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Of nature trusts the Mind that builds for aye."*—WORDSWORTH.

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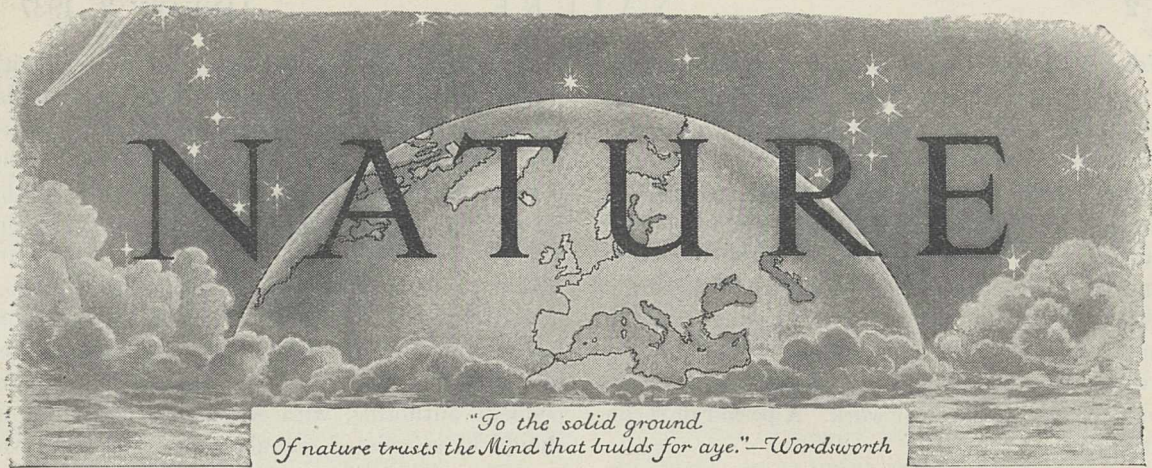
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The Social Opportunity in the Special Areas

IN his presidential address to the British Association at Blackpool, Sir Josiah Stamp pointed out that society and its institutions should now be learning that change is a continuous function, and that meeting it requires the development of an appropriate technique. This passage in which Sir Josiah pleads for the development of social shock absorbers and accommodating mechanisms to assist in the transition and to minimize the disturbances to social relations and institutions arising from the application of scientific discoveries, is immediately recalled by the third report* of the Commissioner for the Special Areas (England and Wales), which has now been presented to Parliament.

The Chancellor of the Exchequer, when introducing the Special Areas Bill to the House of Commons, aptly described it as an experiment—and, we may add, in view of the recent gift by Lord Nuffield of £2,000,000 to form a trust the activities of which will supplement the action of the State, an experiment which begins in the happiest circumstances. The Act may in fact be interpreted as an endeavour to determine the value to the Special Areas of providing special treatment, and to ascertain whether the results thereby obtained warrant a wide application. As such, it may indeed be regarded as an example of the machinery of social change and adaptation which Sir Josiah Stamp had in mind.

In the present report, the Commissioner reviews the progress made since December 31, 1935, in the economic development and social improvement of the Special Areas. In many directions good progress has been made. An auspicious start has been made with trading estate companies for the north-east coast and for South Wales, and their activities should be favoured by the operations of the recently formed Special Areas Reconstruction Association. Evidence that financial assistance is required for small industrialists in the Areas is increasing, and the Commissioner considers that if the objectives of his recommendations are to be attained, somewhat greater risks must be taken in granting loans than are usually accepted by bankers and financial houses.

The formation of trading estates marks a direct and practical effort to attract industry, especially the lighter industries, to the Special Areas. Their expansion is essential to secure a better balanced industrial production, and the Commissioner reiterates the view expressed in his first report. He urges that efforts to attract such industries to the Areas should not be diminished on account of the prospective improvement arising from the defence programme on which Great Britain is now embarked. It is hoped that trading estates will become centres from which increased industrial activities will radiate.

Of specific works initiated, the most important is the construction of the deep-water quays near Jarrow, but the Land Settlement Association, the

* Third Report of the Commissioner for the Special Areas (England and Wales), (Cmd. 5303.) Pp. xii + 210. (London: H.M. Stationery Office, 1936.) 3s. 6d. net.

Welsh Land Settlement Society and the Durham County Council are steadily progressing and the early results of these experiments in land settlement are regarded as satisfactory. They have demonstrated the adaptability and keenness of the settlers, whose general improvement in health and physique is remarkable. It is not generally realized how far below the standard strength and health of the ordinary active working man are those who have been long out of work, and how severely they suffer both physically and mentally from the loss of habit of work. A period of reconditioning is essential.

It is clear from the report that the Commissioner is far from satisfied with the results so far achieved, even if no more could be done with his comparatively limited powers. He repeats the criticism and recommendations of his first report, and especially stresses the importance of the Severn Bridge scheme as a gateway to South Wales, for which he was unable to make a grant. Similarly, to open up western Cumberland for industrial development and tourist traffic, he recommends the improvement of communications from the south and the construction of an arterial road, involving the construction of a bridge across the Duddon estuary. Improved communications between the north and south bank of the Tyne, east of Newcastle, are also recommended, as well as the institution of steps to prevent Maryport harbour from becoming closed and derelict.

Other specific recommendations in this field which have strong claims for State support are the erection of plants for the production of oil from coal in the Special Areas, the installation of a factory in South Wales for the manufacture of calcium carbide, and encouragement of the use of Welsh smokeless coal for domestic purposes. In the same category falls the proposal for the establishment and development on modern lines of a national park in South Wales. The development of the production of oil from coal in the Special Areas is recommended in the interests of national defence, and on the same grounds the Commissioner directs attention to the advantages of relative safety offered by some districts in South Wales and Cumberland in regard to the decentralization of the production of aircraft. For the same reason attention is directed to the value of South Wales, and West Cumberland as sites for the storage of grain and of oil.

The development and attraction of industry, however, is only one of the two main methods

envisaged by the Commissioner for dealing with the problem of unemployment within these areas. Equal stress is laid upon the adoption of measures to decrease unemployment generally, thereby making easier a reduction of its intensity in the Special Areas. In dealing with this question the Commissioner again refuses to dissociate the particular problem of the Special Areas from that of unemployment generally. The effects of transference are being increasingly felt, and he reiterates his recommendation that an impartial and independent authority, with whom the trade unions should be associated, should conduct a survey to ascertain as scientifically and accurately as possible what are the relative prospects of industrial revival in the different districts of the Special Areas. Transference should be concentrated on these districts which obviously offer the least prospect of recovery.

Once again the Commissioner emphasizes the seriousness of the position in regard to unemployment among young persons. Pointing out that more than two thirds of the young men who were interviewed refused training at a Government constructional centre or failed to attend after acceptance, he reluctantly concludes that too large a number of young men in the Special Areas are content to live in idleness as State pensioners and are unwilling to make any effort to find work. The danger involved both to the young men themselves and to society as a whole leads the Commissioner to recommend, first that the proportion of men from the Special Areas who satisfactorily complete a course of training at the Ministry of Labour instructional centre should be greatly increased, and secondly, that such attendance on the part of young men from the Special Areas should no longer be on a voluntary basis but be subject to an approved measure of compulsion.

The scientific worker will be disappointed at finding among these specific recommendations no further reference to those suggestions regarding the application of science to industry which are being considered by the North East Development Board, although following the survey of the industrial facilities of the north-east coast published in April last, a technical advisory committee has been set up to provide for the further exploration of the economic potentialities of the Area. On the other hand, the further discussion of general principles contained in Part 1 of the report raises questions with which scientific

workers are directly concerned. The very fact that the Commissioner, in restating principles previously outlined, finds it necessary to regret that they had not been recognized as a logical conclusion in debating his first report, indicates the need for closer attention to these questions.

As a means of increasing industrial activity in the areas, persuasion has definite limits and in fact is regarded as a failure by the Commissioner. On the other hand, compulsory location is regarded as unnecessary and dangerous; the Commissioner finds an alternative in Government action to prohibit the location of industry in particular areas unless good cause can be shown. His first recommendation is in fact that the further expansion of industry in Greater London should be controlled to secure a more evenly distributed production in which it is hoped the Special Areas would share.

The dangers attending the enormous post-War growth of Greater London, particularly in regard to adequate protection of food supplies in the event of a hostile attack, are cited in support of the Commissioner's argument that Government restraint on the further expansion of industry in the London area would indirectly benefit the Special Areas, and he refers to opportunities of exercising constraint at present available in the execution of the defence programme.

The Commissioner's recommendations involve the adoption of a definite plan to reduce unemployment in the Special Areas. He urges that if the Areas are to be given a reasonable chance of rehabilitation, industry must be attracted to them; to start the movement the initial effort must be powerful. Moreover, although, as he repeatedly points out, the problems of the Special Areas cannot be dealt with entirely apart from the general problems and well-being of the nation, we must not be afraid of making a break with the traditions and practices of the past. The application of unconventional principles may well be called for, particularly in respect of preferential treatment, and the Commissioner's suggestion that the possibility of removing from the live register those who have been out of work for more than five years and are never likely again to obtain employment should be considered, deserves serious attention.

Once again, in fact, Mr. Stewart has made it apparent how closely this problem is linked up with that of rearmament, of health, education and

industrial and social development generally. He firmly dismisses the idea that the defence programme offers any solution, and in fact directs attention to the dangers of armaments activity in the Special Areas if other measures are not simultaneously applied. Similarly, he directs attention to the dangers to health which are inherent in the conditions of the Special Areas, and his proposals for physical exercise and training as well as for instruction on relative food values, simple cooking and on the best way to distribute the portion of family income which is spent on foodstuffs, meet needs which are probably only more intense in the Special Areas but equally to be found elsewhere.

The scientific worker cannot but be impressed with the opportunity which many of the Commissioner's recommendations afford of gaining experience as to the value of numerous suggestions for social development which may well have a wide application if their efficiency is once proved. Action in this direction should not be thwarted by the opposition of vested interests, as is alleged by the Commissioner in regard to at least one of his earlier proposals repeated in the present report, and the attention which the report has already aroused in Parliament indicates that strong support for many of its recommendations should be forthcoming.

Undoubtedly the Commissioner's view of the position in the Special Areas is much less optimistic than that taken by Government spokesmen, and he is most emphatic on the need for definite action in accordance with widely developed and long-range plans. None the less, even when due account is taken of some tragedies of the Special Areas in regard to juvenile unemployment and disintegration of morale, the dominant impression created by the report is that of opportunity and hope. The task of rehabilitating and transforming these Areas and slowly reintegrating them into the national life is not insoluble. It makes big demands on vision and resourcefulness in planning, in research, and in redistribution of material sources and effort. Given the will and a vision of the social possibilities, success is assured, and the experiments may well prove of even greater value in the adaptation of national life as a whole to changed conditions. For this reason alone, apart from their incidental contribution in specific technical questions, the latest survey of the Special Areas claims the close attention of scientific workers as of other members of the community.

The Study of Mankind

L'Espèce humaine

Encyclopédie française, Tome 7. Pp. 574+40.
(Paris: Comité de l'Encyclopédie française; Libr. Larousse, 1936.) 125 francs.

