stage, thanks to the work of Kepler. In fact, the problem of planetary motion was on the high road to solution, and the question between Galileo and his opponents was of a much more elementary kind. Whether Galileo used the actual words "Eppur si muove" may be doubtful, but they express the point in dispute exactly. It was not the nature of the earth's motion which was the subject of controversy, but whether the earth moved at all. Two years after the death of Kepler in 1630, the climax was reached and Galileo was condemned. The retractation extorted by an abuse of ecclesiastical power must have been a bitter pill to a pious man, but nothing was to be gained by obstinacy. *Magna est veritas*, and science needs no martyrs.

Apart from the struggle for freedom in the expression of scientific opinion, astronomy did not provide the field for Galileo's most important achievements. He was a mathematician according to the standard of his age and an acute observer, but above all he was an experimental physicist at a time when a pioneer in that capacity had an unequalled opportunity. His was among the earliest work in thermometry. But Galileo's real eminence rests on the experiments on which he founded the science of kinetics and the laws of motion. From the days of Archimedes little advance had been made in a knowledge of statics, if indeed the point reached in his wonderful discussion of the stability of floating bodies had been so much as remembered. But the notions entertained about the motion of a projectile were, before the days of Galileo, fantastic. By observations of the pendulum, of bodies in free vertical descent, of motion on an inclined plane and of projectiles under gravity, Galileo discovered the composition of velocities, the nature of uniform acceleration and the main principles of dynamics. For the first time the laws of motion were stated with fair precision, though the principle of momentum may have been defined more clearly by Descartes a few years later. A considerable advance was reserved for Huygens, who prepared the ground for Newton, but the essential steps had been taken by Galileo. There can be no happier example of the fruitful combination of well-contrived experiment with penetrating reasoning, for it was a virgin field which was brought under cultivation, and it is impossible to estimate the magnitude of the harvest in the form of practical benefit or in the domain of thought.

The effect on the progress of mathematics deserves particular consideration. Among the items of Greek culture which passed into the keeping of the Arabs, mathematics occupied an important place. They did more, as the very word 'algebra' suggests, and as the arithmetical scale of notation proves, than keep the science alive. But in the three or four centuries before Galileo's time the improvement had not been greatly accelerated on European soil. Geometry remained very much at the point reached by the Greeks, and few went nearly as far as that. Far more signs of life were shown by algebra, and Viète in France, Cardan in Italy and Harriot in England had made considerable advances, while Napier in Scotland had added the logarithm to the list of recognized functions. On the other hand, mechanics were confined to problems of statical equilibrium, and with this went a limitation of algebra to constant quantities and indeed almost entirely to positive constant quantity. Not until the consideration of the moving point and the relation of displacement in space to time was the notion of a variable quantity vividly presented. From that moment algebra and geometry developed into analysis. Thus the germ of infinitesimal calculus and all that is most important in modern mathematics can be traced to the demands of kinematical problems and therefore to Galileo.

Among his pupils two in particular deserve to be mentioned. There was Torricelli, mathematician and brilliant experimenter, who was the founder of hydrodynamics. There was also Cavalieri who, by developing the method of exhaustion of the ancients into the method of indivisibles, founded that Italian school from which James Gregory drew a part of his mathematical descent. Though not his pupil, Descartes was another who found in Galileo's work the source of those fertile ideas which affected the development of mathematics profoundly. Thus coordinate geometry was derived directly as the natural expression of the resolved motion of a point. It led not only to the representation of a curve by a relation between ordinate and abscissa, or from geometry to algebra, but conversely from algebra to geometry by the graphical representation of an equation. Hence the rapid development of the theory of equations which followed, together with the growing sense of generality when the relation of positive and negative quantity was appreciated.

In spite of his recantation, Galileo personified the hero as man of science. He was not the greatest astronomer of his time, nor was he the greatest mathematician. His chief distinction was due to the originality of his work in mechanics. In his life the hour and the man were combined, so that natural philosophy marched forward on a broad front, inspired by a single mind. To appreciate what this means, it is only necessary to consider what progress in mathematics, astronomy and physics was made in the short half-century 1642–92, and then to reflect how the germs of this advance in all branches can be traced to the one brain, Galileo.

In his search for scientific truth as he saw it, Galileo was clear-eyed and free from any scruple. He had expressed himself so candidly and his recantation was so plainly hollow, that it is hard to see what satisfaction his enemies could extract from his humiliation. Yet his attitude to science should not too easily be taken for granted, for it is very far from that which is accepted universally and without dispute. Perhaps the dangers of science have never been so widely proclaimed as at the present day, but they have always been felt, and by various methods it has been sought to mitigate them. Pythagoras and his followers found their method in the restriction of their knowledge to a band of initiates sworn to secrecy, who committed nothing to writing. Thus science was limited to the select and privileged few. The enemies of Galileo were actuated, so far as their aim was respectable, by the same motive—a dread of what would happen when Pandora's box was opened. But their remedy was altogether different from that of the Pythagoreans. What in effect they did was to maintain a system of error against a system of thought which was at least seeking fearlessly after truth. The result was disastrous, because the spiritual dangers which the more enlightened among them anticipated only too well could not be averted except by spiritual means, just as scientific error can only be met on the scientific plane. Changed as the circumstances may seem, the problem remains essentially the same as in the days of Pythagoras and in the days of Galileo. What would have been Galileo's answer can scarcely be doubted, for he was a great teacher as well as a great researcher. The function of science is to seek truth in its own sphere, regardless of consequences. At any stage, whatever the range of this knowledge won, it is necessary to adjust conduct in the light of the truth. The ethical problem is always the same; but the penalty of failure grows with the power which comes with increasing knowledge of the truth.

FOOD AND AGRICULTURE

AT the afternoon session, on January 10, of the Conference on "Science and the War Effort", organized by the Association of Scientific Workers, Sir John Russell took the chair for the discussion of "Food and Agriculture".

Sir John Orr pleaded for the establishment of good will between different political parties in Great Britain and between the different countries of the world by all accepting Lincoln's revolutionary policy that countries should be governed by the people for the people. If Governments are going to govern for the people, their first duty is to provide the necessities of life for those people. These necessities are three: housing, clothing and health. We should plan for temporary housing for two or three years, and this should take precedence over the building of town halls, churches and schools. Our plans for food must be on a permanent long-range basis. We now know the human food requirements, and therefore we know the staple food supplies necessary for each country. More food than this would be waste; less, a waste of human life. We know that in peace-time this waste of human life occurs: in the United States only half the population enjoy sufficient of the protective foods to maintain them in health, and forty-five million people have a diet below the danger-line; and the standard of living in Great Britain is not much higher. If Governments adopted a food policy based on human needs, half the present disease and ill-health would be abolished. Such a policy could be used as a spear-head for trade prosperity and economic stability. Money would be needed; but such a policy would produce new real wealth, and we would be justified in creating credits. For this an international finance organization should be set up for trading in food. Scientific workers could get together to plan this and could say to the world: "We are planning for a post-war world in which every person will receive enough for health." Why have we not done so already? Great Britain should take the lead. We have done so much for the world; here is the next great step.

Prof. H. D. Kay discussed the application of science to the war effort in milk production and utilization. During the War the consumption of liquid milk has steadily increased: the consumption in 1941 was 25 per cent more than in 1938. Therefore, even if the supply of winter milk had remained at the pre-war level, there would have been a shortage during the winter of 1941. Actually, the supply of winter milk has only fallen by 2 or 3 per cent, and so most of the blame for the apparent shortage of milk this winter falls on the consumer. But this is no cause for satisfaction, since we have sacrificed eggs and bacon for milk; and we could have done much better than this had we applied science to dairying in Great Britain during the last few years. By the application of knowledge about breeding and feeding that is widely known—and applied in Denmark but not here—we could have increased the annual yield of milk by 30 per cent, and therefore could have supplied sufficient milk this winter with no increase in feeding-stuffs. There is a grave lack of training in scientific dairying among dairy farmers. With adequate training and the application of scientific principles we could attain what the climatic conditions of these islands and the character of these islanders allow us to attain—the best and most efficient dairying industry in the world.

Sir Daniel Hall considered the regeneration of farming as an economic industry. Farming in Great Britain is, by the admission of its own advocates, "down and out", and can only be kept going by isolation and protection from competition at a considerable cost in subsidies. These grants-in-aid have become substantial and by 1938 reached about forty million pounds a year; this figure must be considered in relation to the estimated value of British land, which amounted to £250 million—a very considerable proportion. The real objection to this policy is that the subsidies are not directed to improving the conditions or the methods of farming: we are giving alms instead of trying to set a poor man on the way to earning his living by removing the causes of his unsuccess. The majority of our farms are units too small to permit of the economies in working rendered possible by power machinery and of the improvements in methods that advances of science have shown to be practical. The two conditions necessary for the rehabilitation of farming are the expenditure of considerable capital in reconditioning the land, and then its apportionment into generally, but not exclusively, larger units. Since the landlords have proved unwilling to invest further in the upkeep of the land, this new capital can only be furnished by the State, and the State can only secure repayment by becoming the owner of the land. The dominant feature of the farming industry would then become large farming units working under conditions similar to those of other businesses, with a general manager, subordinates and other men with minor responsibilities to whom advancement was open. This nationalization of the land would regenerate farming as an economic industry and at the same time would bring into productivity much of the land, our national estate, which is now lying only partly utilized or even wholly waste.

The extent, causes and cure of malnutrition were dealt with by Dr. H. M. Sinclair. Evidence of the extent of malnutrition has been obtained from economic and dietary studies, and very recently from clinical and laboratory tests upon the population. These studies have not only shown the alarming prevalence of malnutrition but also defined the particular food factors most gravely concerned. Surveys have also shown to what extent the War has intensified the problem. Such surveys employing clinical and laboratory methods for the assessment of the state of nutrition of the population are now being made in various countries: in the United States (New York City, Duke University and Vanderbilt University), in Canada (Toronto), in France (Marseilles) and in England (Oxford Nutrition Survey). The study of groups of people living on diets of different quality has shown the effect of food upon health and physique. The incidence of different infectious diseases, for example, tuberculosis, bronchitis, diphtheria, in people of different income-groups is probably due largely to malnutrition, though other factors such as overcrowding are also concerned. Supplementing the diet of school-children has shown the effect of good food upon growth and strength ; and recent work in Toronto has indicated that with proper feeding of poor women, maternal and infant mortalities can be greatly lowered. Very recent work with human volunteers on experimental diets has shown that slight deficiency of particular vitamins produces vague ill-health : lassitude, weakness, fatigue. The primary cause of malnutrition is poverty. Secondary causes are ignorance and the decreased availability of familiar foods. The cure lies mainly in increasing the consumption of protective foods. In peace-time, therefore, public health planning demands an increased production of those things that scientific agricultural planning encourages. The War has intensified and changed the problem ; and in the period immediately following the War there will be world-wide famine. The British Empire, the United States, the U.S.S.R. and China should set up now an international committee of men of science to plan the adequate feeding of the allies during the War, and of the world when victory has been secured. The resources of agriculture alone are insufficient for both these tasks, and must be supplemented by new dietary sources of vitamins, minerals and possibly protein. In this task chemists have an important part to play. By their united action, men of science can abolish malnutrition and produce the greatest advance in public health since the introduction of sanitation.

Prof. F. G. Gregory emphasized the part that vernalization could play in increasing agricultural production. For example, it allows a catch-crop to be taken between the two main crops in the rotation, thereby permitting a much greater production of food from the land. The technique was first used in the U.S.S.R. and has been enormously developed there, but has attracted little attention in Great Britain. A recent Russian memorandum gives full details of the latest advances in vernalization.

Other examples of the failure of agriculture in Great Britain to make the best use of the results of research were given by Dr. A. Walton. Such research has mainly been directed to obtaining a priority value for the progressive farmer, who represents a very small proportion of farmers. Research is run by a complicated system with no less than seven bodies concerned : Parliament, the Treasury, the Development Commissioners, the Ministry of Agriculture, the Agricultural Research Council, the institutes of research and the research worker. The result is that there is a tremendous delay in the research worker obtaining the grant required for his work ; and the research workers themselves, particularly the younger ones who actually do the work, are scarcely represented on any of those bodies. Fortunately steps have recently been taken to short-circuit this delay by the appointment of the Agricultural Improvement Council. In the rationing scheme for feeding-stuffs, and in artificial insemination, there has been lamentable delay. Dr. Walton's own work on the latter subject was repeatedly reported to the Ministry, and the Agricultural Research Council took the view that it was concerned with research and not with practical applications ; when war broke out the reverse position was adopted—that artificial insemination was not immediately practicable, and therefore could not be given subsidies in any way. The result is that Great Britain, for the lack of perhaps a few hundred pounds expended six years ago, has lost some millions that might have been saved, and we are now more than ten years behind the U.S.S.R. in this matter.

From the chair, Sir John Russell drew the threads of these addresses together. In days gone by the conservation of the soil, and especially the preservation of the soil, was the farmer's sole purpose. He thought not only of to-day, but also of to-morrow ; the soil had to last, and had to be available for the next generation. Then followed the long years' policy of cheap food, the farms lost numbers of workers, and those who came back to farming had no experience of arable farming. The soil decreased in fertility. Our system of agriculture postulated peace, because our diet required 1·6 acres a man, and therefore food had to be imported. But in Germany the national dietary had been adjusted to require only 1·1 acres a man, and so they could feed the majority of the population without importing food. We should aim at producing unstinted bread, potatoes and vegetables, and as much milk as possible. Wheat is compact, easily produced and easily transported ; grain requires nitrogenous fertilizers which are available in this War. Germans consume twice the potatoes we do ; and whereas our crop was previously produced in localized areas, it must now be distributed over the country to facilitate transport and increase consumption. But this scattering will introduce new problems such as the control of pests. We must, however, tackle and reduce the enormous waste produced by insect pests. The wire-worm has already done a great deal of harm in this War ; it did much harm in the War of 1914–18, but it was not studied in the interval of peace. The flea-beetle destroyed winter crops needed for the production of mutton. Also we must tackle the rats—often the most intelligent things on the farm. Improvements in agriculture, brought about by increased research and the application of research, will help the spread of adequate nutrition and do much to abolish the evil of malnutrition.