FOUR sumptuous volumes of this encyclopædic work have already appeared within a year under the general direction of Prof. Lucien Febvre. A total of twenty-one volumes is projected, including one of bibliography and one of indexes. The previous volumes are entitled "L'Etat Moderne", "Littératures et Arts Contemporaines"; and the present one, "L'Espèce Humaine", is edited by Dr. Paul Rivet with the collaboration of M. Paul Lester and the aid of fourteen contributors. It has been issued in fifty-five fascicles, the complete quarto volume having a heavy black leather binding case.

The volume under notice is a discussion of anthropology in the widest sense, its three parts being devoted to (1) humanity to-day; (2) the question of peoples or races, including the notion of race, human palæontology, race crossing and the problem of classification; (3) population statistics and demography. Part I is richly illustrated with figures of human types and their activities, and begins with a historical discussion of what ethnology is. The various methods by which primitive implements were produced are described and illustrated in detail, as well as the uses of agglutinants, fibres, barks, fluids, etc. Other chapters are concerned with the social structure and supernatural beliefs of primitive peoples as well as their languages.

A chapter of twenty pages is devoted to the evolution of the idea of race, with illustrations from fossil skulls as well as from modern man. In another chapter, the biological phenomena of race are considered at length, and an attempt is made to introduce genetical conceptions. But although some French writers give Naudin credit equally with Mendel for the discovery of Mendelian inheritance, yet French investigators of heredity have always been few, and the bearing of genetical principles has not yet been widely grasped, especially in anthropology. In the present account the view still survives that mutations apply only to superficial characters, and that segregation in racial crosses frequently fails to occur, for example in negro-white crosses. The conception of duplicate factors and of linkage are conspicuous by their absence; the 15:1 ratio is regarded as contrary to Mendel's laws, and the significance of the

numerous 1:1 ratios for a dominant abnormality crossed with the normal condition is not clearly stated. It is to be hoped that anthropologists will soon recognize more fully that genetical principles apply to man as extensively as they apply to animals and plants. In this connexion, the short account of the blood groups might have been greatly extended to indicate their racial significance.

The white Indians of San Blas are recognized as of mutational origin, but the author hastens to add that he uses the term in a very different sense from the geneticists. The latter, on the contrary, regard these Indians equally as an excellent example of mutation.

The chapter on fossil men contains many interesting views. The Australian aborigines are regarded as the most archaic of living peoples and are classified as belonging to the same species as Neanderthal man; but since the Australians cross with other modern peoples, it is suggested that Neanderthal and modern man must all be merged into one species—an extreme example of the application of the interfertility rule, which modern botanists and zoologists have dispensed with as a necessary criterion of species.

Aurignacian culture is regarded as represented by three races in Europe—Cro-Magnon, Grimaldi and Chancelade—which are all believed to have left modern descendants and to show affinities respectively with the white, black and yellow divisions of living man. A surviving Cro-Magnon type is seen not only in the Guanches on the Canary Islands but also in south-western France, especially the Dordogne, whence it may be traced across the Iberian peninsula. Similarly a modern Grimaldi type is recognized in various parts of northern Italy and the Rhone valley.

Two chapters on miscegenation are followed by a section on the problem of racial classification in which the views of Deniker and of Haddon receive fullest consideration.

Part III is a consideration of population and demographic questions from practically every point of view, including numerous statistics clearly set forth, with discussion of many problems relating to the present and past population of the earth.

The general reader, as well as the specialist, will find in this work ample material, whatever his special interest in man may be or whatever the point he wishes to elucidate. The abundant pages (72) of illustrations include several coloured plates.

R. RUGGLES GATES.

Structural Theory: Investigation and Rule

Final Report of the Steel Structures Research Committee

Department of Scientific and Industrial Research.
Pp. xxvii + 572 + 16 plates. (London: H.M. Stationery Office, 1936.) 12s. 6d. net.

BRITISH technical research has been, in the past, rather contemptuously treated by practitioners at home. The younger technicians have generally been carried away by the apparent profundity of Continental discussion, and the older industrialists have been only too happy to accept information of foreign origin without question. The same idea is displayed in the readiness to take up licences for developments elsewhere. This common and persistent attitude reflects a doubt as to the capacity of home efforts in inquiry and research to provide adequate guidance in design and development.

There may be reasons in some directions, but they can scarcely be held to apply in structural work. Several publications by the Department of Scientific and Industrial Research in recent years have shown that the powers of comprehension and compromise that properly constituted British committees can exercise are of the highest order. This was notably established by the Bridge Stress Committee Report in 1929; and has been maintained by the sequence of reports issued by the Steel Structures Research Committee, the final report of which concludes a line of investigation that is marked throughout by range, insight and decision. By describing this report as final, the Committee probably desires to indicate that it has concluded its work. There is, however, no finality in a study of this kind. Theory may be pursued to finer issues, investigation may lead to clearer data, and rules of design may reflect a fuller comprehension and a surer judgment; but the essential result is a compromise that denies finality since the theory and investigation are both, and separately, necessary and are drastically simplified in the process of rule making.

This final report presents rules for design, after lengthy study and experiment. The first report (1932) did very much the same thing after brief consideration and no experiment. The first report was an essay in creating order out of the chaos of building regulations. The final report is an effort to establish rules that rest upon rational bases elucidated by systematic inquiry. That the inquiry has upset preconceived notions as to the actions and interactions of the elements and

connexions of building frames is an achievement of the Committee that may reduce the value of its own first attempt, but certainly leaves little merit in most other efforts.

The Bridge Stress Committee was almost wholly concerned with dynamic effects in bridge trusses. The Steel Structures Committee has concentrated almost entirely on static effects in building frames. The second report, issued in 1934, showed that in dealing with these, the problem of the characteristics of beam-stanchion connexions is complex and highly important. The work of the second report on this has been greatly extended. The honours in this line fall to Prof. C. Batho and his assistants, and the range and detail of the work now presented on the subject, embodying not only investigations on a wide variety of connexions and the factors influencing their actions, but also laboratory research on a full-scale frame, are remarkable for scope, experimental thoroughness and the manner in which design requirements are analysed. The investigations on bolted joints are strongly characterized by examinations of safe bolt torques, which make an important impression upon the ultimate issues of the report.

The other main experimental investigations presented in this voluminous report are concerned with measurement and analysis of stresses in actual structures. Prof. J. F. Baker and Dr. P. D. Holder are chiefly responsible, and the work marks new levels in large-scale research. Beam and column stresses in three classes of frames have been investigated. These frames are, respectively, for hotel, office and residential flat constructions, and mark the important continuation of the earlier work of this type by Dr. O. Faber on the framework of the Geological Museum, dealt with in the second report.

These measurements were undertaken to acquire information on the effects of workmanship under site conditions and to examine other factors that could, conceivably, influence stress distribution. The three types cover frame constructions with widely different connexion characteristics, the first having unusually rigid connexions, the second of normal order and the third of light construction. In the two latter the joint deformations were directly measured and, for the first, moment-angle diagrams are given as derived from the observed moments in beams and columns. The high degree of accuracy achieved is remarkable in view of the fact that testing was undertaken while actual

construction was in progress. The discussion of the observations and the deductions therefrom are of great value. Such disturbing effects as beam torsion and the influence of unequal yields in the tension and compression cleats of connexions are duly commented upon; and the final review of the tests on the three buildings contains important remarks on the effects of casings and walls.

An analysis is presented of the effect of wind load moments, and attention is directed to the high values set up in the lower parts of the column when the stiffness ratio of beam to column is low. But the final recommendations for design only cover for stresses caused by vertical loads. It is to be accepted that in structures for which the design rules are used, the constructions must resist horizontal or wind forces by means of floor

slabs and walls acting as bracing, or by special framing.

The design rules are presented with great clearness, and are the outcome of the rational lines of analysis developed in the various special studies on frames, stanchions and connexions. The rules are fully supported by tables and curves, and provide a relatively simple and straightforward procedure that is rather remarkable when the extraordinary range of data and detail study from which they emerge is viewed. In the structural trades, the rules will be the ready measure of the Committee's achievement; but to those who understand the technique of data accumulation, analysis and reduction in large-scale work, the labours that lie behind them, and lead to them, will be significant and highly impressive.

Foundations for Animal Painting

Animal Painting and Anatomy

By W. Frank Calderon. (The New Art Gallery, Second Series.) Pp. 336. (London: Seeley, Service and Co., Ltd., n.d.) 21s. net.

MR. CALDERON'S high reputation and the acknowledged influence he has exerted on the work of other distinguished animal painters guarantee that this new work from his hand will prove a trustworthy guide to the presentation of animal form in art. The first part of the manual is devoted to the general principles of picture-making and will repay perusal by the student of any branch of art, for here the author gives, from a ripe experience, much useful guidance in picture-making, combining a wealth of general principles with many useful hints about the handling of technical details—even to such minor points as the farm-hand with a switch who may be employed to prevent flies from disturbing the pose of a restive model! The second and much the larger part consists of detailed studies and descriptions of the anatomy of several animal types and the influence of anatomical detail on posture and surface form.

Both parts are profusely illustrated by pencil and charcoal drawings of admirable clarity, with the names of structures clearly indicated on the plates themselves—a method much to be preferred to numerical references, at the foot of the plates, so often to be found in manuals of this kind. Several useful reproductions of well-known pictures are added, to illustrate anatomical accuracy in observation or, in some instances, the absence thereof.

While the salient blood-vessels, which form such important features at many points in surface anatomy, are well described in the text, these are not so distinctly differentiated from the deeper structures in many of the plates; it would appear to have been worth while to have devoted some plates expressly to showing the prominent lines of these structures on the surface. With later editions in view, it should also be noted that in PL. 58 the skin-muscle is made to look like a bifurcation of the sterno-maxillaris instead of being shown on the more superficial plane to which it belongs. As one concerned to some extent in the correct delineation of human anatomy, the reviewer would also point to the unsatisfactory view of the shoulder girdle in PL. 63, the absence of the coraco-brachialis in PL. 124B and the exaggerated representation of the platysma in PL. 138.

These, however, are but minor points to cavil at in a work of supreme excellence, which is strongly recommended not only to the art student but also to all animal lovers, who will enjoy its *facile* and faithful drawings. No better advice could be given to any student, desirous of acquiring efficient technique in this branch of art, than that he should make careful copies of Mr. Calderon's plates on separate cards and then study those of anatomical detail in juxtaposition with those of surface form; it is certain that his own work will greatly profit in accuracy and natural semblance through the influence of these distinguished drawings.

ALEX. MACPHAIL.

The Excavation of Verulamium

Verulamium, a Belgic and two Roman Cities :
By Dr. R. E. M. Wheeler and T. V. Wheeler.
(Reports of the Research Committee of the Society
of Antiquaries of London, No. 11.) Pp. xii +244 +
120 plates. (London : Society of Antiquaries,
1936.) 15s.