PREPARATION OF PERSPECTIVE DIAGRAMS

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CONTOURED maps, serial sections, or plans and elevations, are capable of providing much detailed information about the form of regular or irregular bodies and surfaces. It is, however, not always possible, from an examination of such diagrams alone, readily to visualize the real shape of the surface and the relationships of the various parts, as the process of mental integration of the series of basic diagrams can often only be carried out after a prolonged study. Moreover, the formation of a complete mental picture, which can be easily used, may not always be possible. To overcome this difficulty, models of the surface may be constructed from the basic diagrams, and in most respects these constitute the ideal solution of the problem, since they can be viewed from many angles with ease. Unfortunately, such models are generally expensive and tedious to make[1,2,3,4], besides being fragile and not easily duplicated, and, when large, not portable. As a consequence, resort is frequently made to diagrams in which it is attempted, with varying degrees of success, to convey an impression of the third dimension. These diagrams have some of the virtues of models, and at the same time they are readily reproduced and stored.

Diagrams which give an impression of solidity and are prepared from contoured maps, serial sections or plans are of three types. The simplest types are orthographic projections, either on the plane of the basic diagrams or on some plane perpendicular to it. Their preparation has been described by Pusey[5], and their effectiveness depends to a large extent on the skilled use of shading. Wilson[6] has given an account of the production of the second or isometric type of diagram for mine workings. Such diagrams may be made by simple geometric methods, or with the aid of one of the instruments described by Lobeck[7] or de Sitter[8]. Although valuable, isometric diagrams have in many instances an unnatural appearance. The perspective diagram, the third type, has a more natural appearance, and is therefore to be preferred. Perspective diagrams can be constructed by geometrical methods[9,10,11] and McPherson[11] gives a computational method for transforming the co-ordinates of points on the surface to co-ordinates of points on the perspective diagram. None of these methods is wholly satisfactory for highly irregular surfaces, for a choice has to be made between plotting comparatively few points accurately and sketching between them, and laboriously plotting a very large number of points in order to define a line almost continuously.

Recently an instrument has been devised for the mechanical production of perspective diagrams from contoured maps[12], but it will not be easily or cheaply constructed, a drawback which is probably shared with any other mechanical devices which may have been invented. However, if a camera lucida (or other suitable optical arrangement) and a mount for the basic diagrams, set on the end of a graduated rack, or its equivalent, are available, perspective diagrams can be prepared by quite a simple method. A search of some of the scattered literature on the preparation of perspective diagrams has not revealed any previous reference to the method, in spite of its general applicability.

Fundamentally, the method merely consists of setting the serial sections or contours successively in the correct relative positions which they would occupy in or on the body, and drawing their appearance from a pre-determined viewpoint, with the aid of a camera lucida. In effect, the basic diagrams are made to describe the surface of which they are sections. The basic diagrams—contoured maps,

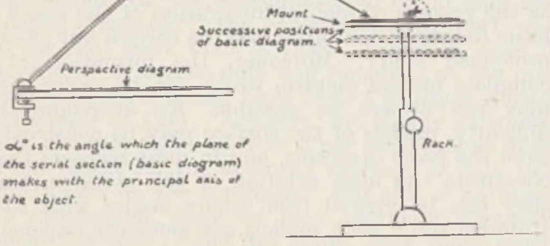

Fig. 1.

ARRANGEMENT OF CAMERA LUCIDA, RACK AND BASIC DIAGRAM FOR DRAWING A PERSPECTIVE VIEW OF AN OBJECT WITH ITS PRINCIPAL AXIS APPEARING TO BE VERTICAL.

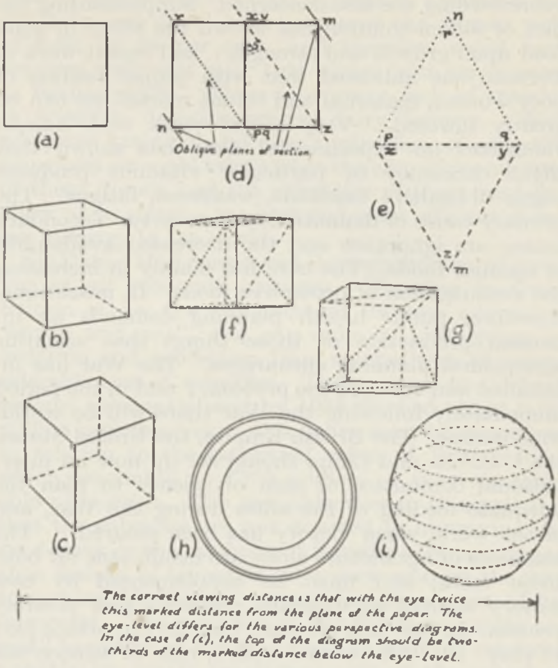

Fig. 2.

(*a*) Basic diagram for the construction of a cube in perspective. The plane of section is at right-angles to the principal axis of the cube.

(*b*) Perspective cube with axis vertical, derived from (*a*) by setting the basic diagram at two levels differing by a distance equal to the length of the side of the square.

(*c*) Perspective cube with inclined axis, and derived from (*a*). Instead of the basic diagram being horizontal as in constructing (*b*), it was tilted.

In making (*b*) and (*c*), the basic diagram was supported in a plane at right-angles to the axis of translation of the rack.

(*d*) Side elevation of symmetrically placed cube, showing the parallel planes of section.

(*e*) Basic diagram obtained by drawing, in their proper positions, the oblique serial sections taken along the planes shown in (*d*).

(*f*) and (*g*). Perspective cubes derived from (*e*). The same basic diagram could have been used to give perspective cubes for the types of positions shown by (*b*) and (*c*). The projections of the serial sections are marked to correspond with the appropriate parts of the basic diagram (*e*). In making these reconstructions, the basic diagram was supported in a plane making an angle of 35° with the axis of translation of the rack.

(*h*) Basic diagram for perspective sphere. The circles, in decreasing diameter, represent sections through a sphere at the following levels, measured from the lowest point on the sphere: $\frac{1}{2}R$; $\frac{3}{8}R$ and $\frac{5}{8}R$ superimposed ; $\frac{1}{4}R$ and $\frac{3}{4}R$ superimposed ; $\frac{1}{8}R$ and $\frac{7}{8}R$ superimposed, where R is the diameter of the sphere. (*i*) Perspective sphere reconstructed from (*h*). The drawings used to define the sphere's outline are shown dotted.

serial sections or plans—if not of manageable dimensions, are first transformed to a readily usable size, that is, to a size in which the necessary lines can be seen and drawn without difficulty when viewed through the camera lucida. In the case of serial sections, it is not usually possible to transfer them to a single sheet of paper without leading to confusion, and hence they must be piled in their correct order and register. (In searching for published serial sections suitable for testing this method, it was found that they are figured without registration marks being included. Consequently, they are not immediately available for reconstructions either as models or as perspective diagrams. The value of such published sections would be increased by the inclusion of registration marks.)

If the basic diagrams are on planes at right angles to the principal axis of the object, and it is desired to make this axis appear vertical in the perspective

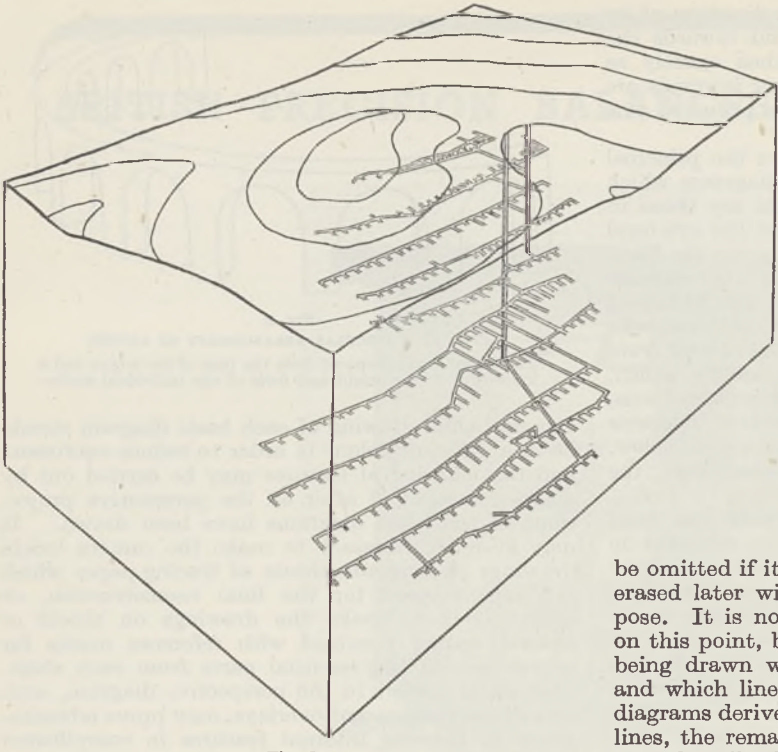

Fig. 3.
MINE WORKINGS, DRAWN FROM MINE PLANS.

diagram, the basic diagrams are mounted in a plane at right angles to the direction of movement of the rack and the latter is set to give vertical motion (Fig. 1). Having erected the camera lucida, the rack with mounted diagrams is placed so that the mid-point of the diagrams is at the appropriate distance from the camera lucida for the lens employed. The diagrams are then racked to a position at which the diagram of the highest contour or section can be seen satisfactorily through the camera lucida, and the basic diagrams are suitably oriented with respect to the viewpoint. Next the highest contour or the topmost serial section is drawn on a fixed sheet of paper while looking through the camera lucida. After removing the topmost section, if serial sections are being used, the mount is racked down by a distance corresponding to the contour interval or the distance of the second serial section below the top section, the distance being in terms of the scale of the maps or sections. The second section or contour next to the highest is now drawn, and all subsequent sections or contours are dealt with similarly. For some purposes it may be desired to magnify the vertical scale in the perspective diagram, although such magnification is not recommended as a general procedure, and should always be noted when used. N-fold magnification of the vertical scale involves racking down the mount N times the true equivalent of the contour or section interval.

In the case of maps, the intersections of roads, rivers or other features with a given contour are marked when that contour is drawn. Afterwards the points of intersection are connected together with the assistance, if needed, of intermediate points obtained by racking the map to inter-contour levels and marking the position of the feature at the corresponding height on the map.

In dealing with large diagrams or a series covering a considerable vertical range, the image of a diagram or of parts of one may not be perfectly focused on the paper on which it is to be drawn, but as a rule no difficulty will be experienced in drawing the image, and a slight uncertainty does not appear markedly to affect the final perspective impression.

After all the basic diagrams or contours have been converted to perspective projections, the outlines of features on the object are filled in by connecting related points, and those parts of the projections of the basic diagrams which are masked by the presence of part of the object between them and the viewpoint are erased or dotted as required. In making the camera lucida drawings, parts of the diagrams may be omitted if it is apparent that they will have to be erased later without having served any useful purpose. It is not possible to give brief general rules on this point, but a little consideration of the object being drawn will indicate broadly which lines will and which lines will not be needed. If perspective diagrams derived from maps are to retain the contour lines, the remainders of the contours are marked in more heavily, but with other objects the remaining lines of the projections of the basic diagrams should be used as a guide in shading, some direction of illumination being assumed, and ultimately erased, as a rule. Shading is of prime importance, for it removes the impression of flatness which is apt to persist in line drawings of curved bodies, permits the indication of features which cannot be shown by definite lines, and enhances the impression of solidity even in the cases of drawings of bodies bounded by sharp edges and plane surfaces.

If it is decided to 'look down' on the object, that is, to incline towards the observer the upper end of the principal axis which is ordinarily depicted as vertical, the rack, with the plane of the mount and

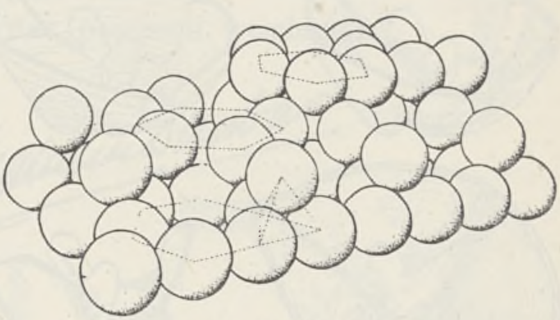

Fig. 4.
PERSPECTIVE DIAGRAM OF SET OF SPHERES SUCH AS MIGHT BE USED TO SHOW THE SPATIAL RELATIONSHIPS OF THE ATOMS IN A CRYSTAL.

Parts of the upper two layers have been removed. While no attempt has been made to depict a mineral species, it may be noted that the tetrahedral relationship of the spheres forming the bottom two layers would be that of the fundamental SiO_4 unit if a small sphere representing silicon were to be placed in the centre of each tetrahedral unit. The diagram was drawn from a plan view of the contoured spheres and a knowledge of the separation of the different layers of spheres vertically.

diagrams still at right angles to the direction of its travel, is inclined with its upper end towards the camera lucida. The procedure is then exactly as described above, and the same contour intervals are measured along the rack as when the principal axis was supposed to be vertical.

With sections cut at right angles to the principal axis of the object, the perspective diagrams which can be drawn with that axis vertical are those in which the object is appreciably below the eye-level (Fig. 2, *b*, *c*, *i*), for it is not possible to see the basic diagrams well when they approach the edge-on position. Perspective diagrams could also be drawn for the object above the eye-level, if the basic diagrams were mounted so that they could be viewed from below. However, if sections are available which, instead of being at right angles to the principal axis, are oblique to that direction, perspective diagrams can be drawn for the object in positions above, below, or intersecting the eye-level, provided that the obliquity is sufficient (Fig. 2, *b*, *f*, *g*).

In order to prepare perspective diagrams from oblique sections, the basic diagrams are mounted on the end of the rack at the same angle as they bear to the principal axis of the object. The construction is carried out in the same manner as for sections cut at right angles to the principal axis of the object. But it should be noted that the shift of the rack between drawing consecutive basic diagrams is equal to their separation along the principal axis, not to their separation at right angles to their own planes. The basic diagrams must be piled so that the points where the vertical axis cuts the separate sections are superimposed. As before, any orientation is possible which leaves the basic diagrams adequately visible. This modification is practicable with serial sections in palæontology, botany and zoology, but not directly with maps, since the contours are drawn on planes at right angles to the vertical (principal axis). Topography and geological structures are almost invariably assumed to be viewed from above for the purposes of diagrams, and as a result, the limitation in contour drawing is of little consequence.

In constructing perspective diagrams of complicated objects with closely spaced sections, the

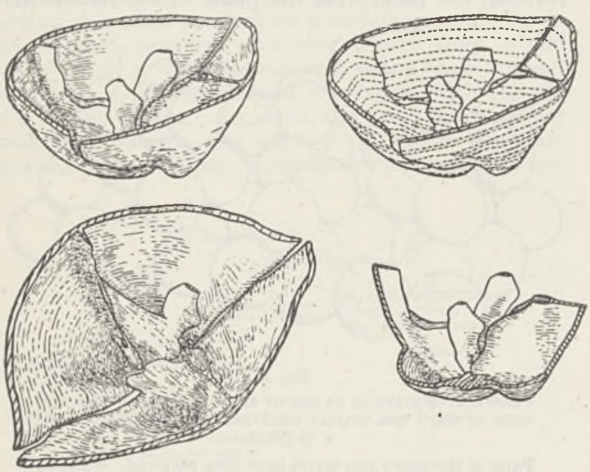

Fig. 5.
Parastrophina hemiplicata. PERSPECTIVE DIAGRAMS PREPARED FROM DRAWINGS OF SERIAL SECTIONS KINDLY LOANED BY DR. J. K. S. ST.-JOSEPH.
Comparison should be made with figures in the *Geological Magazine* (5), 78, 381 (1941). The upper right-hand diagram includes the contours which were used as the basis for shading.

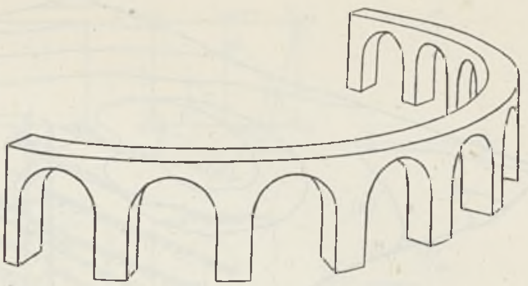

Fig. 6.
PART OF A CIRCULAR ARRANGEMENT OF ARCHES.
The drawing was prepared from the plan of the arches and a knowledge of the height and form of the individual arches.

camera lucida drawing of each basic diagram should be in a different colour in order to reduce confusion, and the marking of features may be carried out by degrees, instead of after all the perspective projections of the basic diagrams have been drawn. It may even be necessary to make the camera lucida drawings on separate sheets of tracing-paper which are superimposed for the final reconstruction, or alternatively to make the drawings on sheets of ordinary paper provided with reference marks for use in tracing the essential parts from each sheet. The use of colours in the perspective diagram, with or without transparent overlays, may prove advantageous in showing internal features in complicated objects.

Some experimentation may be necessary before the most satisfying view is obtained. Moreover, since the usual aim is to give a picture of the whole rather than of the details, it is more important to get the salient features in their proper relationship, balanced by a skilful selection of useful detail, rather than to copy all the detail meticulously, especially if it can only be fully appreciated on the original maps or sections, or if it will encumber the final drawing.

The size of the perspective diagram which can be produced directly by the present method is determined by the need to be able to look through the camera lucida and draw an image which is reasonably well focused. Diagrams about 25 cm. × 25 cm. are probably of the maximum size comfortably producible for a viewing distance of 30 cm. The method is probably used to the greatest advantage for approximately equi-dimensional objects, or those with a small vertical dimension and the other dimensions larger and about equal. Drawings of internal structures can be made with the same ease as those of the outer form. If models were used, such drawings would generally require either the construction of a special model or the partial destruction of the normal type of model.

For some types of basic diagrams optical arrangements other than the camera lucida may be used for producing the perspective views of the separate basic diagrams; for example, a photograph or camera obscura drawing may be made for each setting of the basic diagrams. In the case of photographs, the significant parts are afterwards traced, suitable reference marks being used to get correct super-imposition for each photograph. The fundamental idea of manipulating the basic diagrams is applied exactly as described for the camera lucida.

Perspective diagrams can be prepared by this method, or by means of Bain's perspectograph[12], for any body for which a series of parallel sections can

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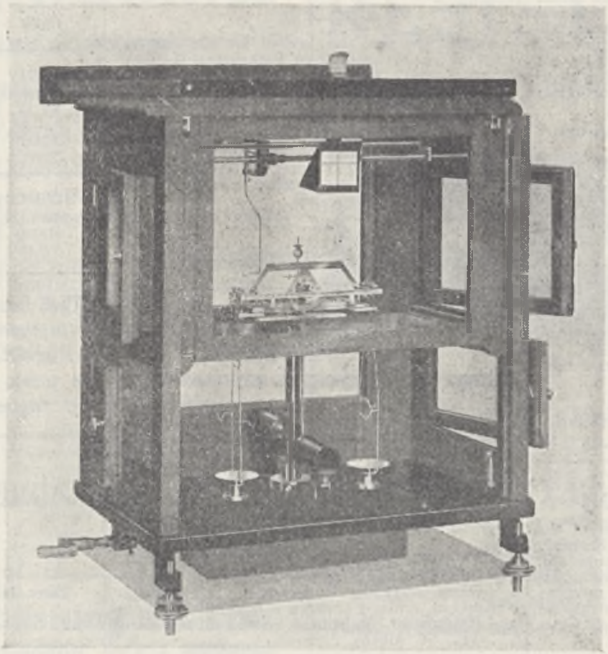

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DEPARTMENT OF AGRICULTURE AND HORTICULTURE

Applications are invited for the post of Advisory Entomologist for the Bristol province, under the scheme of the Ministry of Agriculture and Fisheries for the provision of technical advice for farmers. The post is subject to the conditions of tenure and salary of the Ministry with initial salary according to the qualification of the person selected. Duties to commence on August 1, 1942. Application with copies of testimonials and the names of three referees should be sent on or before March 9, 1942, to the undersigned, from whom further particulars can be obtained.

WINIFRED SHAPLAND,
Secretary and Registrar.

UNIVERSITY OF BRISTOL

Examinations for the following Scholarships will be held in the University early in the Summer term of 1942:

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Further particulars and application forms may be obtained from the undersigned.

WINIFRED SHAPLAND,
Secretary and Registrar.

UNIVERSITY OF LONDON

Applications are invited from members of the University for grants from the Central Research Fund for assisting specific projects of research and for the provision of special material and apparatus. Application forms (which must be returned by March 31, 1942) and further particulars may be obtained from the Academic Registrar, 42 Gyles Park, Stanmore, Middlesex.

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DEPARTMENT OF PATHOLOGY, etc.

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Applications are also invited for the appointment of Junior Lecturer in Pathology: the commencing salary would be £380 rising by annual increments of £20 to a maximum of £570, with superannuation benefits.

Applications should be lodged, not later than March 16, 1942, with the undersigned from whom further particulars may be obtained. Six copies of the application for the post concerned, together with six copies each of not more than three recent references, will be required.

A. C. DOULL, C.A.
Secretary.

February 7, 1942. Summerhall, Edinburgh, 9.

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Basic diagrams	Perspective diagrams
Contoured maps.	Topographical perspectives, with drainage, roads, etc.
Stratum contour maps	Form of geological horizons, faults, etc.*
Mine plans.	Mine workings and the form of ore bodies (Fig. 3).*
Spatial relationships of atoms in a crystal, obtained from X-ray diffraction patterns.	Perspective diagrams of the positions of atoms in a crystal, with coloured or differently sized spheres representing the various kinds of atoms (Fig. 4).
Serial sections.	Palæontological, botanical or zoological objects (Fig. 5).
Plans for the various levels at which a change in form occurs.	Architectural and engineering structures (Fig. 6).
Sections for significant levels.	Engineering objects ; for example, pieces of mechanism, castings, lay-out of pipes, etc.
Series of curves relating two quantities, for different values of a third quantity.	Perspective view of the surface represented by the relationship between the three quantities, with or without the separate curves.

* These may obviously be combined with topography.

be obtained or easily constructed. The accompanying table summarizes some of the possibilities.

In conclusion, it may be recalled that perspective diagrams are prepared for one eye at a definite point, and hence they may not appear satisfactory even though accurately constructed, when they are viewed with both eyes and from a point appreciably different from that for which the diagrams were made. Consequently, the normal reading distance should be borne in mind when preparing perspective diagrams for publication. If they are drawn for a very different viewing distance, that distance should be indicated. Furthermore, in the case of very small objects involving the use of greatly enlarged sections, the resultant perspective diagrams may be somewhat unfamiliar because of the different angle subtended at the eye.

[1] Armstrong, F. W., *Trans. Inst. Min. Met.*, **41**, 106 (1931–32).
[2] Sollas, W. J., *Phil. Trans. Roy. Soc.*, B, **196** 259 (1903).
[3] Uren, L. C., "Petroleum Production Engineering", 69.
[4] Bravinder, K. M., Sheldon, D. H., and Koogle, J. E., *Pet. Tech.*, Jan. 1941 ; *A.I.M.M.E. Tech. Pub.* No. 1271.
[5] Pusey, H. K., *J. Roy. Micro. Soc.*, **59**. 232 (1939).
[6] Wilson, W. H., *Trans. Inst. Min. Met.*, **43**, 545 (1934).
[7] Lobeck, A. K., "Block Diagrams".
[8] de Sitter, L. U., *Leidische Geolog. Med.*, **8**, 315 (1936–37).
[9] Lawrence, W. H., "Perspective", *Encycl. Brit.*, 14th Ed., **17**, 614.
[10] Sellar, W., Assoc. Engineering and Shipbuilding Draughtsmen, Tech. Sect. Pamphlets (1925–26).
[11] McPherson, G., *Trans. Inst. Min. Met.*, **47**, 347 (1938).
[12] Bain, G. W., *Econ. Geol.*, **36**, 71 (Jan.–Feb. 1941).

OBITUARIES

Prof. R. S. Seton

The death of Robert Sutherland Seton in Leeds on January 12, at the age of seventy-four, will be deeply regretted among the agricultural educationists in Great Britain. Seton was a native of Watten in Caithness and became a student of agriculture at Edinburgh under the late Prof. Robert Wallace: he graduated in 1894 and then studied chemistry for a time at the Royal College of Science in London. After holding appointments at the Downton Agricultural College and the Harris Institute, Preston, he was appointed in 1900 to the chair of agriculture at Leeds, where he remained until he retired under the age limit in 1932.

As a teacher he set a very high standard in the personal attention that he gave to each student and to each applicant for admission to the agricultural courses. The written information on the form of application meant little to him ; he had to get hold of the individual and discuss with him in detail the problems of his training and his career. There will be many agriculturists at home and abroad who retain vivid memories of these first discussions and who are grateful for their beneficent influence. The successful careers of so many of his students will be in large measure due to the thoroughness with which he discussed their training with them at the outset and to his insistence on adequate practical experience before entering upon a university course.

While Seton was responsible for designing and carrying out many important field experiments, it was never his policy to adopt a special sphere of research as his own personal life-work. He was far more concerned to stimulate and encourage the work of his colleagues in all the various sections of his diverse department. He maintained a uniform interest in all branches of agriculture and the agricultural sciences, and no hour of the day or night was to him inopportune for the discussion of any piece of work going on in the department. He gave his time and help to his colleagues in this way without any concern for the recognition of his personal contributions to the work.

In the development of the advisory services of members of the staff among Yorkshire farmers, Seton did pioneer work. An advisory service whereby specialist officers are available to farmers is now established uniformly throughout Great Britain, but such a service was long before in existence in Yorkshire under Seton's direction and inspiration. In directing his colleagues in this advisory work he brought not only valuable help to the farmer but also considerable inspiration to the teaching in the Department by keeping lecturers in touch with practical problems.

The development of the Agricultural Department in Leeds in its teaching function, its research work and its advisory service will always remain as Seton's life-work. To this work he devoted an enthusiasm that remained undiminished to the end. Nevertheless he found time for other interests. The Board of Greenkeeping Research, on the committee of which he served, will remain indebted for the help he gave, and his influence was brought to bear upon agricultural education in Great Britain as a whole through his long and active membership of the Agricultural Education Association.

Seton will be remembered with great personal affection by all who worked with him and studied under him. N. M. Comber.

Prof. J. P. d'Albuquerque

Prof. John Pedroso d'Albuquerque, who died at Ilfracombe on December 20 at the age of seventy-six, was a brilliant chemist.

From the City of London School he went up in 1885 to St. John's College, Cambridge, where he was for a time demonstrator to Prof. Liveing. Scholar, exhibitioner and Wright Prizeman, d'Albuquerque took first class honours in chemistry in Part I of the Natural Sciences Tripos in 1887 and again in Part II in 1889. It was predicted that he would attain high academic distinction in England; but he preferred to migrate to Barbados, having been offered in 1890 the post of Island professor of chemistry there in succession to Prof. Harrison, who had been transferred to British Guiana. Harrison and J. R. Bovell had recently discovered (or, as some say, rediscovered) the fertility of sugar-cane seed and had successfully raised seedling canes. This work was continued by d'Albuquerque in collaboration with Bovell, and many new varieties of cane resistant to disease which was decimating the Bourbon cane were made available. In 1898 d'Albuquerque assumed the additional duties of consulting chemist to the newly formed Imperial Department of Agriculture. As chemist-in-charge he was responsible for carrying out (still in co-operation with Bovell) an extended programme of experiments and research. Many published reports recording the results remain as a monument to his and his fellow-worker's industry, which exercised a profound influence on cane cultivation throughout the sugar-producing world and laid the foundations on which the present West Indian Cane Breeding Station in Barbados was built.