THE fame of the excavations at Verulamium, by St. Albans, has been widespread. They were visited by many thousands, and accounts were constantly disseminated by the lay Press, as well as by technical journals. Dr. and Mrs. Wheeler have done more than anyone else to create a great and genuine popular interest in the archæology of Great Britain. They have proved once and for all that English people do not need the enchantment of Egyptian or Mesopotamian distance to stimulate their enthusiasm for the unearthing of the past. Under the care of the Office of Works, and, in the case of the theatre, through the generosity of Lord Verulam, the remains of important buildings on the site are now permanently open to view, and the enlightened action of the St. Albans Corporation in initiating the whole enterprise will doubtless be maintained and extended in the future. The success of the work has been a fine example of co-operation between local and national authorities, private owners, archæologists, volunteer students, and the general public. Now the official report, worthily published by the Society of Antiquaries, is before us as the abiding record of the whole four years' campaign. It is no less an abiding reminder of the irreparable loss that we have sustained a few months since in Mrs. Wheeler's grievously premature death.

The very wording of the title, "A Belgic and Two Roman Cities", would have seemed almost impossible seven years ago. It had indeed long been guessed that the pre-Roman stronghold of the Belgic King Cassivellaunus, stormed by Julius Cæsar in 54 B.C., lay hereabouts, but its site had never been precisely localized. By their inspired refusal to rest content with exploring the later Roman Verulamium alone, Dr. and Mrs. Wheeler have not only identified and outlined the history of a pre-Roman town, but also have come as near as possible to giving Cassivellaunus' *oppidum* a well-certified location five miles away in the great earthworks at Wheathampstead. They have shown, too, that the earthwork known as the 'Fosse' is the rampart of an early Roman Verulamium, in great part distinct from the recognized site of the later Roman city.

The historical sequence thus revealed is broadly speaking as follows: In the decades before Cæsar's invasions, Belgic conquerors from northern Gaul appeared in the Hertfordshire district, establishing their greatest stronghold at Wheathampstead, and fortifying their north-west frontier with the immense barrier of the Beech Bottom Dyke between the Rivers Lea and Ver. Forty years or more after Cæsar had come and gone, the first Verulamium came into being on the Præ Wood hill above the ford of the Ver opposite the Beech Bottom alignment. Here King Tasciovanus, the father of the greater Cunobeline, had his capital and mint.

After the Roman Conquest of A.D. 43, this site was abandoned, and the early Roman city was settled on the slopes below leading down to the all-important ford; through it ran the Imperial road from London to Chester, our Watling Street. This *municipium* was still without defences when it was sacked by Queen Boudicca's rebels in A.D. 61, but when restored thereafter it was furnished with the rectilinear defensive 'Fosse'.

In the second century, a further downhill move was made, and a new Roman city was laid out on an ambitious scale along the Watling Street beside the river, and dignified with the massive masonry-faced ramparts and deep ditches in part still to be seen. These tremendous walls, their towers and gates, two triumphal arches, a forum, shops, temples, a theatre unique in Britain, and many comfortable private houses, all attest "an age of colonial enterprise" when "the dignity of a distinguished provincial municipality demanded expression", and furthermore, "reflect an epoch when imperial and private speculators were investing their wealth in the British province to an extent which, in fact, the issue failed utterly to justify". A hundred years later, all was in decay, and the revival which under Constantius ushered in the fourth century was indeed accompanied by much rebuilding, but ended with that century in the shrunken decline of economic failure.

For the pre-Roman phases, this historical framework is mainly based on mutually helpful studies of fortifications and of pottery, though the excavations could not be extended over much of the actual areas of settlement. This handicap is graver in the case of the first Roman city, where the confident handling of the evidence from the defensive 'Fosse' makes one almost forget that the interior remains absolutely unknown. With the second Roman city the position is in a measure reversed:

from inside it, information is abundant, but the walls, towers, and gates have not been too generous of material, and their chronology has required some rather anxious argument from negative evidence.

The built-up areas within have provided the most uniformly successful sections of the report; probably no excavation on a Romano-British town site has ever been more laborious yet more superbly conducted and brilliantly described. It is impossible to go into detail here, but the section on the 'Triangular' temple demands especial mention, while the peculiarly interesting theatre has called for publication at greater length in *Archæologia* by

its excavator, Miss Kathleen Kenyon. The plans and drawings, mostly by Dr. Wheeler himself and Mr. A. W. G. Lowther, are everywhere splendid, and the coloured reproductions of the mosaic pavements by Mrs. Wheeler and others are as beautiful as their text is illuminating.

To historians, and especially economic historians, this work should above all be commended; the archæological method is now an essential instrument of their science, and seldom can a single excavation report have carried so much matter for thought so far beyond the circle of archæological specialists.

C. F. C. HAWKES.

Illustrations of Weeds

Weed Plates

By Prof. Dr. E. Korsmo. Series 2, Plates 31-60: Comprising 44 Species of Weeds on Cultivated Soil. 33in. × 25in. With explanatory Booklet of 92 pp. (Oslo: Norsk Hydro-Elektrisk Kvaestofaktieselskab; Leipzig: Koehler und Volckmar A.-G. und Co., 1935.) Paper, 22 gold marks; Leather paper, cloth edges, eyeletted, 38 gold marks.

THIS second series of illustrations of farm weeds fully maintains the high standard of execution and reproduction of the preliminary set (see NATURE, 135, 937; 1935). The presentation of each weed provides an education in its life-history and in many cases demonstrates in a most striking manner why any particular species is peculiarly difficult to eradicate.

The plates reveal the variety of methods of reproduction of individual weeds, many of which are frequently overlooked by the trained botanist as well as by the casual observer. For example, *Ranunculus ficaria* produces seed, bulblets in the leaf axils, and 'root tubers', all capable of withstanding a variety of adverse conditions and thus insuring the safety of the species. The great range of subterranean systems of weeds often remains unsuspected, as the aerial parts give little hint of what is happening below ground. The variety of morphological development in this direction may be indicated by *Mentha arvensis*, which possesses an amazing underground range of tubers, *Campanula rapunculoides* which forms an extensive creeping underground system with storage roots, *Bunias orientalis*, a crucifer with an exceptionally deep root and great basal leaves which may be two feet long, while *Polygonum bistorta* gains its name of 'snakeweed' from its fantastically twisted and curved rhizome.

A valuable feature of the illustrations is the help they give in distinguishing closely allied species, such as *Bromus secalinus* and *Bromus mollis*. For teaching purposes, also, many details are brought out which usually escape observation. Most students regard a poppy capsule as a partitioned box filled with numerous loose seeds, as it actually is when ripe, while the systematic attachment of the young seeds on the walls of the loculi is seldom realized. Another point is the wide range of variation in the size of the fruit of such species as *Atriplex patula*, which at first sight appears accidental, but is in reality a feature of the species. Yet again, special notice is taken of characteristic forms of hairs, which are often valuable aids in the determination of species, as the stellate hairs found in *Berteroa (Alyssum) incana*. Examples of this kind might be multiplied indefinitely, all pointing to the expert knowledge of teaching requirements which inspired the preparation of the plates.

Throughout the series, each weed is recognized as an individual, and no stereotyped form of treatment has been attempted. In each case the particular points of interest have been worked out, and the development of a single detail is often illustrated by a whole series of drawings. Of special value are the sketches of the early stages of such weeds as *Galeopsis*, which are not usually at all well known by botanist or student.

A third series of plates is due to appear, and on their publication the botanical world will be in possession of a work on the morphological details of farm weeds which is outstanding in the accuracy of its workmanship. These charts, together with Prof. Korsmo's recent book on weed seeds, with its beautiful coloured illustrations and detailed letterpress, will undoubtedly become a classical work of reference for many generations to come.

Sex

By Dr. B. P. Wiesner. (Home University Library of Modern Knowledge, No. 180.) Pp. 256. (London: Thornton Butterworth, Ltd., 1936.) 2s. 6d. net.

It is not surprising to find that this book departs in some ways from the tradition set by others on scientific subjects in this well-known series. In the first place, the subject itself is not restricted by the formal confines of academic curricula, and Dr. Wiesner has had to draw on such diverse branches of knowledge as physiology, anatomy, endocrinology, genetics, general biology and psychology. In so doing, the author has revealed a second feature of his departure from Home University Library orthodoxy, by showing himself an original thinker and by asking the lay reader to consider hypotheses, to weigh evidence and, in short, to puzzle things out for himself, instead of merely accepting *ex cathedra* statements about scientifically established 'facts'.

The nature of Dr. Wiesner's subject has doubtless in part dictated his technique of exposition, but a reading of this concise survey suggests that temperamental influences may also have played their part. However that may be, he has produced a book that is packed with information and interest; this may make it less easy reading for the layman than the conventional popular exposition of a technical subject, but will give it a special appeal to the scientific worker.

Apart from a few minor oversights in typography and phraseology, the actual presentation of Dr. Wiesner's matter calls for little criticism, for it lacks neither clearness nor elegance—if, indeed, any distinction whatever is to be made between the two. The drawings and diagrams add to the general lucidity of exposition. To the technician, the most controversial, and therefore the most attractive, part of the book will probably be the discussions on the relation between sexuality and reproduction (especially Chapter v) and on the evolution of sexuality.

A. L. B.

Tables annuelles de constantes et données numériques de chimie, physique, biologie et technologie

(Annual Tables of Constants and Numerical Data; Chemical, Physical, Biological and Technological). Données numériques sur le pouvoir rotatoire (Numerical Data on Rotatory Power). Par Prof. E. Darmon. Années 1931 à 1934. Pp. 68. (Paris: Gauthier-Villars; New York: McGraw-Hill Book Co., Inc., 1936.)

THIS is a collection of data obtained on optical rotatory power between 1931 and 1934, and is an advance paper from vol. 11 of the well-known "Tables annuelles". The matter is grouped in seven sections: specific rotatory powers; influence of temperature, concentration and solvent; rotatory dispersion; resolution of racemic compounds; mutarotation; effect of additions; and general theories. Of these the largest section is that on rotatory dispersion, which occupies more than half the volume. Among the interesting results recorded in this section one may note in passing the work of Lowry

and Gore on the vapour of camphor and camphorquinone, and that of Levene on a number of aliphatic compounds in which the rotatory dispersion is followed through an absorption band. Section 4 includes a number of resolutions of theoretical interest such as Mann's purely inorganic compound $\text{Na}[\text{Rh}(\text{SO}_2\text{N}_2\text{H}_2)_2(\text{H}_2\text{O})_2]$, and on the organic side Pope and Whitworth's resolution of *spiro*-5:5-dihydantoin and Backer and Schurink's work on *spiro*-heptane dicarboxylic acid.

The numerous workers in the field of optical activity will be grateful to Prof. Darmon for this valuable summary of recent work.

Technische Kunstgriffe bei physikalischen Untersuchungen

Von Prof. Dr. Ernst von Angerer. (Sammlung Vieweg: Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik, Heft 71.) Dritte Auflage. Pp. ix+201. (Braunschweig: Friedr. Vieweg und Sohn, 1936.) 9.80 gold marks.

PROF. VON ANGERER was entrusted with the preparation of the volume on experimental technique for the Wien-Harms "Handbuch der Experimentalphysik", and the present publication represents the third edition of his "Kunstgriffe", so that it must from the outset command attention. Indeed, it is a most interesting little book in which every experimenter is bound to find something which will appeal to him personally.

It is obvious that the author has taken considerable pains to keep himself thoroughly up to date with modern advances in laboratory arts and technique, and it is clear, too, that in many instances he has tested them for himself. Omissions, so far as the reviewer has been able to judge, are very few, although it is surprising that no mention is made of Hulett's method of purifying mercury, and also to find that two constant-temperature baths instead of three are shown in thermo-couple diagrams. However, such details detract but little from the excellence of the work as a whole, and it can be heartily commended.

L. F. B.

Experimentelle Grundlagen der Wellenmechanik

Von Dr. S. Flügge und Dr. A. Krebs. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 38.) Pp. x+236. (Dresden und Leipzig: Theodor Steinkopff, 1936.) 16 gold marks.

THE collaboration of a theoretical physicist with a colleague who is an experimenter naturally results in a book of wide appeal, even if both authors feel it necessary to deal with many important branches of modern physics in a small space. It provides a ready guide for readers who wish to know the present state of wave mechanics theory, its experimental basis, and how far the theory is able to provide new and more adequate explanations for the results of fundamental experiments. It is an interesting compilation. The reviewer, however, would scarcely term Schopper's experiment for the direct measurement of e , a method for finding e/m .

The Oxford University Arctic Expedition, 1935-36

By A. R. Glen

THE plans of the Oxford University Arctic Expedition, 1935-36, were briefly outlined in an article which appeared in *NATURE* of April 20, 1935, p. 604. The Expedition returned to England in September last after a stay of fourteen months in the barren North-East Land. The country, which is somewhat larger than Wales,

The biological work of the Expedition will be dealt with in another article. For the remainder of the research, it may first be said that the whole programme of the Expedition was successfully achieved. Climatic conditions did nothing to facilitate this, for although the temperature never fell so low as had been anticipated nor were the

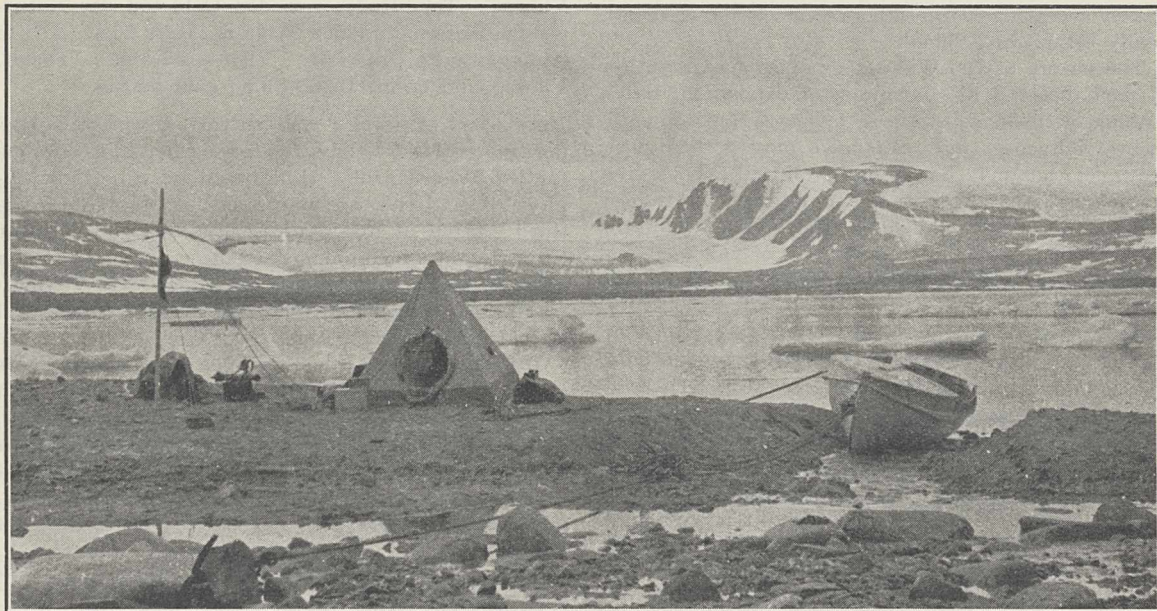


Fig. 1.

A CAMP ON THE NORTH COAST OF NORTH-EAST LAND DURING THE BOAT SURVEY JOURNEY IN THE FIRST SUMMER.

has the greater part of its interior covered by ice cap; its coasts are broken up by many deep fjords which are divided one from the other by rocky promontories from which the ice covering has long since disappeared. The north coast, which fringes the Polar Ocean, was practically unknown, while there was also little knowledge of the east coast, which is made up of an almost continuous stretch of ice cliffs—these being the largest expanse outside the Antarctic.

The personnel of the Expedition consisted of ten members who were as follows: A. R. Glen (leader and glaciologist), N. A. C. Croft (photographer), A. Dunlop Mackenzie (organizer), J. W. Wright (surveyor), A. S. T. Godfrey (surveyor), R. M. Moss (physicist), R. A. Hamilton (physicist), A. B. Whatman (in charge of radio research), D. B. Keith (biologist), K. J. Bengtssen (trapper).

gales so severe as had been feared, yet prevailing blizzard and predominant fog much complicated survey and geological investigations. During the summer of 1935, the western part of the north coast was surveyed in the course of a boat journey made by Wright, Keith and Bengtssen. The polar ice retreats from the coast during the summer, allowing the use of small boats until the bays begin to freeze again in September, and this party only returned to the base before the autumn gales began. In the following spring, Wright and Mackenzie started off with a dog team to sledge along the eastern part of the north coast so as to complete the survey and if possible to continue it down the east coast. In the previous autumn and winter, journeys had been made in the darkness to lay depots at three strategic points, Cape Leigh Smith, Palander Bay and Wahlenberg Bay, which

should be used by this spring survey party. What had not been allowed for, however, was the weather; continuous fog and low cloud made survey quite out of the question except on one or two days during each month. The result was that by the time the bay ice was beginning to break up in early July, a considerable part of the north coast still remained to be mapped. Wright and Mackenzie therefore returned to the base in Brandy Bay after a narrow escape from disaster when crossing Rijps Bay in an improvised boat. A second party was quickly fitted out, and a few days later Wright and Hamilton set off for Cape Leigh Smith, which they reached after nine days hard travelling. The weather suddenly became good, and in a fortnight's work the mapping of the north coast was completed (Fig. 1). The greater part of the survey of the rest of the country was also carried out by other sledge parties, and North-East Land must now be considered as one of the best mapped countries in the Arctic.

The main problem of the geological investigations was in connexion with the relation between the Hecla Hoek rocks and the granites and gneisses which are found around North Cape and also form the eastern part of the north coast. The eastern arcs of the Caledonian folding have affected this region, and although the absence of a full-time geologist greatly hindered this work, a considerable amount of research was carried out on these problems. The geological structure of the western part of the north coast was mapped in detail and some interesting discoveries were made in the little metamorphosed rocks of the younger Hecla Hoek series.

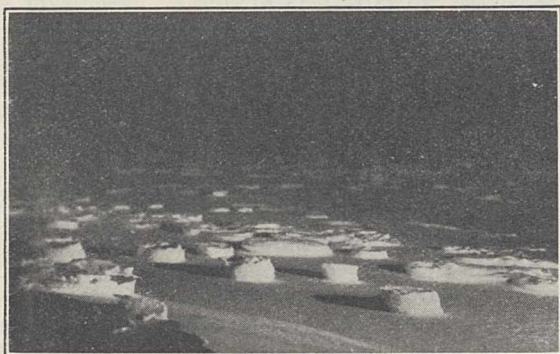


Fig. 2.

RAISED FOOTSTEPS ON THE SNOW SURFACE DURING THE WINTER. FOOTSTEPS ARE PACKED DOWN AND THE SOFTER SURROUNDING SNOW IS REMOVED BY WINDS, LEAVING THE FOOTSTEPS RAISED ABOVE THE REST OF THE SURFACE. TAKEN AT MIDDAY IN DECEMBER AT THE NORTHERN ICE CAP STATION DURING THE FOUR MONTHS WINTER DARKNESS.

Perhaps the most interesting work of the Expedition was in connexion with the glaciological investigations. In order to carry these out, it was

planned to establish two stations on the inland ice, each of which should be maintained by two men over the winter. The only previous work of this



Fig. 3.

CREVASSE DISCOVERED AT THE CENTRAL ICE CAP STATION WHILE A SHAFT WAS BEING DUG TO 40 FT. BELOW THE SURFACE. A DEPTH OF 70 FT. WAS REACHED IN THE CREVASSE, BEING ONLY A FEW FEET FROM THE LAND BELOW.

nature was accomplished by the German expedition under the late Alfred Wegener, when their station Eismitte was set up in the centre of the Greenland ice cap. Difficulties of transport resulted in only the barest minimum of food and equipment being brought to Eismitte, and in appalling circumstances the Germans succeeded in producing a wonderful harvest of scientific results. Our problem was simpler in so far as distances were shorter, and we had the guidance of previous experience; but there were the same difficulties to be overcome in the way of blizzards and low temperatures, while four months darkness was a further complication. A solution was found in having the stations cut out of the ice, and amazing warmth and comfort was attained in this troglodytic-existence. Moss was in charge of the central station for ten months, during three of which he was alone, while Glen and Dunlop Mackenzie formed a wintering party at the northern station (Fig. 2). Meteorological investigations were taken

three times daily at each station at the same hours as at the base, whence results were sent by wireless after each reading to Norway.

The net balance of the ice cap—that is to say, the ratio between the factors of accumulation and ablation—was determined for the west ice over the year, and preliminary discussion of the results obtained indicate that the northern part of the ice cap is probably both shrinking and retreating. The different factors obtaining both in accumulation and ablation were separately measured and their relative proportions assessed, while research was also made on various physical questions connected with the ice itself and with the change of snow into ice. The temperature gradient was measured down to a considerable depth, and it was found at the central station that the temperature remained at a fairly constant 0.0°C . at a depth of 70 ft. Certain indications of the thickness of the ice were obtained indicating that at least the west ice is very much thinner than had been thought. A crevasse was discovered while digging a shaft at the central station, and through it we were able to penetrate to a depth of more than 70 ft., where an unfrozen ice lake was found (Fig. 3). The walls of the crevasse were covered with a glittering array of ice crystals while magnificent icicles across the passages formed curtains

which had to be cut down before a way could be found along them (see also NATURE, Nov. 7, p. 803).

At the base in Brandy Bay, Whatman and Hamilton were stationed practically continuously throughout the whole expedition. They were in charge of the important research on the ionosphere which was being carried out for the first time north of the auroral belt. Before departure from England, it had been feared that the severe climatic conditions would make it impossible successfully to accomplish this work, but so efficient was the whole apparatus and the Petter electrical generating unit, that not a single serious breakdown occurred over the entire year. The results are now being examined by investigators at the Radio Research Station at Slough, in co-operation with which, and also with the Norwegian Government Station at Tromsø, the records were taken. Special studies were also made of the aurora, and measurements were made of the atmospheric ozone.

By the end of August the scientific programme had been accomplished and the M.S. *Heimland* arrived in Brandy Bay on August 21. The base hut has been bought by the Norwegian Government, and after it had been inspected and the stores and equipment loaded on to the ship, we left Brandy Bay on the following evening.

Scientific Centenaries in 1937

By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.