Between 1899 and 1909, d'Albuquerque acted as Imperial commissioner on numerous occasions. In 1910 Barbados seceded from the Imperial Department. A separate Department of Agriculture for the Colony was constituted with Bovell as head, and, after his retirement in 1925, d'Albuquerque was appointed director of science and agriculture. In that capacity he attended the Imperial Agricultural Conference in London in 1927. His activities were many. Besides performing the onerous duties of director, he remained in charge of science teaching at Harrison College, the Lodge, and Combermere School, and several generations of boys profited greatly from his teaching. He also reorganized the Government analytical laboratory, which was concerned not only with foods, drugs, and public health, but also commercial sugar analysis, a work which increased enormously as, thanks to his precepts, the planters became more scientifically minded. It is not too much to say that d'Albuquerque succeeded in revolutionizing the ideas of the planting community on the place and value of scientific research in tropical agriculture.

When in 1928 d'Albuquerque retired on account of failing health, Barbados was the poorer by the loss of a prominent scientific worker and a genial resident, who for nigh on forty years had identified himself with the social and official activities of the island which he had made his home.

d'Albuquerque was a keen Freemason. He was District Grand Master of the Barbados Lodge from 1906 until 1930 and a founder of the Caribbean Lodge. He was married in 1891 to Miss Beatrice Alice Langley, who with a son (a barrister-at-law) and a daughter survive him.

ALGERNON ASPINALL.

We regret to announce the following deaths:

Dr. Elsie C. Parsons, president of the American Anthropological Association, on December 19, aged sixty-six.

Prof. Hans Schinz, formerly professor of botany in the University of Zurich, aged eighty-three.

Prof. Virgilio Tedeschi, professor of biological physics in the National University of La Plata.

NEWS and VIEWS

Central Planning Authority

MR. ARTHUR GREENWOOD, Minister without Portfolio, announced in the House of Commons on February 11 that a Central Planning Authority is to be set up. Duties in connexion with town and country planning at present exercised by the Minister of Health will be transferred to the Minister of Works and Buildings, whose title will be changed to "Minister of Works and Planning". The newly styled Ministry will guide local authorities and will exercise the powers to be conferred by legislation arising out of the acceptance by the Government of the first report of the Uthwatt Committee, laying down the general principles to which planning must conform. The Secretary of State for Scotland will exercise corresponding powers in Scotland. The two ministers concerned will be assisted by committees of senior officials of the Departments on which their activities will impinge in order to secure consistent action throughout the country. By this means the Government hopes to secure the most appropriate development and use of the country, taking into consideration the recommendations of the report of the Royal Commission on the Distribution of the Industrial Population, and also the need for avoiding measures which would interfere with the over-riding aim of raising the standard of living to the highest possible level.

Lord Reith, who now becomes Minister of Works and Planning, made a similar statement in the House of Lords, amplifying it with an account of steps which are already being taken. The decision now announced, he said, implements the Uthwatt Committee's assumption of the early establishment of a central planning authority. Meanwhile, that Committee is now making an objective analysis of the subject of the payment of compensation and recovery of betterment in respect of public control of the use of land. Lord Reith's consultative panel has also been active. The Director General of the Ordnance Survey, Dr. Dudley Stamp and Prof. Eva Taylor are preparing maps for planning, showing physical features, land uses, movements of population, industry and communications. Lord Justice Scott's committee considering conditions which should govern constructional developments in rural areas is at work, as is also the inter-departmental committee co-ordinating the views of the various departments concerned. The latter has prepared a Bill to give effect to the recommendations of the Uthwatt Committee, and has considered long-term planning, the preservation of amenities, etc. His own group of special assistants has been responsible for the work of this committee and for the research which is the essential foundation of any scheme of national planning. In addition, the supply and standardization of materials have been under consideration, of necessity from the point of view of the war effort, but also with regard to the post-war implications. The central problem is to achieve the maximum benefit to the country of limited land resources available.

The Wartime Social Survey

One of the most recent developments in State research in the field of sociology is the Wartime Social Survey. After an initial period of growing pains, this Survey is now emerging as a valuable machine for conducting any type of inquiry capable of investigation by the method of interviewing samples of the population. Two Government Departments, the Ministries of Information and Food, required a market research machine for investigating the effects of their advertising. When the Wartime Social Survey was set up to meet this need, it became apparent that there were problems facing other Government Departments which could only be solved by the method of interviewing samples of the population, and to meet this need the Survey was extended. It now carries out investigations for not only the Ministries of Information and Food, but also for the Board of Trade, the Ministries of Health, Home Security, Works and Buildings, Supply and the War Office.

With the exception of its superintending research officer, none of its staff are Civil servants. This is one of an elaborate series of precautions adopted to make sure that the names of the persons interviewed are not available to the Civil Service. The headquarters staff consists of eight scientific workers, a number of coding tabulators, administrative officers, etc., while the interviewing staff consists of about fifty field-workers. So that this level of scientific work shall be as high as possible, a small panel of scientific consultants has been set up. They are Prof. A. M. Carr-Saunders, Prof. L. T. Hogben, Mr. B. Seebohm-Rowntree, Mr. A. D. K. Owen, Dr. Bradford Hill, and Dr. Aubrey J. Lewis. Every report produced is submitted in interim form to the consultants for critical comment before the final draft is prepared. Further, technical problems in the phrasing of questions, the selection of samples, etc., are submitted, particularly when any difference of opinion arises between a requesting Department and the scientific staff of the Survey. Owing to the speed at which war-time investigations have to be carried out, more detailed consultation is impossible, but the present system has shown that the needs of Government Departments for social survey investigation can be met by a Government-controlled machine without loss of scientific impartiality. Among studies recently undertaken are: the feeding of employed adolescents; the methods of heating and cooking in working-class households; salvage habits; clothes-rationing problems; food-rationing problems; and a study of female foundation garments. It will be noted, of course, that this useful Survey is dealing with problems arising out of the War.

Nazism and Science

In a recent Thinker's Forum pamphlet entitled "The Nazi Attack on International Science" (London: C. A. Watts and Co., Ltd., 6*d*.), Dr. Joseph Needham presents a brief but telling analysis of the nature of Nazism, and describes some of the effects it has produced in science and learning both inside Germany and outside. Society is now passing through an era of change from individualistic capitalistic economics to some form of collectivism, and just as the earlier change from a feudal aristocracy to capitalist democracy was marked by violent upheavals such as the Thirty Years' War and the French Revolution, so Dr. Needham believes that Nazism and Fascism are by-products of the present phase of the evolution of society. The necessary conditions are two powerful groups between which there are relations of mutual fear; and the racketeer, in this case the Nazi, plays off one against the other. The Nazis have played this part successfully with the German people and also with other nations. Having attained power, the Nazis had to have "a nation of tools". This they achieved by the doctrines of anti-intellectualism, racialism, restriction of science to matters of military value, and the principle of the 'leader'. Incidentally, Dr. Needham points out that the war between China and Japan has its origin in a similar racial-national spirit which has arisen in the latter country.

Turning to biological fallacies exploited by the Nazis, Dr. Needham refers particularly to their misuse of the doctrine of the struggle for existence; they overlook the distinction between inter- and intra-specific competition, forgetting that the latter has led to the development of unwieldy size, exaggerated fertility and other characteristics which in the past have brought about the extinction of the species concerned. They also make play with the analogy between the social organism and the animal body with its various organs or members. But associations of organisms capable of rational thought cannot be regarded as associations of living cells having only the primitive characters of life. It is a fundamental mistake "to suppose that higher levels of organization can be explained and handled in terms of lower levels". Dr. Needham recapitulates the facts already known about the repression of learning in Germany and the occupied countries, the dismissals of staff and their replacement, if at all, by political figures. One example of the effect of repression on scientific publications quoted by Dr. Needham is worth mention. Three scientific journals in his own field of work were, even before the War, one fifth or less of their former size; one of these, the *Biochemische Zeitschrift*, decreased from 13 volumes in 1927 to 5 in 1938 and 2 in 1939, although the number of non-German contributors remained roughly the same. Science in Nazi Germany is valued solely in its relation to the needs of war.

British Electrical and Allied Industries Research Association

The twenty-first annual report (Ref. E.R.A./*T*320) of the British Electrical and Allied Industries Research Association summarizes the work which has been carried out during the year ended September 30, 1941, and lists by titles the various research reports which have been issued during the period. The work is reviewed in seventeen major classifications among which are the highly important ones of dielectrics, cables and overhead lines, electric control apparatus, steam-power plant and condensers, magnetic materials, transformers, surge phenomena and rural electrification. Emphasis is laid upon the work which is still being carried out on circuit making and breaking, surge phenomena, and the properties of insulation, and attention is directed to the consideration now being given, for example, to the storage of electrical energy, the mechanical strength of transformer windings, and the quality improvement of electrical sheet steel. Practical circuit breaker design has been influenced considerably by the Association's investigations. In the insulating materials field, special account is being taken of the latest developments in plastics.

A new section with appropriate sub-committees has been set up to deal with problems of transformer engineering arising especially from war-time and post-war requirements. An exhaustive account has been published of seven years investigation for the Central Electricity Board on surge phenomena, and work has been carried out at the National Physical Laboratory on the surge properties of insulating materials and the surge resistance of tower footings. Researches on conductors, earthing, continuity and on electric control apparatus continue, and the hard gas circuit breaker is receiving special attention. The work of the Association on the application of electricity to agriculture and horticulture continues and is beginning to receive wider recognition in those circles.

The report discloses that the work of the Association is now carried on by no less than 109 technical sections, sub-committees and panels, comprised of experts engaged in industry and in universities and other training institutions. Eighty-three technical reports, relating to a wide variety of subjects, have been issued by the Association during the year, and thirty others were in an advanced stage of preparation at the end of the year. The Association has been recognized as an essential undertaking and a closer liaison has been developed during the year with the Ministry of Supply and, to a lesser degree, with the Fighting Services. The activities of the Information Bureau and Library have been increased by war-time requirements, and work on a complete analytical index to reports of the Association has been carried on during the year. The report is an encouraging survey of the researches which are being undertaken for the electrical industry to meet the needs, not only of war-time requirements, but also of the post-war reconstruction period. It is rightly considered that particular importance should be attached to reconstruction problems, which should receive adequate and timely attention from the point of view of research as new ideas, findings and methods must be absorbed by industry long before research results are needed in commercial enterprises.

Agricultural Meteorology in India

THE annual report of the Agricultural Meteorology Section, India Meteorological Department, for the year 1939–40 covers the last year during which the section was being financed by the Imperial Council of Agricultural Research, the Government of India having taken over the Section from April 1, 1940. The report describes a number of investigations, most of them concerned with the micro-climatology of crops, that is, with the climates experienced within growing crops, as distinct from the more artificial climate of the ordinary meteorological instrument enclosure which is of greater interest for comparisons between the climates of different countries. A number of new instruments have been developed, including several forms of portable but accurate galvanometer for use with thermocouples of copper and constantan for the measurement of temperature in micro-climatology. The recently completed 35-ft. tower at the Central Agricultural Meteorological Observatory at Poona has been found very useful for mounting thermographs, hygrometers and anemometers, for studies of the variations of temperature, humidity and wind with height, which are important in the control of the vertical exchange of heat and moisture between the soil and the overlying air. At Poona, insolation even in January is found to be so strong that the convective layer, with temperature decreasing with height, does not normally disappear during the night, and is generally still to be observed as a layer one or two feet thick at 6 a.m., when temperature in the lower layers is near its minimum. At that time it is generally coldest at a height of one or two feet, with temperature increasing upwards from that level for several hundred feet, the rise amounting already to about 3° C. on reaching the top of the 35-ft. tower. By April the greater insolation is more than counteracted in its tendency to maintain the convective layer by the effect of a higher average nocturnal wind speed, the net result being that the layer has almost disappeared by 6 a.m. The report includes a number of other studies relating to micro-climatology, among which is a table showing the average wind speed in the afternoon at various heights up to 8 ft. in eight different crops, expressed as a percentage of the wind at the same height above open ground. Up to 2 ft., wheat and sugar cane show the highest degree of sheltering, tobacco and suran the least.

Nobel Laureates in the United States

THE philanthropy of Alfred Nobel, the Swedish industrialist, is usually commemorated on December 10 in Stockholm or Oslo with the announcement of the new Nobel Prize winners. In its place a dinner was held in the United States on December 11 at which eleven Nobel laureates were guests of honour. The celebration marked the fortieth anniversary of the first awards. Nobel laureates who were present at the dinner included Dr. Viktor F. Hess, Dr. C. J. Davisson, Prof. Enrico Fermi, Prof. Otto Meyerhof, Dr. Karl Landsteiner, Dr. Irving Langmuir, Prof. H. C. Urey and Prof. Peter J. W. Debye. Dr. Vilhjalmur Stefansson presided.

Medical Research Council: Radiotherapeutic Research Unit

THE Medical Research Council announces that its Radiotherapeutic Research Unit (formerly Radium Beam Therapy Research) has now resumed clinical work in new quarters which have been provided by the London County Council at Hammersmith Hospital. For the present, this work will be confined to the treatment, by radium beam therapy or X-rays, of cases of carcinoma affecting the buccal cavity, tongue, pharynx and larynx. The director, Dr. Constance A. P. Wood, would be glad to have suitable cases referred to her: these should be patients who have had no previous treatment, either surgical or radiological, and preferably not in a very advanced stage of the disease. The physical work under the charge of Mr. L. G. Grimmett, which has meanwhile been continued in temporary quarters at the Imperial College of Science and Technology, has also been transferred to Hammersmith Hospital.

American Chemical Society: New President

DR. PER K. FROLICH, director of the Chemical Division of the Esso Laboratories of the Standard Oil Development Company at Elizabeth, N.J., known for his work in the development of synthetic rubber, has been elected president of the American Chemical Society for 1943. Dr. Frolich took office as president-elect on January 1, when Dr. Harry N. Holmes, head of the Department of Chemistry at Oberlin College, became president, succeeding Prof. William L. Evans, head of the Department of Chemistry at the Ohio State University. In addition to his contributions to the development of synthetic rubber, Dr. Frolich is best known for his work on transformation and chemical utilization of hydrocarbons, high-pressure gas reactions, catalysis and applied colloid chemistry. On September 9, 1940, he and his research associates read the first technical report on the discovery of butyl rubber, made from petroleum.

Dr. Frolich was born in Christiansand, Norway, in 1899, and graduated from the Norwegian Institute of Technology in 1921. He received the degree of master of science from the Massachusetts Institute of Technology in 1923, and the degree of doctor of science from the same institution in 1925. He was assistant chemist at the Norwegian Institute of Technology during 1919–1921, instructor at Christiansand Business College during 1921–1922, and American-Scandinavian Foundation fellow at the Massachusetts Institute of Technology during 1922–1923. He served as assistant in the Massachusetts Institute of Technology Research Laboratory of Applied Chemistry during 1925–1927. He became assistant director of the Laboratory in 1927 and was advanced to associate professor in 1929, the year he joined the staff of the Standard Oil Development Company. He was awarded the Grasselli Medal in 1930 for outstanding achievement in chemistry, particularly in the field of high-pressure reaction of gases.

Centenary of Flammarion

Camille Flammarion, the French astronomer whose books found readers in all parts of the globe, was born on February 25, 1842, at the small town of Montigny-le-Roi, in Haute-Marne. The son of a shopkeeper, he was educated at a church school and then began work in an engraver's office. His merits being brought to the notice of Leverrier, at the age of sixteen he was given a place in the Paris Observatory, where he stayed four years. At the age of twenty he published his first book, "The Plurality of Inhabited Worlds", the forerunner of his "The Marvels of the Heavens", "Popular Astronomy", "The Planet Mars", "Astronomy for Amateurs" and many others. His "Popular Astronomy" when first published in French in 1879 was awarded the Montyon Prize of the Paris Academy of Sciences and was selected for use in the French public libraries. Through an admirer of his writings, Flammarion, in 1883, came into possession of a small château and park at Juvisy-sur-Orge and he built an observatory there. The previous year he had founded the review, *L'Astronomie*, and five years after that, in 1887, he started the Société Astronomique de France. His death took place at Juvisy, June 4, 1925, when he had reached the age of eighty-four.

University of Sheffield

The University of Sheffield has received a bequest of £1,200 by the late Mr. L. N. Ledingham to found a bursary fund for students in the Department of Metallurgy, to be called "The Ledingham Bursary Fund".

The Council decided that because of the close association of the Department of Pharmacology with clinical teaching and because the professor of pharmacology is responsible for the teaching of therapeutics, the Department of Pharmacology should in future be given the title of Department of Pharmacology and Therapeutics, and that the professor of pharmacology should be given the title of professor of pharmacology and therapeutics.

Announcements

Dr. R. L. Waterfield has been awarded the Jackson-Gwilt Medal and Gift of the Royal Astronomical Society "for his general contributions to astronomy, and in particular for his photographic work on eclipses and comets and his visual observations of planets". The Medal will be presented at the annual general meeting to be held on April 10.

The King has approved the following awards of the Polar Medal in silver for good services with the Oxford University Arctic Expedition to North East Land in 1935 and 1936: Lieut. A. R. Glen; Instr. Lieut. R. Moss; A/Major N. A. C. Croft; Major A. S. T. Godfrey; Capt. A. B. Whatman; R. A. Hamilton, D. B. Keith, A. Dunlop-Mackenzie, J. W. Wright.

The Edison Medal for 1941 has been awarded by the American Institute of Electrical Engineers to Prof. J. B. Whitehead, director of the school of engineering of the Johns Hopkins University, "for his contributions to the field of electrical engineering, his pioneering and development in the field of dielectric research, and his achievements in the advancement of engineering education".

The Committee of the Athenæum has elected the following gentlemen, under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, or the arts, or for their public services: Air Chief Marshal Sir Wilfrid Rhodes Freeman, Vice-Chief of the Air Staff; Prof. E. H. Minns, emeritus professor of archæology, University of Cambridge; Prof. P. H. Winfield, Rouse Ball professor of English law, University of Cambridge.

Dr. H. Spencer Jones, Astronomer Royal, will deliver the Symons Memorial Lecture of the Royal Meteorological Society on March 18. He will speak on "The Atmosphere of the Planets".

The following appointments in the Colonial Service have recently been made: Mr. J. C. Alley, veterinary officer, Nigeria; Captain L. Nicholls (conservator of forests), deputy chief conservator of forests, Nigeria.

We have received a copy of the 1941 edition of the Official Directory of the British Chemical Plant Manufacturers' Association, containing a directory of members, a classified list of products and services, a list of proprietary and trade names and marks, and other information. A copy of this Directory will be issued gratis to inquirers interested in the purchase of British chemical plant on application to the Association, 166 Piccadilly, London, W.1.

Erratum. In the article "Feeding Post-War Europe", by Dr. Geoffrey Bourne, Nature, February 14, p. 182, the amount of vitamin C required by Great Britain should read "700 tons" and not "30 tons" as printed.

We regret that it has not yet been possible to issue the Index to vol. 148 of Nature. An announcement will be made as soon as the date of publication is fixed.

LETTERS TO THE EDITORS

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

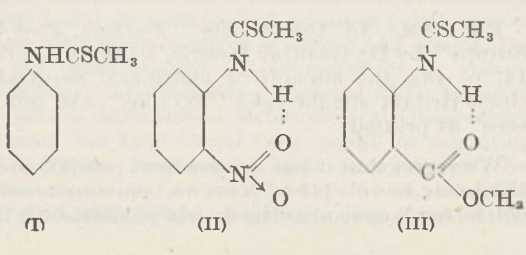
Hydrogen Bonds Involving the Sulphur Atom

THE view is very generally expressed[1] that sulphur does not take part in hydrogen-bond formation. This conclusion is based mainly on the normal physical properties of hydrogen sulphide, as compared with water, and on the absence of molecular association in thioalcohols and thiophenols. Such evidence is obviously only valid against the S-H-S bond.

On the contrary, there are various indications that the sulphur atom can form hydrogen bonds of the type S-H-O and S-H-N possessing considerable stability. For example, quinhydrone-like complexes between quinones and thiophenols or mercaptans have long been known; their existence is probably due to S-H-O bonds. Again, the tautomerism of the thio-acids, R.COSH ⇌ R.CSOH, is probably attributable to their associated (hydrogen bond) structure. Contemporary American workers have recently attributed the anomalous behaviour of mercaptans in certain donor solvents in regard to heats of mixing[2], and infra-red absorption[3], to the formation of weak S-H-N and S-H-O bonds.

Recent work[4] from this laboratory has indicated that a factor which contributes more than any other to hydrogen-bond stability is the condition that the hydrogen atom constituting the bond should be tautomeric. We have, therefore, sought evidence of hydrogen-bond formation in the thioamides and the thioanilides, the tautomeric behaviour of which is formally represented by the equilibrium R.CSNHR′ ⇌ R.C(SH) : NR′. Cryoscopic measurement of molecular weight of a large number of thioamides in naphthalene solution has shown that those which possess an unsubstituted imino-hydrogen atom (as in $R.CSNH_2$ and R.CSNHR′) exhibit marked molecular association, whereas those in which both imino-hydrogen atoms have been replaced (for example, R.CSNRR′) are invariably unimolecular. It would appear, then, that the association of the former type is due to intermolecular S-H-N bonds.

Further evidence of the hydrogen-bond structure of the thioamides is provided by the behaviour of nuclear-substituted derivatives of thioacetanilide (I). We find that the considerable molecular association shown by this compound[5] is completely checked by the substitution of suitable *o*-substituents capable of chelating with the anilido-hydrogen atom. Evidently, the hydrogen atom thus engaged is incapable of further union with the sulphur atom of a second molecule. Thus, *o*-nitro- (II) and *o*-carbmethoxy-thioacetanilide (III) are substantially unimolecular.



(I) (II) (III)

A parallel investigation of the molecular condition of the thioacids has confirmed that they also are associated (originally observed in the single case of thioacetic acid by Auwers[5]), whereas their esters (R.COSR′) are not. Evidently the association of the thioacids is due to intermolecular S-H-O bonds.

A more complete account of this work will be published elsewhere.

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G. HOPKINS.
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[1] See, *inter alia*, Sidgwick, "The Covalent Link" (Cornell, 1933), p. 164. Lassettre, *Chem. Rev.*, 20, 267 (1937); Pauling, "The Nature of the Chemical Bond" (Cornell, 1940), p. 290.
[2] Copley, Marvel, and Ginsberg, *J. Amer. Chem. Soc.*, 61, 3161 (1939).
[3] Gordy and Stanford, *J. Amer. Chem. Soc.*, 62, 497 (1940).
[4] Hunter *et al.*, "The Associating Effect of the Hydrogen Atom, Parts I–IX", *J. Chem. Soc.* (1937–1941).
[5] Auwers, *Z. phys. Chem.*, 30, 529 (1899).

Quantum Efficiency of Photosynthesis

IT is generally accepted that about four energy quanta of red light ($\lambda = 660\ \mu\mu$) are needed to promote the assimilation of one molecule of carbon dioxide. This conclusion is based in the main on the measurements of Warburg and Negelein[1], who determined the ratio W/E, that is, the volume of carbon dioxide assimilated by Chlorella during the absorption of one calorie of light energy. They designated this ratio by φ and, since it is well known that φ increases with decrease in light intensity, the value φ_0 found with the minimum intensity was adopted.

As the mean of nine measurements it was found that 116·8 c.mm. of carbon dioxide were assimilated during the absorption of one calorie of red light energy. It follows from this that 191,781 calories would be absorbed during the assimilation of one gram mole of carbon dioxide and, since the value of $Nh\nu$ at $\lambda = 660\ \mu\mu$ is 43,112 calories, that 4·45 energy quanta were absorbed for each molecule of carbon dioxide assimilated. In a similar series of measurements with blue light ($\lambda = 436\ \mu\mu$) it was found 5·1 energy quanta were absorbed for each molecule of carbon dioxide assimilated.

Now these and any similar determinations of the quantum efficiency of photosynthesis are based on the assumption that the whole of the light energy absorbed is utilized in promoting the assimilation of carbon dioxide. Expressed in other words, this assumption means that the absorption of light energy by Chlorella is entirely caused by the photo-assimilation which takes place. If this were correct, a suspension of Chlorella in which photo-assimilation has been inhibited by hydrogen cyanide would not absorb red or blue light and hence would be almost colourless.

Furthermore, Warburg[2] proved that, when the light intensity and temperature are maintained constant, the number of molecules of carbon dioxide assimilated in unit time by Chlorella increases at first very rapidly and then more slowly as the external concentration of carbon dioxide is increased from 1×10^{-6} to 90×10^{-6} gram mole per litre. On the assumption made by Warburg and Negelein, this indicates that the number of energy quanta needed to promote the assimilation of one molecule of carbon dioxide decreases with increase in the external concentration of carbon dioxide.

Then again it is well known that the leaves of plants exhibit fluorescence during photo-assimilation and Kautsky and Hirsch[3] proved that the intensity of this fluorescence is much less with strongly assimilating leaves than under normal conditions. This radiation of light energy during photo-assimilation proves that the whole of the light energy absorbed is not utilized in promoting assimilation.

It thus becomes manifest that the assumption that the whole of the light energy absorbed is utilized in promoting photo-assimilation cannot be justified. Warburg and Negelein's calculations of the quantum efficiency would, therefore, appear to be invalid.

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[1] *Z. phys. Chem.*, **106**, 191 (1923).
[2] *Biochem. Z.*, **100**, 258 (1919).
[3] *Naturwiss.*, **19**, 964 (1931).

Waves and Tidal Streams

IT has been shown[1] that the steepness of secondary waves riding on primary ones ranges from $s(1-\pi S)^{-2}$ to $s(1+\pi S)^{-2}$, at crest and trough of primary, S and s being primary and secondary steepness. The special case in which the tidal wave is the primary, and the larger wind-formed waves are the secondaries, is of some interest. As S is then almost nil, s does not vary. This means that the steepness of wind-formed waves is unaffected by the mere turn or making of the tidal stream. So some further explanation must be sought for the great change in the state of the sea when the stream turns to the weather, a change too great to be accounted for by the increase in speed of wind over water, and one which ordinarily takes place even after the wind has dropped, as will be assumed here.

Change in direction or strength of stream will not change the steepness of the waves if they are travelling through an area of uniform tidal strength—uniform maximum strength. It is different when the (maximum) strength varies as between one position and another. Then maintenance of the sequence of the waves constituting the swell involves the crests opening out or closing up according to the change in stream, the closing up of sailing vessels as they run into a calm patch, or of road traffic which has to climb a steep hill, being analogous examples. The reduction in length when waves meet a foul stream of greater strength entails reduction in their speed, and in the speed of their energy through the water, with greater percentage reduction in the speed of the energy over the ground. Then continuity of the supply causes the energy to crowd up, and the greater number of units of energy squeezed into each square foot of water surface entails increase in wave height. Thus wave-length is reduced, and wave-height increased, and the sea steepens.