WHEN reference was made in these columns a year ago to the scientific centenaries in 1936, the first man of science to be recalled to mind was the famous German mathematician Johann Müller, or Regiomontanus, who was born in 1436. In reviewing the centenaries which will fall this year the first name to be included is that of Christopher Clavius (1537–1612) whose birth occurred a century later. Born at Bamberg, in Germany, he entered the Society of Jesus, taught for many years in Rome—earning for himself the appellation of “the Euclid of the 16th Century”—was employed by Pope Gregory XIII on the reformation of the calendar, and in 1604 published his most important book, “*Geometria Practica*”. He died February 6, 1612. Another mathematical worthy of the sixteenth and seventeenth centuries was Henry Gellibrand, who was born in London in 1597 and died as Gresham professor of astronomy in February 1636 (o.s.) or 1637 (n.s.).

It was Sir Henry Savile who turned Gellibrand's attention to mathematics, and at the Gresham College he became the close friend of Henry Briggs.

“Mr. Gellibrand's situation at the College, free Converse with the Lovers of Mathematical Studies, and diligent Enquiries, gave him,” wrote Benjamin Martin, “an Opportunity of contributing much to the Improvement of Navigation, which probably would have owed more to him had he lived longer: But he was taken off February 9, 1636, in the 40th Year of his Life, and was buried in the Church of St. Peter the Poor, without any Inscription to his Memory”.

The year 1637 also saw the birth of another English mathematician who had but a short life, William Neile, who died at the age of thirty-four years. He had been elected a member of the Council of the Royal Society at the age of thirty, and according to the antiquary Hearne, his

powerful genius for mathematical studies was such "that had he not been cut off in the prime of his years in all probability he would have equalled, if not excelled, the celebrated men of that profession".

Whatever interest is to be found in the lives of Clavius, Gellibrand and Neile, however, is far surpassed by that which surrounds the activities and strange ending of the great Dutch naturalist Jan Swammerdam (1637-80). He imbibed a love of natural history from his father, and was trained for medicine. He became famous both as an anatomist and as a microscopist.

"Swammerdam," said Prof. Miall, "treated the microscope as an instrument of continuous biological research. In his eyes it was a sacred duty to explore with the utmost faithfulness the minute works of the Creator. Insects yielded him an inexhaustible supply of natural contrivances, in which closer scrutiny always brought to view still more exquisite adaptations to the conditions of life. He was able to throw a beam of steady light upon the perplexed questions of insect-transformation, and swept from his path the sophistries with which the philosophy of the schools had obscured the change of the caterpillar into a moth, or of the tadpole into a frog. . . . He bequeathed to his successors many noble examples of the way in which life-histories ought to be investigated."

About 1672, Swammerdam came under the influence of that strange religious visionary, Antoinette Bourignon, and, already of feeble constitution, he slowly sank into an early grave through overwork and the melancholy engendered by mysticism. Under the pressure of indigence he had sold many of his writings and drawings. These came into the possession half a century later of Boerhaave, who caused them to be published under the title "Biblia Naturæ", in 1737.

Passing from the men of science who laboured in the seventeenth century to those who belong to the eighteenth century, the outstanding name is that of Aloisio Galvani, the bicentenary of whose birth falls on September 9. Born at Bologna, he was educated, and practised and lectured there, and it was there he made his discoveries on animal electricity which his countryman Volta referred to as "a great and luminous discovery which forms an epoch in the annals of physical and medical science". His death took place in 1798; the centenary of which event was marked by suitable ceremony at Bologna. Of other men born in 1737, mention may be made of Dr. Richard Watson (1737-1816), Bishop of Llandaff, who lectured at Cambridge on chemistry; Guyton de Morveau (1737-1816), whose career is noticed in another column (p. 18); Jean-Nicolas Ceré (1737-1810),

who as director of the Royal Botanical Garden at Mauritius earned the gratitude of European naturalists by his gifts of plants; Alexander Dalrymple (1737-1808) who, in his early days a writer in the East India Company's service, rose to be hydrographer to both the East India Company and the Admiralty; William Bayly (1737-1810), the astronomer who accompanied Cook on some of his voyages; William Forsyth (1737-1804), the Scottish horticulturist, whose name is recalled by one of our most beautiful of early flowering shrubs; Colonel H. Watson (1737-86), who translated Euler's work on the construction and manœuvring of ships and practised naval architecture with great success; and Dr. Charles Hutton (1737-1823). Hutton began life with few advantages, but by unremitting labour gained for himself a prominent place among British mathematicians. For thirty years he was a professor at the Royal Military Academy, Woolwich, and in 1779 he became the foreign secretary to the Royal Society. He was editor of the *Ladies' Diary*, made the calculations in connexion with Maskelyne's experiments on the density of the earth, carried out experiments on gunnery, and in 1795 published a valuable mathematical and philosophical dictionary.

Of those whose lives began in the eighteenth century but who died a hundred years ago, the one with, perhaps, the highest reputation was Karl Ernst Adolf von Hoff (1771-1837), the German geologist to whom a tribute was paid in NATURE for June 8, 1905. "Von Hoff's position as an original thinker," it has been said, "is at least equal to that of Lyell." A diplomatist and immersed in the international confusion of the Napoleonic era, he yet found time to establish a geological journal in 1801 and carried on those studies which led to the writing of his great work, "The History of the Changes in the Surface of the Earth". Other men of science who died in 1837 include Edward Turner (1798-1837), professor of chemistry in University College, London, who did important work on the atomic weights of the elements; William Ritchie (1790-1837), a student under Gay Lussac and Biot, who in 1829 became professor of natural philosophy at the Royal Institution; Domenico Scina (1765-1837), a learned Sicilian physicist who became chancellor of the University of Palermo; Martin van Marum (1750-1837), a Dutch physicist who made many electrical experiments and was secretary to the scientific society of Haarlem; and John Latham (1740-1837), the ornithologist, who at eighty years of age began his "General History of Birds" (1821-28). To engineers the name of Arthur Woolf (1766-1837) recalls many important improvements in the steam engine, while that of Claude-Pierre

Molard (1758–1837) will always be associated with the foundation in Paris of the Conservatoire des Arts et Métiers. Early in his career, Molard was brought into contact with Vaucanson, and was placed in charge of the collection of models which Vaucanson gave to France. It was only natural that when the Government, on the report of the Abbé Grégoire, decided to found the Conservatoire, Molard should be appointed its first director. When elected to the Paris Academy of Sciences, Molard was given the seat vacated by Napoleon.

During the last hundred years, through various causes science has engrossed the attention of so many workers that the list of men eminent for one reason or another who were born in 1837, a century ago, is a long one. The list given below does not claim to be complete, but the notes given will suffice to recall some of the activities of the nineteenth century. Among the ranks of the physicists, Eleuthère Elie Nicolas Mascart (1837–1908) was certainly one of the most widely known scientific men of his day. As successor to Regnault at the Collège de France, as director of the Central Bureau of Meteorology in Paris, and as president of the Paris Academy of Sciences, he rendered notable service to science in France, while as president of various international gatherings he had a wide reputation as an organizer. He died on August 26, 1908, and was buried with military honours in the cemetery of Montparnasse, in which rest the remains of Regnault, Biot, Foucault, Dumas and Ampère. Another eminent French physicist born in 1837 was Emile Sarrau (1837–1904), a professor in the Ecole Polytechnique and for many years director of the laboratory of the Ecole des Poudres et Salpêtres. He wrote on light, heat, gases and ballistics, and was a collaborator with Berthelot on investigations on explosives. The year 1837 also saw the birth of the German meteorologist Wilhelm von Bezold (1837–1907), director of the Meteorological Institute in Berlin; of Admiral Carl Koldewey (1837–1908), the commander of two arctic expeditions and an authority on magnetism; of Johann Diderik van der Waals (1837–1923), the eminent Dutch physicist; and of the Belgian Jesuit Eugène Lafont (1837–1908), a pioneer in scientific education in India. Sent to St. Xavier's College, Calcutta, in 1865, Lafont erected a meteorological and astronomical observatory and a physical laboratory, and afterwards took an active part in the work of the University of Calcutta, and was a founder of the Indian Association for the Cultivation of Science.

What Lafont did for physics in India, Edward Divers (1837–1912) did for chemistry in Japan. In 1873, at the invitation of the Public Works Department of that country, he with ten other

Englishmen went to Tokyo to found a college of engineering. For twenty-six years he laboured there, and to-day a bronze statue of him stands in one of the courtyards of the Imperial University. In 1905–6 he was president of the Society of Chemical Industry. The chemist, John Alexander Reina Newlands (1837–98), was also born a hundred years ago. As a young man of twenty-three years of age he fought under Garibaldi for Italian freedom, and it was soon after his return home and while practising as an analytical chemist in London, that he sent a letter to the *Chemical News* containing his earliest views on periodicity among the chemical elements; views which were regarded at first as fantastic but which afterwards gained for him the Davy Medal of the Royal Society.

The ranks of astronomers have ever been recruited from many sources, some of the most eminent workers in this science beginning their careers in circumstances which were little likely to lead them to the computing room and the observatory. This is exemplified by the lives of several men whose centenaries fall this year. Richard Antony Proctor (1837–88), one of the most popular lecturers and writers on astronomy, and one of the keenest observers, began life as a bank clerk in London; Ralph Copeland (1837–1905), who was Astronomer Royal for Scotland in 1889–1905, spent his early years on the sheep-runs and amid the gold diggings of Australia, while Frank McClean (1837–1904), as well known for his generous gifts to astronomy as for his own work on the spectra of the stars, was originally a civil engineer. William Harkness (1837–1903), too, who was born at Ecclefechan, Scotland, and who became director of the Naval Observatory at Washington, was a medical man before he became an astronomer, while his American contemporary Henry Draper (1837–82), in whose honour the United States Government struck a transit of Venus medal, was a professor of physiology. On the other hand, Edmund Weiss (1837–1917), assistant and successor of Littrow at the Vienna Observatory, began life as an astronomer. Another name of interest in connexion with these centenaries of astronomers is that of the American financier Charles Tyson Yerkes (1837–1905), who, with funds accumulated through his railway enterprises in Chicago, founded the Yerkes Observatory of the University of Chicago.

In conclusion, passing reference may be made to a few men distinguished for their work in various other branches of science or industry whose centenaries fall this year. Henry Hicks (1837–99), the president of the Geological Society in 1896–98, was a surgeon by profession, and it was his contact with J. W. Salter which

made him a devoted student of geology and palaeontology; Raphael Pumpelly (1837-1923) turned geologist on coming under the influence of Noeggerath at Freiburg, and so embraced a profession which brought him a life full of adventure in many lands, while Thomas Davies (1837-93), who edited the *Mineralogical Magazine*, followed in the footsteps of his father William Davies (1814-91) when in 1858 he entered the service of the British Museum. Among metallurgists, few in his day were known better than George James Snelus (1837-1906), who for his work on the

elimination of phosphorus from molten pig iron, received in 1883 one Bessemer Gold Medal, while another was given to Sidney Thomas. In Germany, no man did more to establish the engineering industry on a sound basis than Ludwig Loewe (1837-86), the founder of a still famous firm, while American invention and engineering are recalled by the names of Robert McAlpine (1837-1911), a pioneer in the manufacture of paper from ground wood pulp, and Colonel Washington Augustus Roebling (1837-1926), to whom fell the task of constructing the Brooklyn Bridge at New York.