It will suffice to take the case in which waves run from a deep slack-water area into one in which the depth is D and speed of stream C, for the final result will be the same whether they pass directly from depth D_1 and stream C_1 into depth D_2 and stream C_2, or do so through intermediate deep slack water. Let L_0, T_g, V_0, G_0 be length, period and speeds of waves and energy in deep slack water, and L, V, G_w, G_g be length, wave speed through water, and speeds of energy through water and over ground, where the depth is D and the stream has speed C, C being negative when weather going or foul. T_g will also apply to the second area, if observed from the shore. Owing to continuity of sequence :

$$T_g = \frac{L_0}{V_0} = \frac{L}{V+C}.$$

It follows that

$$\frac{V}{V_0} = \tfrac{1}{2}\tanh\frac{2\pi D}{L}\left\{1 \pm \sqrt{1 + \frac{4C}{V_0}\coth\frac{2\pi D}{L}}\right\};$$

or, for deep water,

$$\frac{V}{V_0} = \tfrac{1}{2}\left\{1 \pm \sqrt{1 + \frac{4C}{V_0}}\right\}$$

Where $C = -\frac{1}{4}V_0$ in deep water, $G_g = 0$, and the waves must break, however small their initial steepness. This leads to the rather unexpected result that waves with slack water lengths of 100 and 400 ft. cannot stem streams stronger than $3\frac{1}{2}$ and $6\frac{3}{4}$ knots. With appreciable initial steepness they will break at earlier stages, but may survive after some of their energy has been dissipated into heat. Thus in a tide race, or on a bar, there may be more or less standing lines of breakers, even without sudden change in depth. To leeward of the position where $C = -\frac{1}{4}V_0$, the sea will be calm.

When D/L is small, the plus sign only operates until $C = -\frac{1}{4}V_0$. Then the minus sign comes into play, and holds good until $G_g = 0$. But its reign will be a short one, for analysis shows that unless D is less than $L_0 \div 20$, the minus sign only starts to function when C is within 5 per cent of the strength necessary to reduce G_g to zero.

As $G_w = V - L\frac{dV}{dL}$, $L\frac{dC}{dL} = G_g$: and so, when G_g has become small, the waves only retain a small margin of stability, and the sea will be confused.

For present purposes, stream athwart the direction of wave travel may be ignored, and the water regarded as slack. So onshore waves may be taken as passing from slack water into stream, fair or foul, as they enter an estuary. Those which enter late on the ebb will steepen, and in so far as the estuary is of uniform tidal strength, their steepness will be unaffected by the turn of the stream. But later waves, entering on the early flood, will lengthen, so that their energy will travel faster through the water, and tend to catch up that of the earlier batch. This may account for what would otherwise seem a rather astonishing statement on the part of some Bristol Channel pilots—that the worst seas off the Foreland occur towards the end of the flood. The Bristol Channel is almost long enough for overtaking to take place, so that the two lots of energy tend to become superimposed.

When the earlier batch of energy, intensified by entrance on the ebb, passes a bay in the shore of the estuary after the flood has made, the drainage from its main stream due to its spreading out laterally into the bay will be rapidly made good, owing to its increased speed over the ground. Thus the supply is maintained, and there will be a heavy roll in the bay during the flood, a common occurrence.

Lastly, as the length of swell is unaffected by the mere turn of the stream, observation of period, made from the shore of an estuary, may not necessarily give an accurate indication of wave-length in the open.

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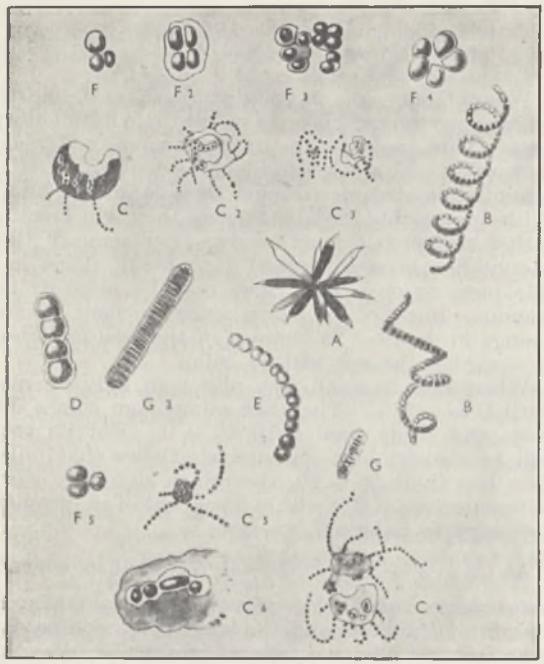
[1] Nature, 148, 226 (1941).

Normal Rumen Microflora and Microfauna of Cattle

The elucidation of the factors concerned in the digestive assimilation by cattle of starch, cellulose, and also of protein substitutes, necessitates an



Iodophile microflora of cattle.

A, rosette association of unidentified organisms; B, giant spirillum; C–C_5, stages in disintegration of starch grains by coccoids; C_4, surface of grain showing lacunæ surrounding coccoids; D, coccoid chains (giant form); E, coccoid chains (normal type); F–F_5, sarcina packets; G, G_1, *Oscillospira guillermondi*.

accurate knowledge of the functional activities of the rumen micro-organisms. On this subject very conflicting opinions have been advanced[1,2,3] based in many cases upon the results of inoculation of rumen-contents into artificial media. The value of these results, moreover, must always remain uncertain[4,2] until the characteristics of the normal rumen microflora and microfauna have been independently determined by direct microscopical observation. Appropriate methods have been applied by me to the investigation of the gastro-intestinal contents of various herbivora[4,5,6,7,8].

With the assistance of a grant from Imperial Chemical Industries, Ltd., these studies were extended in order to afford a microbiological control to *in vitro* incubations of rumen contents in progress at the Hannah Dairy Research Institute[9]. Observations were made upon local (Guildford) slaughter-house material as well as upon fistula samples submitted by the Institute. Fresh and formalized material was examined. The very numerous samples investigated made it possible to construct a representative picture of the normal rumen microflora and microfauna. This always includes:

(*a*) Protozoa of the families Ophryoscolecidæ and Isotrichidæ. These have been described and monographed by numerous investigators[10,11].

(*b*) An iodophile microflora, that is, an association of taxonomically diverse species exhibiting, in consequence of the presence in them of 'bacterial starch' or granulose, the common characteristic of giving a blue reaction with iodine. Such organisms have hitherto received scant attention from the majority of investigators, though they are found in all domestic Herbivora[12]. At least five species easily distinguished by their large size ('giant' forms) and characteristic morphology were invariably encountered, namely:

(1) *Oscillospira guillermondi*, Chaton and Perard[13] (Oscillaria caviæ, Simons[14]). A colourless spore-forming oscillarian (5–20 × 3–4 μ).

(2) *A giant spirillum* (15–40 × 1–2 μ) divided internally by transverse septa into spherical or ovoid compartments.

(3) *Large Sarcina packets* (1·5–3 μ).

(4) *An unidentified navicular organism* (bacterium) forming rosette-shaped associations of 5–30 units (4–8 × 0·9–1·5 μ).

(5) *Coccoid chains* of 2–8 units (*a*) (4–10 × 1·5–2 μ). (*b*) (*Smaller variant* 15 × 1·2–1·5 μ).

By the use of the polarizing microscope and histochemical methods[1,13], it was demonstrated that certain iodophile micro-organisms play a determinant role in the decomposition both of starch and cellulose. These results confirm those established by me for other Herbivora[2,4].

The functional activities of the rumen micro-organisms can be still further elucidated by *in vitro* incubations of rumen contents. In such experiments the maintenance of the iodophile microflora and protozoan microfauna clearly establishes the preservation of normality over the period of incubation. During this period, therefore, the results of biochemical and micro-biological analysis may reasonably be assumed to give a true representation of processes occurring in the living animal. By the use of counting methods the influence of chemical and physical factors upon the growth-rate of the iodophile micro-organisms could be ascertained. Thus a qualitative and quantitative control of the conditions established *in vitro* was secured.

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Jan. 12.

[1] Krebs, K., *Zent. Agriculturchemie*, (B), 9, 394 (1937).
[2] Mangold, E., "Handbuch der Ernahrung, etc., der landwirtschaftlichen Nutztiere" (Berlin, 1929).
[3] Pochon, J., "Rôle d'une bactérie cellulolytique de la panse" (Laval, 1935).
[4] Baker, F., *Sci. Prog.*, No. 134 (Oct. 1939).
[5] Baker, F., *Zent. Bakt.*, Ab. II, 88, 17 (1933).
[6] Baker, F., and Martin, R., *Zent. Bakt.*, Ab. II, 96, 18 (1937).
[7] Baker, F., and Martin, R., *Zent. Bakt.*, Ab. II, 97, 201 (1937).
[8] Baker, F., and Martin, R., *Zent. Bakt.*, Ab. II, 99, 400 (1939).
[9] Owen, K., Smith, J. A. B., and Wright, N. C., Nature, 147, 710 (1941).
[10] Doflein, F., "Lehrbuch der Protozoenkunde", 5te Aufl. (Jena, 1928).
[11] Wenyon, "Protozoology", Vol. 2 (London, 1926).
[12] Baker, F., and Martin, R., Nature, 141, 877 (1938).
[13] Chaton, E., and Perard, C., *C.R., Soc. de Biol.*, 74 (1913).
[14] Simons, H., *Zent. Bakt.*, Ab. II, 50 (1920).

Afferent Innervation of Mammalian Abdominal Viscera

THE afferent nervous pathways from abdominal viscera have been studied by McSwiney and his co-workers by means of the changes in pupil diameter induced by stimuli such as weak faradic shocks applied to the central end of the cut splanchnic nerve (Bain *et al.*[1]), or to the central end of the cut abdominal vagus nerve (Harper *et al.*[2]). Investigations, by oscillographic methods, of the afferent nervous activity in the frog's viscera have been carried out by Tower[3], and later confirmed by Burns[4]. It was shown that the gut and mesentery gave rise to fast nerve impulses in the sympathetic rami in response to light touch. These impulses are not dissimilar to those in cutaneous sensory nerves in response to light touch on the frog's skin. On examining the afferent nervous mechanism in visceral nerves of the cat and rabbit, it has now been shown that a somewhat similar mechanism sensitive to light touch is present. Thus in response to light touch on the gut or the mesentery, trains of impulses of a fast type can be shown to ascend in the small nerve trunks which run, in company with blood vessels, across the mesentery from its intestinal attachment towards the mesenteric root. The exact distribution of this tactile sensibility and the function of the cat's mesenteric Paccinian corpuscles are being investigated.

Expenses grants towards this work from the Medical Research Council and the Government Grants Committee of the Royal Society are gratefully acknowledged.

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Aberdeen.
Jan. 26.

[1] Bain, W. A., Irving, J. T., and McSwiney, B. A., *J. Physiol.*, **84**, 323 (1935).
[2] Harper, A. A., McSwiney, B. A., and Suffolk, S. F., *J. Physiol.*, **85**, 267 (1935).
[3] Tower, S. S., *J. Physiol.*, **78**, 225 (1933).
[4] Burns, W., *J. Physiol.*, **100**, 11P (1941).

Biology and War

IN these days when both comfort and efficiency are so dependent upon science and its applications, it is surely astonishing that so little weight is attached to the teachings of biological—apart from medical and agricultural—science in relation to problems which in these days have urgent importance.

An impressive example is afforded by the continued misuse of paint or pigment in relation to camouflage although the main principles of this were worked out more than a quarter of a century ago. Another is seen in the development of aircraft with refusal to grasp the fact that Nature had provided in the bodies of rapidly swimming fish a ready-made demonstration of the streamlined form most effective for rapid movement, whether through a denser medium such as water or a more tenuous one such as air. It is only now, after much needless expenditure of time and money, that the fuselage of fighter aircraft is seen to attain the correct form indicated by Nature.

Still another is concerned with the varying power of 'light' of different wave-lengths, as regards, on one hand, visibility by the human eye and, on the other, power of penetrating the atmosphere. A walk along a straight road on a hazy winter evening is enough to show by the reddening of the lamps with increasing distance the greater penetrating power of rays towards the red end of the spectrum. A walk by day when the sky is clear but the ground enveloped in thick haze shows a complete absence of the sharp shadows of sunlight; and yet the photographer armed with films sensitive to infra-red rays sees these shadows sharply depicted in his photographs, the infra-red rays finding their way past the water particles suspended in the atmosphere until these become big enough to form wet fog or rain. Yet no steps are taken to compel all ships of considerable size to be equipped with the necessary apparatus—photographic or fluorescent—to see through haze dense enough to conceal dangers to navigation though fine enough in the size of its water particles to allow the passage of the infra-red rays.

Blindness to such simple examples is necessarily accompanied by blindness to more elusive teachings of biology. Perhaps the most striking feature in the evolution of animal organisms is their advancement in size from small microbes to the relatively large creatures familiar in the animal world of to-day. This onward progress is a normal feature of evolution. It brings with it increased efficiency, increased power, increased speed of movement. But it also brings with it the seeds of decay and death. The geological record of evolution is littered with the remains of great powerful creatures which have become extinct while their smaller, feebler contemporaries have survived. The increase in size has in fact been attainable only by a corresponding increase in complexity of organization, involving the development of an ever greater multiplicity of parts, an ever greater sensitiveness to impressions from without, an ever greater centralization of control both over normal activities and over the appropriate reactions to emergencies. All this brings with it serious danger: vital processes are apt to become clogged and slowed down; destruction may come to the whole through the failure of some small part.

Blindness to such biological facts finds expression in many of our troubles of to-day. The air is full of complaints regarding the slowness of Government departments to act or to react—slowness which at times may have disastrous consequences. It is unfair in such cases to concentrate all the blame upon particular officials. It should rather be realized that many departmental shortcomings are inevitable results of their growth in size; and the only sure way to get rid of them is to diminish the potency of the size factor by a reversal of the normal evolutionary development. In some cases this can be effected by the resolution of the overgrown department into a number of more or less independent smaller ones. In others where this is not practicable, much can be done by the free delegation of authority by the central government to local bodies familiar with local conditions and free to take action on their own responsibility. The obvious dislike of the central departments to delegate any of their authority, to give up any of their powers of control, seems sometimes to imply a cynical disbelief in the reasonableness, or indeed the honesty, of the average citizen—a view which if it exists is most undoubtedly wrong.

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Feb. 4.