The Iguanodons in the Brussels Museum

WE are glad to record that the unique collection of skeletons of the Wealden dinosaur *Iguanodon* in the Royal Museum of Natural History at Brussels has now been installed for safe preservation in two air-tight glass cases, which are probably the largest exhibition cases hitherto placed in a museum. The twelve skeletons, which are mounted in their natural position on iron framework, occupy a case which measures 18 metres in length, 11 metres in maximum width, and 7 metres in height. Part of it is shown in the accompanying photograph (Fig. 1). The skeletons which still lie attached to masses of rock are covered with a case measuring 20.5 metres in length, 13 metres in width, and 7 metres in height. The cases were made by the Belgian branch of the English firm, Messrs. Fred. Sage and Co. Ltd., which has supplied cases to the British Museum and to other English museums.

When these fossil bones were first extracted from the rock and prepared for study between 1878 and 1900, they were hardened with an aqueous solution of gelatine. The treatment, however, proved to be insufficient to prevent the decay of the iron pyrites with which most of the specimens were permeated, and a few years ago it became evident that the collection could only be preserved by some other method of hardening the bones and by protecting them in future from contact with more or less damp air.

To devise a new treatment was difficult, because much of the gelatine still remained in the fossils and prevented the absorption of any other material. Experiments were therefore made, and it was decided to remove the gelatine so far as possible

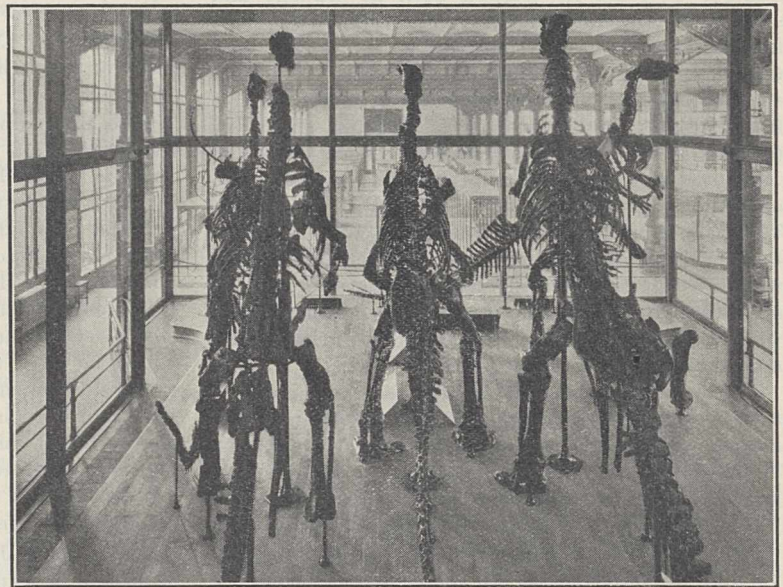


Fig. 1.
IGUANODONS IN THE ROYAL MUSEUM OF NATURAL HISTORY, BRUSSELS.
Photo by E. Sergysels, Brux.

and replace it with shellac to be deposited from a solution in alcohol. The bones were washed with tepid soapy water to which a little carbonate of soda had been added, and after each washing they were rinsed with tepid water and carefully dried in a heated chamber. Immediately after drying, and while still at a temperature of 45° C., they were placed for twenty-four hours or more,

according to size, in a bath containing shellac dissolved in alcohol, one part of shellac to three parts of alcohol at 94° C. When the bones were taken out of the bath they were washed with alcohol to remove the excess of shellac, and then they were left to dry in a current of air at the ordinary temperature while the solution completely impregnated them. The process was repeated once, and the bones were then ready for the preparators, who mended cracks and other deficiencies. Finally, a weaker solution of shellac, one part to four parts of alcohol, was driven by a compressed-air syringe into the surface of the

bones, and they were again left to dry. This process was repeated three times, and the specimens were then re-mounted on their supports.

All the mounted skeletons of *Iguanodon* are now complete, and it is anticipated that all the bones exposed in the rock masses will be treated before the end of this year. The skeletons of the associated fossil crocodiles, *Goniopholis* and *Bernissartia*, will then be preserved from decay in the same manner. The Belgian Government and Dr. V. Van Straelen, the director of the Brussels Museum, and his staff, are to be congratulated on their success in an important scientific undertaking. A. S. W.

Obituary Notices

Sir Herbert Jackson, K.B.E., F.R.S.

SIR HERBERT JACKSON, whose death occurred on December 10 after a very brief illness, was born on March 17, 1863. After attending King's College School, he entered King's College, London, in 1879 as a special student of chemistry, and for a number of years he worked both as student and student-demonstrator in Prof. C. L. Bloxam's private laboratory. His association with King's College continued without interruption until 1918. He held successively the positions of lecturer, assistant professor (1902), and professor of organic chemistry (1905); he was elected a fellow of King's College in 1907, and was finally appointed Daniell professor of chemistry on the retirement of Prof. John Millar Thomson in 1914. He was regarded with affection by all the students of the College for the zest with which he participated in their social and athletic activities, which affection was enhanced among those who studied under him by their recognition of his admirable teaching capabilities.

During this period, Sir Herbert Jackson's research activities covered an extraordinarily wide range. He carried out a lengthy investigation into the production of phosphorescent materials, and made an extensive study of the phosphorescent and fluorescent phenomena produced in various materials by ultra-violet light or by electric discharge in low-vacuum and high-vacuum discharge tubes. In the course of his experiments with high-vacuum tubes he observed that in some instances phosphorescent materials in close proximity to the tubes gave a luminous response when the tubes were excited. This observation was not followed up immediately as it did not fall into the general line of investigation which was being pursued at the time, otherwise the discovery of X-rays, which was announced by Röntgen a few months later, might well have been made by Sir Herbert Jackson. Immediately Röntgen's discovery was published, Sir Herbert Jackson constructed an X-ray tube of the type described by Röntgen—the first X-ray tube to be produced in Great Britain—

and thereafter he devoted a considerable amount of attention to a study of the effects which could be produced by the 'new' rays and to the development of X-ray tubes of improved forms. The 'Jackson' focus-tube, which he devised—and which he refused to patent—was a development of very great importance, since it provided practically a point source of X-rays and thus ensured sharp definition in X-ray photographs; the curved cathode which was its essential feature was adopted universally.

It is impossible to give any complete account of the many lines of investigation which Sir Herbert Jackson pursued while he was at King's College, but by way of contrast to the foregoing, mention may perhaps be made of two other items. He made a considerable study of the detergent action of alkalis, oils, soaps and chemical solvents, and of their behaviour on fabrics of different types. His work in this direction and the lectures and demonstrations which he gave to special classes for laundresses are gratefully remembered by the laundry industry as a whole for their immense practical value. Sir Herbert also brought his scientific knowledge to bear on methods of protecting stonework against weathering action, and for many years devoted a good deal of attention to this important problem.

Sir Herbert Jackson was recognized as a microscopist of the first rank. In the widely varied types of scientific work which he had undertaken he had made very considerable use of his microscope, and he was, in consequence, familiar with the appearances presented under all available types of illumination, by bacilli, crystals, diatoms, fibres, gratings, powders, rulings, metals and all the more usual microscopic objects. He had also made a considerable study of the microstructure of porcelains, glazes, opal and coloured glasses, etc., and his observations, backed by his chemical knowledge, enabled him to draw important and far-reaching conclusions relating to the methods which had been employed in the production of Chinese and other ceramic wares, ancient

beads, ancient glasses, etc. He was always ready to place his expert microscope technique at the disposal of others, whether to enable them to acquire some small measure of his skill or to help in the elucidation of problems on which critical microscopic observation might be able to throw some light. In his hands, the microscope was an all-revealing instrument, and it was at once a pleasure and an education to be allowed to join with him when there was microscope work to be done.

Very early during the Great War, Sir Herbert Jackson was asked to advise on a variety of urgent chemical problems, and as the extent of his knowledge and the value of the suggestions which he could invariably put forward became more widely known, his advice was increasingly sought. Chief among his many war-time activities must be counted his experimental work on glasses needed for chemical purposes and for X-ray tubes, and, later, his working out of the formulæ for many types of optical glasses not previously manufactured in Great Britain, but essential for such instruments as gun-sighting telescopes, and other optical munitions. In recognition of his valuable war-work, in particular of his work on glass, he was created Knight Commander of the British Empire in 1917, and was elected to the fellowship of the Royal Society in the same year.

When the British Scientific Instrument Research Association was in process of formation under the research association scheme of the Department of Scientific and Industrial Research, Sir Herbert Jackson was invited to become its first director of research. His versatility and his remarkable experimental ability, combined with his keenly analytical mind and quick grasp of essentials, fitted him admirably for this position. Under his guidance, the Association came to be regarded more and more as a source to which any matter concerning the development or manufacture of scientific instruments could be referred with the certainty that useful suggestions would be forthcoming practically at once, if, indeed, a complete solution of the particular problem submitted could not be immediately put forward. Sir Herbert Jackson filled this position with distinction from 1918 until he retired in 1933; he afterwards acted as consultant to the Association, and served as a member of the Association's Research Committee up to the time of his death.

Sir Herbert Jackson held office as president of the Röntgen Society (1901-3) and as president of the Institute of Chemistry (1918-21), and was for some years a member of the senate of the University of London. He served as chairman or as a member of many scientific and advisory Committees, including the Adhesives Committee and the Building Research Advisory Committee of the Department of Scientific and Industrial Research, the Interdepartmental Committee on Optical Glass, the Advisory Committee on Research of the L.M.S. Railway, and others of equal importance.

His death removes one who has rendered valuable service in very many fields, and is deplored by all who were privileged to work with him and to be included in his wide circle of friends.

Captain Oscar Wisting

CAPTAIN OSCAR WISTING, the Norwegian arctic explorer, was born in 1871 and at the age of sixteen years went to sea and in 1892 joined the Norwegian navy. His tastes, however, led him to polar seas, and after a few voyages in whalers and sealers he joined the expedition of R. Amundsen in 1909.

This expedition was originally intended to be an arctic venture but on news of Peary's attainment of the Pole reaching Europe, Amundsen decided to change his plans and make for the Antarctic. The *Fram*, Nansen's famous old ship, carried the party to the Ross Sea and their base on the Ice Barrier. Wisting was one of the four men who reached the South Pole on December 14, 1914. Amundsen attributed not a little of their success to Wisting's careful work in making the sledges, clothing and tents for the journey.

Amundsen's next expedition, the exploration of the Arctic Ocean, was delayed by War conditions and the necessity of building a new ship, but when he sailed in 1917 Wisting was his second in command. After three winters in the ice, the *Maud*, making the North-East passage, reached Alaska, only to return for another winter on the Siberian coast, this time in charge of Wisting, who had only three other men with him. After refitting at Seattle, Wisting again took the *Maud* north in 1922 and returned five years later, having failed to penetrate the inner arctic seas.

In 1926 Wisting was one of the men who accompanied Amundsen in the airship *Norge* in its flight of 3,393 miles from Spitsbergen across the Pole to Teller, in Alaska. When Nobile's airship *Italia* came to grief in 1928, Amundsen flew to the rescue from Norway. On the disappearance of his aeroplane Wisting went to Spitsbergen to join the vain search.

In 1926 Wisting retired from the navy with the rank of captain and in recent years had been custodian of the *Fram*, which is now kept on land at Oslo as a polar museum. It was on board the *Fram* that he died on December 4.