RESEARCH ITEMS

Early Man in New Mexico

An interesting excavation has been undertaken by F. C. Hibben, of the University of New Mexico, at Sandia and other cave sites in the Sandia-Manzano region of New Mexico. A stratigraphical sequence of deposits was obtained, there having been six levels in all, three of which contained archæological remains separated by sterile layers (Smithsonian Miscellaneous Collections, 99, No. 23). The uppermost level yielded pottery of early Spanish or immediately pre-Spanish date, the second one produced a Folsom industry, while from the lowest archæological bed there was unearthed a new pre-Folsom industry to which has been given the name of the site—Sandia. This industry, judging from the descriptions and photographs, would seem to be related to that of the middle, Folsom, level, but must be considered more primitive. Its typical tool is a sort of shouldered laurel leaf. At the bottom of this Sandia level the standard of flaking was not too good, very different indeed from the beautiful technique used by the makers of the true Folsom points. "Basal thinning" and "facial channels" are absent; the edges of the bases are smooth. The Sandia points from the upper part of the level, however, are far better made, being elongated with parallel sides and straight or somewhat indented butts. As before, the points are shouldered, doubtless for hafting purposes. A few scrapers were found, but the Sandia level as a whole was not rich in types. Such a clearly stratified pre-Folsom industry as this is obviously a matter of great interest. In an appendix to Hibben's paper, Kirk Bryan of Harvard University has attempted to demonstrate a high antiquity for the Folsom and Sandia levels at this site. He bases his theory on a study of the deposits themselves, which leads him to the conclusion that the Folsom layer is to be equated with our Pomeranian (late quaternary) glacial stage (= Mankato continental ice of North America), while the Sandia level is, of course, even older. This problem of the antiquity of man in the Americas is always cropping up, and it will be interesting to see whether Kirk Bryan carries his colleagues with him in assigning such a great age to these industries.

Elasticity of Bovine Cervical Mucus

An interesting adaptation of the measurement of a physical property to the study of a biological process is given by Scott Blair and others (*Biochem. J.*, 35, 1039; 1941). Determination of nitrogen and solid content, viscosity and flow elasticity have been made on bovine cervical mucus during the œstrous cycle. Flow elasticity shows a marked maximum at œstrus, and a simple apparatus, the 'œstroscope', for the measurement in the cowshed is described. It is believed that the œstroscope technique should be of practical value to stock breeders, especially for prediction of œstrus in cases where it is liable to be missed and for its diagnosis in cases where ovulation is unaccompanied by external signs of heat (see also NATURE, 147, 453; 1941).

Lecithinase Activity of *Cl. welchii* Toxins

Knowledge of the chemical nature of the specific toxins from toxic culture filtrates would be advantageous in preparing antitoxic sera and in studying the mode of action of the toxins on the cell. Because of the importance of *Cl. welchii* in war-wound infections, M. G. Macfarlane and B. C. J. G. Knight (*Biochem. J.*, 35, 884; 1941) decided to investigate the enzymic activity of toxic culture filtrates of this organism. It has been known that the activity of the toxin in producing an opalescence in human serum or egg yolk is a measure of α-toxin content. The authors now show that the specific α-toxin, the lethal hæmolytic and necrotic factor, is probably identical with a lecithinase (optimum *p*H 7·0–7·6) activated by Ca^{++}, which decomposes lecithin into phosphocholine and a diglyceride. It is probable that this lecithinase would confer hæmolytic and necrotic powers on the toxin, since it would have a disintegrating effect on any cell membrane or intracellular lipoprotein complex the integrity of which depended on the presence of lecithin. The anti-lecithinase activity of *Cl. welchii* (type *A*) antitoxic sera runs parallel with the animal protection titre and is a fair measure of the α-antitoxin.

Problems of Bee Keeping

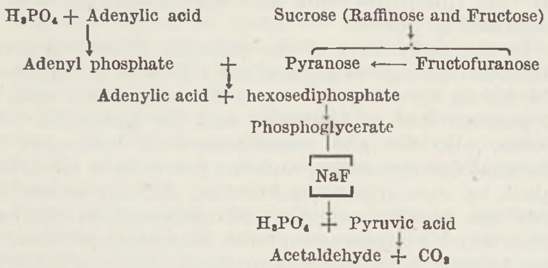
It is learned from the *Bee World* of January, 1942, that some important advances in knowledge of bee diseases have emanated from the Liebefeld Research Institute. It appears that Hans Schneider has found that a form of the mite Acarapis, which frequents the wings and first abdominal segment, is distinct from those previously known. The provisional name of *A. vagans* has been given (*Mitt. Schw. Entom. Ges.*, 18, 6; 1941). This mite is stated to occur only in quantity in stocks badly infected with Nosema. Prof. R. Burri, until 1937 director of the Institute named above, has made a notable advance in knowledge regarding European foul brood. He claims that the organism concerned, namely, *Bacillus pluton*, has been cultivated for the first time in an artificial medium. This discovery if substantiated is one of great value since there has always been room for doubt whether *B. pluton* is the actual causative agent of European foul brood disease because it could never be cultivated outside the bee larva. So far no particulars have been published regarding the nature of the culture medium employed. A third item referred to in the *Bee World* concerns the Frow remedy for acarine disease. It appears that V. Peterka and J. Svoboda have found that nitrobenzene is the ingredient in the Frow treatment that is lethal to the mites concerned. They also find that safrol oil does not kill the mites and is the substance responsible for injuring the bees. They therefore substituted methyl salicylate for saf ol oil and found that the treatment thus modified is preferable to the original remedy.

Inheritance in the Grasshopper

M. Creighton and W. R. B. Robertson (*J. Hered.*, 32, 339) have studied the inheritance of several colour patterns of *Chorthippus longicornis* of Iowa which may correspond with *C. parallelus* of Britain. Their results show that there is a multiple allelomorph series which controls colour on the sides and back. The most commonly found colour form—'plus' type—is the most recessive form. Interesting comparisons are made between the life-histories of *C. longicornis* in Iowa and *C. parallelus* as studied by Sansome and La Cour (*J. Gen.*, 30, 415; 1935). The colour forms are different, while the number of eggs per pod, the time of development of the insect and the development of elytra are dissimilar.

Respiration in Barley

In two further contributions by James and his co-workers to our knowledge of the respiratory system in barley (James and Bunting, *New Phyt.*, 40, 268; 1941; Bunting and James, *New Phyt.*, 40, 262; 1941) the carboxylase activity of barley powders and expressed saps is further examined and its presence confirmed. From the fact that a mixture of the sap and the powder obtained from the residue after sap expression is greater than the sum of their separate activities it is further concluded that the carboxylase system includes an insoluble apoenzyme and a soluble coenzyme. A typical clear barley sap gave a positive fluorescence test for cocarboxylase and it is estimated that 100 gm. of barley tissue contains about 30 γ (as diphosphothiamine) of this substance. In the second paper, respiration in barley is shown to follow much the same course as in yeast. Adenylic acid added to barley saps containing sugar and free phosphate give an increased CO_2 production as compared with untreated controls. The addition of hexosediphosphate and of phosphoglycerate to the digests increases the carbon dioxide output to about the same extent, and the effect of the former is completely inhibited by $M/40$ sodium fluoride. Since the enzymatic conversion of phosphoglycerate to pyruvic acid is exceptionally sensitive to this poison, it is concluded that phosphoglycerate follows hexosephosphate in the chain of respiratory reactions. From this and previous work, respiration in barley is represented along the following expanded scheme:



Kalsilite-bearing Volcanic Rocks in Uganda

At the Mineralogical Society on January 22, A. Holmes described a suite of volcanic rocks from south-west Uganda containing the new mineral kalsilite, a hitherto unrecognized polymorph of $KAlSiO_4$. The leading volcanic types of the Bunyaruguru field are distinguished by the following pairs of the four critical minerals: augite, melilite, leucite and kalsilite.

Ugandite	=	Augite + leucite	With abundant olivine, perovskite and black ore ± glass.
Mafurite	=	Augite + kalsilite	
Katungite	=	Melilite + leucite or leucitic glass	
Kalsilite-katungite	=	Melilite + kalsilite	

For the new rock-type characterized by the association augite-kalsilite the name mafurite is proposed. A heteromorphic variety with abundant biotite is distinguished as biotite-mafurite. Varieties transitional to ugandite are described as leucite-mafurite and kalsilite-ugandite. Melilite-mafurite, transitional to katungite, also occurs. Six new chemical analyses are presented. F. A. Bannister and M. H. Hey have investigated the new mineral by X-ray and microchemical methods respectively. The grains of kalsilite yield a hexagonal Laue pattern which is much simpler than those of nepheline and kaliophilite. The refractive indexes of kalsilite are $\omega = 1{\cdot}542$; $1{\cdot}537$; and it is thus not possible to distinguish kalsilite from nepheline in thin section.

Environmental Factor in Corrosion

According to V. J. Albano (*Bell Lab. Rec.*, 20, No. 3, Nov. 1941) corrosion results from the natural tendency of ordinary metals to revert to stability by combination with the surrounding elements, variation in the chemical properties of which, however, may be such that a metal which is resistant to corrosion in one way becomes attacked quickly in another. In Nature, sufficient traces of moisture and dissolved chemicals are usually present to render the environment active, but under certain conditions protective films form on many metals. Film formation requires an environmental substance that reacts with the metal to form an insoluble, impervious and adherent surface compound. The presence of corrosive substances militates against the formation of such a film. Distilled water lacking film-forming substances corrodes lead very easily, whereas city tap-water covers the lead with an inert and invisible protective film. Environment also governs galvanic corrosion between dissimilar metals, corrosion being accelerated by electrochemical action, seriously so in industrial and marine atmospheres, in soils and in waters. The more direct way to mitigate corrosion is to remove the corrosive constituents in the environment. The removal of dust and sulphur gases from air and the addition of film-forming ions, such as silicates, chromates and phosphates to water, or the removal of activating materials like chlorides, nitrates, and dissolved oxygen are all aids to the mitigation of corrosion. The indiscriminate selection of a metal for service in a specific environment based on its corrosion behaviour elsewhere is both unsatisfactory and uneconomical.

Great Sunspot of September 1941

In the December issue of *Observatory* (64, 161; 1941) H. W. Newton describes the sunspot group which crossed the sun's disk between September 10 and 23, 1941. At maximum, on September 18, the group had an area of about 2,500 millionths of the hemisphere, which ranks it among the 'great' spots. A short-wave radio fade-out beginning at 0830 U.T. on September 17 was evidently associated with a brilliant chromospheric eruption first observed, close to the leading spot, at 0838, and with a characteristic kick on the Abinger magnetic traces at 0821. About 20 hours later an intense magnetic storm began, the major disturbances lasting for more than 24 hours. The total ranges in the magnetic elements during the period were 2° 3′ in declination, 1,252 γ in horizontal intensity, and 1,116 γ in vertical intensity. This range in V is bigger than that produced by any other magnetic storm of the present solar cycle. Auroral displays in unusually low latitudes were observed on the morning of September 18 and the evenings of September 18 and 19. The sequence of events here is similar to that of the magnetic storms of March 1 and July 14, 1941, namely, a brilliant chromospheric eruption, accompanied by a synchronous radio fade-out and a small magnetic disturbance, is followed after a day or so by a great magnetic storm and associated auroræ. The eruption is usually associated with a sunspot, though not necessarily with a large one, hence the looseness of the correlation of magnetic storms with great spots. The information accumulated during and since the last sunspot maximum points to the significance of chromospheric eruptions in causing not only the radio fade-outs which occur simultaneously, but also the magnetic storms which follow after a time lag of about 20 hours.

EVOLUTION IN THE PETROLEUM INDUSTRY

In a paper on the above subject read before the Royal Society of Arts on January 21, Mr. James Kewley did not restrict the term 'evolution' to its purely biological sense of adaptation of species of organisms to changing conditions of environment. Rather he gave to it an added significance and power to embrace not only spontaneous changes, but equally predetermined policies designed by man to meet, or even anticipate, commercial and economic demands. Thereafter he proceeded to determine the measure of success achieved within the industry by citation of facts which by their very baldness proclaim the power of such man-made evolution.

In 1895 the deepest well drilled was 1,200 ft. Then came the cry for greater production of crude oil. To meet this, deeper and deeper wells were drilled until in 1940 the record was held by one sunk to a depth of 15,000 ft., or 2·8 miles. In 1859 the demand was for a reliable and cheap illuminant to replace the vegetable oils then in use. Kerosine fulfilled the demand and remained the chief product of petroleum for nearly forty years.

The next landmark in evolution of the petroleum industry was the incidence of the internal combustion engine, which presented the twofold problem of adequate supply of motor spirit and economic utilization of other crude oil products. Statistics show that in 1915 there were 15·8 tons of crude oil available per automobile registered, and in 1935 only 4·9. Nevertheless the demand for motor spirit was met by increasing its volatility and at the same time the yield of this product from the raw material. Hydrocarbons available in the natural gas from the casing heads of wells and in the gases or uncondensed vapours from distillation plants, for example, pentane and butane, were incorporated in the motor spirit fraction, thus increasing its volatility. Increase in yield by this method, however, was small compared with the impetus given to the industry by development of the cracking process, which proved to be a highly flexible technique both from the point of view of control of yields and character of products obtained. In fact, largely owing to the influence of the cracking process the yield of motor spirit from crude oils has been increased fourfold. In 1910 a yield of 13 per cent was obtained, while in 1940 the estimated figure was 55 per cent.

At this stage parallel evolution in the motor engine industry, involving higher compression ratios, created a demand for motor spirits of higher anti-knock value. That the petroleum industry met this demand is evinced by figures relating to the octane numbers of motor spirits in the United States. In 1931 the anti-knock value expressed in terms of octane-number and related to a standard C.F.R. engine was 58; in 1933 it was 67; and in 1940, 73. It so happened that crude oils produced from fields of younger geological age than those first discovered yielded motor spirits of higher octane number and also that cracking processes produced spirits of better anti-knock value, but whether this had been the case or not, evolution in the petroleum industry would not have been seriously retarded. Large-scale development of dopes, particularly tetra-ethyl lead, would have met the contingency.