R. N. R. B.

Señor Don Juan de la Cierva

THE death of Señor Cierva in the accident to a Dutch air liner on December 9 is a grave loss to aeronautical science. Fourteen years ago he invented the main principles of the autogiro, and in the intervening years he was assiduous in working, chiefly in England, on schemes for its improvement. His very latest model, the direct lift type, after being successfully demonstrated, has now reached the point of being built in numbers. Hence its inventor may be said to have lived just long enough to see his invention reach the fullest development attainable by that type of aircraft.

Señor Cierva was born in 1895 at Murcia in Spain. He received his scientific training at the Civil Engineering School in Madrid, and four years later he began his work on rotating wing aircraft, being convinced from his experience of the fixed wing type that the danger of accident by stalling was irremovable by other means. In his new plans he

arranged for the peripheral speed of his 'windmill' to be several times as great as the highest horizontal speed of the entire craft, and since this peripheral speed remained nearly constant, the craft could always count on adequate lift, however slowly the machine as a whole might be flying. In fact experiment soon showed that against a modest wind of twenty miles an hour or so, the autogiro could keep station in descent over a definite spot on the ground.

The autogiro could, however, not compete with a helicopter in vertical 'take-off', and it was to this point that Señor Cierva devoted the later years of his life. He devised a mechanism whereby the pitch angle of the rotating blades of the windmill could be changed, and he used this mechanism to change, from a zero pitch angle to a large one, the angle of attack of the rotating blades at the moment of starting flight. This caused the craft literally to jump into the air—as much as 30 feet—and then to climb on a gentle path free from ground obstructions. In this way, the inventor considered that he had added to his autogiro the main advantage claimed for the helicopter of being able to rise from a very small field.

At each stage in the development of his ideas, Señor Cierva gave an account of his work to the Royal Aeronautical Society, of which he was a fellow. From that Society he received its Silver

Medal and later the Wakefield and Guggenheim Gold Medals. In his lifetime he always expressed himself warmly on the recognition he received from the Royal Aeronautical Society, as he did on the encouragement given to him by the Air Ministry and the Aeronautical Research Committee, from his earliest flying demonstration to an astonished assemblage at Farnborough until the day of his death.

We regret to announce the following deaths:

Dr. L. Gustave Binger, *correspondant* for the Section of Geography and Navigation of the Paris Academy of Sciences.

Prof. William Campbell, Howe professor of metallurgy in Columbia University, an authority on physical metallurgy, on December 16, aged sixty years.

Prof. Augustus H. Gill, emeritus professor of chemistry in the Massachusetts Institute of Technology, an authority on hydrocarbons, on November 11, aged seventy-two years.

Prof. Edouard J. B. Goursat, formerly professor of mathematics in the Sorbonne, on November 26, aged seventy-eight years.

Dr. Henry B. Hedrick, formerly ballistician in the U.S. Ordnance Department, known for his work on the preparation of mathematical tables, on October 6, aged seventy-one years.

News and Views

Louis-Bernard Guyton de Morveau (1737-1816)

THE bicentenary of the birth of Guyton de Morveau recalls the career of a man of science who was a prominent figure in what is, perhaps, the most interesting epoch in the history of science in France, if not in French history itself. Ingenious, versatile and courageous, he engaged in many enterprises and as a man of science had a wide reputation. Born at Dijon on January 4, 1737, Guyton de Morveau was the son of the professor of civil law in that city. He himself was educated for the law at Dijon and Paris, and after he had practised for a short time, his father procured for him at the price of 40,000 francs the appointment of advocate general to the local parliament at Dijon, which he held for twenty-three years. Always of an inquiring mind, he became attached to the Academy of Sciences in his native city, devoted himself to the study of chemistry—being assisted by Baumé—and in 1776 began to lecture on that subject. He also established on scientific principles a saltpetre factory which was conducted by Courtois, the father of the discoverer of iodine. He became acquainted with the men of science in Paris, and in 1780 he was induced by Panckoucke, the bookseller, to undertake the chemical section of the famous 'Encyclopédie Methodique'. Seven years later he joined Lavoisier, Berthollet and Fourcroy in the

publication of the "Methode de Nomenclature Chimique", which revolutionized chemical nomenclature.

As with so many of his countrymen, at the outbreak of the Revolution, de Morveau's energies were diverted into another channel. He was chosen a deputy to the Legislative Assembly, of which he became secretary in 1791, and president the following year. In the Convention he was one of those who voted for the King's death; and in 1794 he accompanied the army into Belgium and made balloon ascents at the battle of Fleurus. With the return of more settled conditions he was made a professor in the newly founded Ecole Polytechnique, and in 1795 was chosen a member of the Council of Five Hundred, and also one of the forty-eight members of the National Institute which had arisen over the ashes of the old academies. He acted as director of the Ecole Polytechnique during the absence of Monge, who had accompanied Napoleon to Egypt, and he continued to lecture there until he was seventy-six years of age. He was made a baron in 1811, and died in Paris on January 2, 1816. The range of his writings can be seen from the list of more than 190 papers appended to the biographical sketch of him by Thomas Young in the earlier editions of the

"Encyclopædia Britannica". He was one of the first to be converted to Lavoisier's views on combustion, and did much to make known the advances made by French chemists. No great discovery is associated with his name, but his influence on the progress of chemistry was far reaching.

Mr. G. C. Robson

ZOOLOGISTS, especially those interested in the study of Mollusca, will learn with regret that Mr. G. C. Robson has been compelled by ill-health to resign from the scientific staff of the British Museum (Natural History). Mr. Robson went to the Museum from Oxford in 1911 as an assistant in the Department of Zoology, and devoted his attention to the Mollusca, studying more especially their anatomy and ecology. Among his more important works were his account of parthenogenesis in the gasteropod *Paludestrina* and his contributions to the systematics of the Cephalopoda, especially the Octopoda, on which he wrote a monograph published in two volumes by the Museum in 1929 and 1931. His interest in the more general aspects of biology is shown in his book "The Species Problem" (1928) and in the recent volume "The Variation of Animals in Nature" (1936), in which he collaborated with Dr. O. W. Richards. In 1931 he was appointed one of the two deputy keepers in the Department of Zoology. Mr. Robson's work at the Museum has brought him into contact with malacologists all over the world, and his many friends will hope that freedom from official responsibility will bring about his restoration to health and to scientific activity.

Messel Research Fellowship

DR. J. E. HARRIS, of Christ's College, Cambridge, has been awarded a Messel research fellowship in biology by the Royal Society as from January 1. Dr. Harris held a Commonwealth Fund fellowship at Columbia University and the Guggenheim School of Aeronautics in 1933-35, and has since been University demonstrator in zoology at Cambridge. He proposes to investigate how far current morphological views on the evolution of the fins of fish are substantiated by a study of the functions of these organs. From an analysis of the effect of the fins on an accurate model of the dogfish suspended in a wind tunnel, it has been found possible to draw fairly definite conclusions concerning the action of these fins on the static stability of the living fish. It seems likely that an extension of these methods to other types will throw light on the relationship between the form of the fins and the habits and possible course of evolution of the different groups. The work will be combined with a study of the neuromuscular mechanism and of the forces produced by actively moving fins, the methods available for such study having already proved adequate. It is hoped that time will also permit of the confirmation and interpretation of Dr. Harris's somewhat striking observation, that there exists in the nucleus of the unfertilized egg of echinoderms a physical polarity which can be demonstrated by observations on the rate of free fall of the nucleolus in the germinal

vesicle. Dr. Harris will work at Cambridge and possibly also at the Tortugas Laboratory of the Carnegie Institution of Washington, and the Guggenheim School of Aeronautics, New York.

The British Broadcasting Corporation

THE present British Broadcasting Corporation was granted its first charter of incorporation on December 20, 1926, and a supplemental charter on August 14, 1931. The special Committee, which was set up by the Postmaster-General, has recently conducted an inquiry into the broadcasting service and has recommended that the service should continue to be developed and exploited to the best advantage and in the national interest. This action is very desirable on account of the widespread interest in broadcasting, as illustrated by the fact that more than seven and a half million persons in Great Britain and Northern Ireland now have licences to instal apparatus for the reception of broadcast programmes. Accordingly, the British Broadcasting Corporation will continue in being under a new charter which came into operation on January 1, 1937, the draft of which has recently been published by H.M. Stationery Office as Cmd. 5329 (4d. net). In this paper, the objects of the Corporation are described in some detail; briefly, they may be summarized as the development, exploitation and maintenance of a public utility service for broadcasting to the public by means of wireless telephony and television any matter of interest, which may be permitted within the terms of the licence and agreement between H.M. Postmaster-General and the B.B.C. The draft of this licence is also included in the White Paper referred to above. The charter outlines the organization of the Corporation by means of a chairman, vice-chairman and body of governors, and the chief executive officer of the Corporation is the director-general. The Corporation is authorized and empowered to receive and administer the funds granted annually by the legislative for the objects in view, and provision is made for the submission of an annual report and statement of accounts. To the lay mind, it is satisfactory to note from this paper that the broadcasting service in Great Britain will continue to maintain its unrivalled reputation, controlled and yet not hampered by Government administration, free to develop and exploit to the full the technique of broadcasting by both sound and vision.

Salvador Earthquake of December 20

FOR its size, the small republic of Salvador, containing only 7,225 square miles, has been visited by great destructive earthquakes more frequently than any other country. During the nineteenth century, there were at least fifteen such earthquakes, and Montessus records the ruin of San Salvador eleven times between 1538 and 1854. San Vicente, a town of 26,000 inhabitants and lying about 35 miles to the east of San Salvador, has suffered from earthquakes several times during the last century, and was almost ruined by a violent shock on the morning of December 20. With one

exception, all the important buildings in the town have been thrown down, but, fortunately, without any outbreak of fire. The loss of life and property is not yet definitely known, as communications with the capital are almost destroyed, but, according to official estimates, 220 persons have been killed. It is feared that, as in 1835, there may also be an eruption of the neighbouring volcano.

Bushman Hybrids

IN another column of this issue of NATURE (see p. 37) a summary is given of a short paper by Dr. T. F. Dreyer of Bloemfontein on "The Significance of the Bushman Skull", of which the importance for the anthropologist, the sociologist and in the long run possibly also for the statesman, is by no means to be gauged by its brevity. It opens up a wide vista of further research and inference on the all-important question of miscegenation. Students of the effects of racial contact and admixture, from lack of positive and unequivocal evidence, have long hesitated to endorse the popular verdict that cross-breeds in man have the vices of both parent races and the virtues of neither. They prefer, or rather are forced, to attribute the observed defects in character of such hybrids, and especially of hybrids between white and coloured, to the environmental influence of the social conditions to which as a rule they are confined, rather than to any inherent hereditary weakness. Some, perhaps, would go so far as to concede the possibility that extreme diversity in physical make-up of two widely separated races in the parents may react unfavourably in the offspring; but on the whole, notwithstanding the results of a number of investigations, judgment has more or less remained in suspense.