Having solved the problem of production of high-quality motor spirit, refiners were faced with the difficulty of commercial utilization of the other components of crude oils. Consumers had to be convinced of the practicability of using fuel oil as an alternative to gas, which was in fact much easier to handle. Persistence was rewarded and when the Diesel engine came upon the scene suitable fuels were already available.

Study of figures for sales of Diesel engines (expressed in horse-power) in the United States indicate how great was the demand for this type of fuel:

1915	86,000
1925	536,000
1935	1,200,000
1939	2,726,000

The so-called space-heater for domestic purposes created a demand for a distillate intermediate in character between kerosene and gas-oil. The use of asphaltic bitumens for road-making, waterproofing, impregnating and a variety of other purposes became an established fact, and methods of blowing or oxidizing bitumens to suit them for particular applications were gradually perfected.

Then came the call for more and more aviation spirit, a product which had hitherto been considered of negligible importance and the small demand for which had been met by a volatile motor spirit. To-day it is a complex mixture of carefully selected components made by a variety of processes, and refiners are concerned not only with its production in vast quantities, but also in maintaining a high standard of purity.

In the early days of the industry there was a deplorable wastage of natural gas. Now it is harnessed for use in a variety of ways. The dry gas is used as a gaseous fuel in refineries and for industrial purposes, also for the manufacture of hydrogen by thermal decomposition and the production of carbon black by incomplete combustion. Ethane is cracked into the reactive unsaturated hydrocarbon ethylene from which by interaction with iso-butane is obtained neo-hexane, a valuable component of aviation spirit. "Bottled-gas" is produced by liquefaction of butane and propane by pressure at ordinary temperatures and is distributed in steel bottles for domestic cooking and lighting.

Finally, brief mention was made by Mr. Kewley of the ever-increasing number of special oils of the lubricating class, of the numerous new applications of paraffin waxes in the electrical and waterproofing industries, and of the uses to which are put the waste products from various refining processes, for example, naphthenic acids and cresylic acids.

All these data are amassed in support of the main theme of the paper, which is to demonstrate how successfully the petroleum industry has adapted itself to current demands and at the same time to adduce evidence pointing to the maintenance of this process of evolution in all its intricacies.

THE LIGHTNING DISCHARGE

An official communication (Ref. *S/T* 18*a*) from the British Electrical and Allied Industries Research Association upon this subject has been published by C. E. R. Bruce and R. H. Golde (*J. Inst. Elec. Eng.*, Pt. II, Dec., 1941). The contribution is an important one, and it presents several new theses. It is considered that the potential required to cause a lightning discharge is only a small percentage of that hitherto believed necessary, namely, of the order of 5×10^7 volts as compared with Wilson's 1×10^9 to 6×10^9 volts. The energy involved in a flash is of the order of 250 kwh., while the average charge is of the order of 50 coulombs, or 50 per cent greater than had been previously accepted. About one third of this charge is probably neutralized in the intervening space charge.

Available statistical data show that thunderstorms all over the world have similar flash time characteristics and numbers of strokes per flash. Strokes to the Empire State Building, New York, were found to be similar in overall duration to those occurring in ordinary country, due allowance being made for the duration of the initial continuing stroke. The currents in the flashes, however, were greater than those in flashes to normal country. Evidence purporting to suggest that storms in temperate regions vary in the number of strokes per flash was found to be inconclusive, and it is suggested that the later strokes of a flash are less intense than the earlier ones. These successive strokes are initiated by streamers *from* the original stroke *to* other cloud centres, and it is thought that strokes to transmission line conductors which do not cause flashover are unlikely to be followed by subsequent strokes.

Support was obtained for the suggestion that the wave forms of atmospherics are due to successive reflexions from the ionosphere and not to current pulsations in the lightning channel.

Negative flashes to earth are more frequent than positive flashes, the ratio being considerably smaller in temperate than in tropical regions. The polarities of direct strokes to transmission lines are unobtainable from magnetic-link observations on transmission towers. A higher proportion of positive currents has been observed by the cathode ray oscillograph as compared with negative currents.

Norinder's values for individual stroke currents are shown to be in error, an important selective principle having been neglected when comparing these with magnetic-link data.

SOUTH AFRICAN PREHISTORY

A NUMBER of interesting articles are contained in the *Transactions of the Rhodesia Scientific Association*, 37 (April, 1941). It is good to learn that the study of the rock-shelter paintings of Southern Rhodesia continues, and the Hon. L. Cripps speaks of thousands of sites of which he has visited and made copies of paintings at some six hundred. This is no mean work, and his little paper, scientifically written so far as it goes, is, one hopes, only the precursor of a larger work. The author has continued to study the superpositions of the different coloured paintings (though making no mention of any changes of style or subject-matter) and by these means makes out an age-colour sequence not materially differing from that which I was able to suggest in 1928. Further, he considers that the paintings were connected with the burial of the dead, and that the present-day natives are the descendants of the artists. I venture to suggest that some at least of the paintings go back to a very remote period, and that much migration into the country has taken place since they were made. It is always difficult to deny continuity of blood in any given instance, but I doubt whether there is any general direct descent from the earliest painters to the modern inhabitants. Indeed, I am not even sure that the painters in claret were themselves the direct descendants of those who used the earlier colours. May I perhaps remind Mr. Cripps that the problem of dating the paintings will surely involve excavations in the sites and that Bambata and Nswatugi seem to point the way and have in fact already helped in this direction ?

Mr. K. Radcliffe-Robinson describes a Stone Age industry from the Wedza district, some three hundred yards from the Sabi River on the banks of a tributary. Dolerite is the chief material used. Implements of various types occur, and, if the industry is really homogeneous, the age cannot be very remote, although some handaxe-like types and a possible burin occur. But so does a polished tool ! The occurrence of burins in more or less recent levels has been noted by Schofield in Natal, and rough core tools somewhat of a handaxe type are also not unknown. The technique of polishing is not very common, but examples are known from Southern Rhodesia, and farther to the south, for example, there are local specimens in the Museum at Grahamstown. In no case does this technique appear to be very ancient so far as we can determine. At a part of the site a little distant from the main mass of these tools there was found a Rhodesian Stillbay industry of quartz and ironstone, but owing to the lack of any stratigraphy it is, as is so sadly usual in this country, impossible to prove any relative dating of the two industries. This paper, too, shows a scientific attitude to the problems of Rhodesian prehistory ; the drawings are adequate but might have been better arranged.

Mr. C. Martin describes pottery-making in Nanyikaland, an art which is apparently dying out. As usual in Bantu tribes, pottery-making is woman's work. A good description and some interesting photographs are given.

M. C. BURKITT.

DRUG PRODUCTION IN THE BRITISH EMPIRE

IN a paper on "British Empire Drug Production" before the Royal Society of Arts on December 16 (*J. Roy. Soc. Arts*, 90, 138 ; 1942), Dr. Maurice Ashby points out that we are normally dependent on imports from overseas for practically the whole of our requirements of crude drugs, and a large proportion of our pre-war imports came from countries outside the Empire, the continent of Europe being our main source of supply of such vital drugs as belladonna, digitalis, henbane and stramonium. Dr. Ashby, after emphasizing the difficulties which might be encountered, owing to the influence of environment and inherent physiological differences, in growing medicinal plants in a new country where the climate or soil conditions might not be quite the same as in its original home, gave an encouraging account of what is being done in Empire countries to meet essential needs.

In Canada the most important development is the introduction of cascara as a crop, but some years will be required before supplies are available from the new plantings. In Australia and New Zealand the two most important items are agar-agar and ergot, and both Australia and New Zealand appear hopeful of producing really good-quality agar on a commercial scale.

Large-scale experiments on the artificial production of ergot on rye were undertaken in Australia on behalf of the British Government. New Zealand could probably produce most of the medicinal herbs we formerly imported from Central Europe, but the high cost of labour would make this uneconomic. With regard to India, Burma, Ceylon and Malaya, about 90 per cent of the world's supply of cinchona bark came from Java, which holds a virtual monopoly of the market. Indian production is still largely confined to Bengal and Madras, and has always aimed at satisfying local needs. Cinchona cultivation has been revived in Ceylon in recent years and there has also been experimental work in Malaya and Tanganyika. We have flourishing ipecacuanha industries in Bengal and Malaya but the quantities produced are very small, South America, particularly Brazil, being practically the only source of supply and, as ipecacuanha is a difficult crop to grow and takes some three years to mature, development must be slow. Malaya is also the leading producer of derris root, and strains have been developed with a far higher rotenone content than the original wild material or that produced by other countries.

The citronella oil industry of Ceylon has now assumed added importance, while in India karaya gum is proving a satisfactory substitute for some of the more costly gums like gum tragacanth and gum arabic. The Himalayas offer endless possibilities for belladonna, henbane, etc.

In the Mediterranean area the chief items are liquorice root and squill, particularly in Cyprus and Palestine. From South Africa the chief drug products are Cape aloes and buchu leaves. Cascara production in East Africa has been moderately successful and there has been experimental work on ephedra and on ocimum oils as a source of camphor, but the most striking success has been the pyrethrum industry.

FORTHCOMING EVENTS

(Meetings marked with an asterisk are open to the public)

Saturday, February 21

North of England Institute of Mining and Mechanical Engineers (at Neville Hall, Newcastle-upon-Tyne), at 2 p.m.—Mr. L. C. Maitland: "Mining Timber, Possible Economics and Substitutes".

Monday, February 23

Royal College of Surgeons of England (at Lincoln's Inn Fields, London, W.C.2), at 2.30 p.m.—Prof. J. Beattie: "Physical and Chemical Changes in the Blood associated with Shock and Hæmorrhage".

Royal Geographical Society (at Kensington Gore, London S.W.7), at 5 p.m.—Geographical Films.

Tuesday, February 24

Royal Society of Arts (Dominions and Colonies Section) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Prof. C. W. Wardlaw: "Banana Research at the Imperial College of Tropical Agriculture, Trinidad".

Chadwick Public Lecture (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Mr. Ewart G. Culpin: "Reconstruction after the War, with special reference to the Problems of Town and Country Planning".*

Royal College of Surgeons of England (at Lincoln's Inn Fields, London, W.C.2), at 2.30 p.m.—Prof. J. Beattie: "Physical and Chemical Changes in the Blood associated with Shock and Hæmorrhage".

Institute of Physics (Joint Meeting of the London and Home Counties' Branch and the Royal Photographic Society) (at the Royal Photographic Society, 16 Princes Gate, London, S.W.7), at 5 p.m.—Mr. E. R. Davies: "The Role of Photography in the Detection and Measurement of Radiation".

Wednesday, February 25

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. James Hogan: "The Post-War Home—its Interior and Equipment". 6: "Pottery, Glass and Plastics".

Coke Oven Managers' Association (Joint Meeting with the Institute of Fuel together with the Iron and Steel Institute and the Institution of Gas Engineers) (at the Royal Victoria Station Hotel, Sheffield), at 2.30 p.m.—Mr. J. G. Bennett: "The Future of Coke".

Geological Society of London (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. K. S. Sandford: "The Geology of Italian North Africa".

Thursday, February 26

Royal Institution (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Rt. Hon. the Earl of Onslow, G.B.E.: "The Preservation of the Existing Fauna of Great Gritain in a Wild State after the War".*

Friday, February 27

Institution of Mechanical Engineers (at Storey's Gate, London, S.W.1), at 2.30 p.m.—Mr. Hal Gutteridge: "Proneness to Damage of Plant through Enemy Action".

British Institution of Radio Engineers (Midland Section) (at James Watt Memorial Institute, York House, Great Charles Street, Birmingham 3), at 6 p.m.—Mr. G. Bernard Baker: "Thermionic Frequency Control".

Saturday, February 28

Royal Sanitary Institute (at the Nuffield Institute of Clinical Research, Oxford), at 10 a.m.—Mr. H. H. Crawley: "The Storage of Emergency Drinking Supplies"; Mr. Stewart Smith: "Administration of the Government Evacuation Scheme".

Nutrition Society (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 10.30 a.m.—Conference on "Food Production and Distribution in relation to Nutritional Needs". (Speakers: Sir John Orr, F.R.S., Dr. N. C. Wright, Mr. E. T. Halnan, and Sir John Russell, F.R.S.)

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh. Section A (Mathematics and Physical Sciences). Vol. 61, Part 2, No. 13: Some Disputed Questions in the Philosophy of the Physical Sciences. By Prof. E. T. Whittaker. Pp. 160–175. 1s. 3d. Vol. 61, Part 2, No. 14: Further Investigations in Factor Estimation. By D. N. Lawley. Pp. 176–185. 9d. (Edinburgh and London: Oliver and Boyd.) [22

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1941. Pp. 19+4 plates. (Kirkhill: Hannah Dairy Research Institute.) [22

Mines Department. Nineteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1940. Pp. 36+3 plates. (London: H.M. Stationery Office.) 1s. net. [22

Imperial Forestry Institute: University of Oxford. Seventeenth Annual Report, 1940–41. Pp. 20. (Oxford: Imperial Forestry Institute.) [42

Other Countries

University of Illinois Engineering Experiment Station. Bulletin No. 330: Heat Transfer to Clouds of Falling Particles. By Prof. H. F. Johnstone, Robert L. Pigford and John H. Chapin. Pp. 58. 65 cents. Bulletin No. 331: Tests of Cylindrical Shells; a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in co-operation with the Chicago Bridge and Iron Co. By Prof. Wilbur M. Wilson and Emery D. Olson. Pp. 132. 1 dollar. Bulletin No. 332: Analyses of Skew Slabs; a Report of an Investigation conducted by the Engineering Experiment Station, University of Illinois, in co-operation with the Public Roads Administration, Federal Works Agency, and the Division of Highways, State of Illinois. By Prof. Vernon P. Jensen. Pp. 112. 1 dollar. (Urbana, Ill.: University of Illinois Engineering Experiment Station.) [32