DR. DREYER'S study of the processes of growth which have produced the characteristic Bushman skull suggests a line of research, which, if it should yield results analogous to those observed in Bushman hybrids, will afford grounds for the conclusion that hybridization of certain types may produce specific modification of structure and function, which being abnormal, may be presumed to be unfavourable to the organism as a whole. The Bushman hybrids observed by Dr. Dreyer showed in their abnormal development in the direction of acromegaly or the reverse condition the result of a disturbance of the function of the pituitary—an inference supported by evidence that that body was either over- or under-developed. Should further research show this conclusion to be of general application, it will do much to remove at least one line of argument in the discussion of racial contact from the influence of racial prejudice.

Bronze Age Cemetery near Glasgow

AN important addition to the record of recent finds of prehistoric age in the neighbourhood of Glasgow is a bronze age cemetery site at Springhill Farm, Baillieston, identified and examined by Mr. J. Harrison Maxwell and other members of the Glasgow

Archæological Society. The first indication of the site was the unearthing of two food vessels in May last by workmen, when excavating a hillock for sand and gravel. Of these two vessels, one, according to a description in *The Times* of December 21, was in perfect condition. It was hand-made and of reddish brown clay, with two zones of decoration made by string impression, the upper zone in horizontal, the lower in vertical or slightly oblique lines. The second vessel, unfortunately broken by the workman in digging, but now skilfully restored, is of a more elaborate and beautiful character. Its rim is bevelled inward, and for ornament it has an upper zone of decoration formed by horizontal rows of impressions of barley ears, while elsewhere are impressions or punch marks made by the end of a hollow bone, stick or reed. This discovery led to a careful watch on the progress of excavation, and a number of burials, seven cremated and two inhumed, were recorded. The most important discovery, however, was that of a bronze age cist of unusual type in that instead of two long and two short stones, it is built of a large number of small stones and is tongue-shaped, about four feet long and two feet broad at its greatest breadth. The cover consisted of two large stones, that to the south being very thick, while that to the north had an oblong cut-out on the east side. The floor was a pavement of water-rolled pebbles. There were two cremation burials on top of, and two inside the cist. Discoveries of bones and a burial were made in November and December, of which the latest has not yet been excavated. The bones are under examination. Two square-shaped pits containing iron slag point to the existence of a later 'bloomery' or forge.

Roman Sussex

A DISCOVERY of Roman remains, of interest for its topographical bearing, is reported from West Sussex. Workmen, while laying a water-main from Wickford Bridge, east of Pulborough, to Hurston Farm, discovered Roman walls of rough sandstone, and bonding courses of Roman tiles at a depth of 1-7 feet. They lay just north of Lickfold along the west side of the Wiggonholt Road. According to the account given by the workmen, as reported in *The Times* of December 24, two walls running parallel to the road and about fifteen feet in, formed a passage, at the end of which was a small square apartment. From the character of the red burnt sandstone and flue tiles thrown out, it is considered reasonable to infer that this had been a stoking chamber and hypocaust belonging to a house site, similar to one of which there are indications one hundred yards away. Surface finds of pottery belong to the turn of the first and second century. The importance of the find lies in the fact that it corroborates the identification of the modern road as being on the line of the Roman road from Stane Street at North Heath, Pulborough, by Wiggonholt to the South Downs north of Storrington. The great depth at which the remains were found is due, it is suggested, to the drift of light sandy soil on a down slope.

The Ministry of Health

THE seventeenth annual report of the Ministry of Health, recently issued, summarizes the work of the Ministry during 1935-36 (London: H.M. Stationery Office, 1936. 5s. net). The services administered by the Department involved expenditure amounting to £159,500,000. About one expectant mother in every two now makes use of local authorities' facilities for ante-natal examination, a steady increase on previous years. Maternal mortality was 3.93 per 1,000 births, the lowest figure since 1924. Infantile mortality, that is, deaths of infants less than one year of age, was 57 per 1,000 births, the lowest figure on record. The total deaths from all forms of tuberculosis fell below 30,000 for the first time on record. Of other infectious diseases, diphtheria showed some decline in 1935, only one case of smallpox was notified in that year, the deaths from pneumonia were nearly 1,000 fewer, and scarlet fever and measles were less prevalent. Much progress is reported in slum clearance, abatement of overcrowding, and in town and country planning. As regards public assistance, progress continues to be made in eliminating small and old-fashioned country institutions, and vagrancy appears to be steadily declining. Some 11 million men and 5½ million women in England and Wales are now entitled to health insurance benefits, upon which £27,780,000 was spent in 1935. The annual State contribution for widows, orphans, and old age pensions grows automatically by one million a year until 1943, and is now (1936-37) £15,000,000. The section upon food gives information on new administrative measures, and details of the examination of 143,831 samples of food and drugs, of which 7,972 were given adverse reports.

The Nation's Health in 1935

THE seventeenth annual report of the Chief Medical Officer of the Ministry of Health, which was published on December 4, covers the year 1935. The deaths numbered 477,401, an increase of 591 over 1934, the principal certified causes of death at all ages being, in order, (1) diseases of the heart and circulatory system, (2) cancer, (3) bronchitis, pneumonia and other respiratory diseases. Attention is directed to the changing age-distribution of the population. Since the beginning of the century, the proportion of persons under twenty-five years has fallen by nearly twenty-five per cent, due to the fall in the birth-rate, and the fall in the general death-rate, which increases the proportion in the older groups. This increasing longevity of the population, together with more accurate diagnosis, probably accounts for the increase of the number of deaths from cancer, which is a disease of the later ages, from 63,263 in 1934 to 64,507 in 1935, and it is probably fallacious to assume that there is a real increase of cancer. For 1935, the incidence of scarlet fever, diphtheria, tuberculosis, venereal and rheumatic diseases has declined, and only one case of smallpox was notified. Attention is directed to the relation of food to health and disease, and to the extension of the maternity and child welfare services.

Was Sherlock Holmes a Drug Addict?

AN occasional correspondent contributes an amusing article to *The Lancet* of December 26 entitled "Was Sherlock Holmes a Drug Addict?", as his friend Dr. Watson represented him as being. The correspondent's reply is in the negative on the following grounds. In the first place, Holmes was a man of immense mental resource and initiative, being an expert chemist, an accomplished linguist, an assiduous student of Black Letter texts, a capable performer on the violin, a composer and an authority on medieval music. Nor was he of the stuff of which cocaine addicts are made, who are sociable, lacking in mental capacity and need the stimulus of a drug to rouse their interest in life. The continued use of cocaine leads to physical, mental and moral degeneration. Holmes, on the other hand, was the most unsociable of men and showed no deterioration in his mental powers, physical activity or character. The correspondent suggests that Holmes was playing a trick on Watson when he pretended to give himself an injection of cocaine and showed an arm dotted and scarred with numerous puncture marks.

Institute for the Study of Animal Behaviour

AN Institute for the Study of Animal Behaviour has been formed by a number of zoologists, naturalists, physiologists and psychologists with the object of promoting and encouraging research into animal behaviour. The Institute intends to act as a clearing-house for information regarding work that is being done upon animal behaviour in all its aspects, and to bring together field and laboratory workers for the discussion of their problems. A quarterly bulletin is being issued, and meetings for the transaction of scientific business are held. Those whose work is concerned with animal behaviour in any of its aspects will materially assist the work of the Institute if they will send offprints of their papers to the honorary secretary. Dr. J. S. Huxley is president of the Institute, and Mr. F. B. Kirkman is honorary treasurer. All information regarding membership and activities may be obtained on application to the honorary secretary, R. C. Oldfield, Psychological Laboratory, Downing Place, Cambridge.

The Making of Chemical Plant

THERE is a school of economics which lays stress on the importance of exports in order that Great Britain may pay for its imports. At the same time, the home manufacturers ask for some measure of protection so that they can supply the home markets and maintain a manufacturing plant of sufficient size to ensure reasonable costs. An industry which has progressed quite rapidly in Great Britain since the Great War is that of making chemical plant, about which the *Industrial Chemist* of November has published some interesting statistics. The export trade has gone up from a figure of 100 in 1933 to 131 in the first nine months of 1936. The plant exported goes to less highly industrialized countries and, therefore, is not of the same complexity and costliness of design which the home market demands:

thus the average value this year is £67 per ton. Australia and South Africa are now the chief customers for British chemical plant. Great Britain also imports chemical plant, and since there is increasing activity in the chemical industry, the amount of this has increased more than three-fold since 1935, though there are now signs of abatement. The average value per ton this year is £143. Most of the plant, which is generally of a highly specialized nature, has come from Germany. These figures give no indication of the activities of the British plant manufacturers in the home trade, but the same number of the *Industrial Chemist* seeks to remedy this by several pages of pictures of actual plant and new equipment which has been delivered this year, featured under the heading of "Progress".

Forest Products Research

THE report of the Forest Products Research Board for the year 1935 has been issued by the Department of Scientific and Industrial Research (London: H.M. Stationery Office, 1936). The report includes the report of the director of the Research Laboratory at Princes Risborough for the same year. The Board itself met only once during the year, when various pieces of research work under investigation were considered, as also the possibility of establishing a sub-station of the Laboratory in Scotland. The Board noted with appreciation that there was direct evidence of interest by industries concerned in the manufacture of both wooden and fibre-board boxes, as well as by users of such boxes, of the facilities now available in the new box-testing laboratory. The investigations into the physical properties of timber which have a direct influence on its behaviour during seasoning and when in use have been advanced; and the results, it is considered, promise ultimately to be of material importance to architects and others engaged in industries dependent upon timber. As a result of visits to the Laboratory by many representatives of firms engaged in the manufacture of timber and timber goods, and instructors in building science or woodworking at various technical schools, some of whom have spent periods of varying lengths at the Laboratory, a new departure has been instituted. To minimize the interference with the routine work which such visits involved, a short educational course of one week's duration was given in September of which full advantage was taken.

An Alchemical Manuscript

IN a reprint from *Osiris* (2, 220; 1936), W. J. Wilson, of the Library of Congress, Washington, deals with a treatise copied by Arnaldus de Bruxella at Naples between 1473 and 1490, and purchased by Lehigh University, Pennsylvania, in 1881 for the price of ten dollars. It is a compendium of chemical and alchemical recipes of a type fairly well known through other manuscripts of similar date in Paris and elsewhere. Mr. Wilson gives an account of the contents of the manuscript with extracts, which are translated, and an index of names and technical

terms. He shows how its contents are related to other treatises, and deals in separate sections with the origin and development of alchemical tradition, the operations of alchemy, allegorical and mystical aspects of alchemy and its relations to magic and medicine. This commentary, which is the fruit of a careful study of texts and literature on the history of alchemy, is provided with an excellent bibliography and is of very considerable value in presenting an accurate and concise statement of the position of modern research into the origins of alchemy and early chemistry. The scholarly treatment is on a much higher level than many accounts in that it takes into consideration the Chinese and Indian sources, without which no modern study can be said to have any particular significance.

Decline in Malaria in Soviet Russia

AS the result of the energetic measures adopted by the Soviet authorities, the incidence of malaria in the U.S.S.R. has greatly declined. According to Prof. Sergiyev, head of the Malaria Department of the Commissariat of Health and director of the Central Tropical Institute, during the first six months of 1936 there was a drop of about 35 per cent in the number of malaria cases and of 40 per cent in the number of deaths from malaria as compared with the corresponding period of 1935. With the object of destroying the malaria-carrying mosquitoes, two and a half million infested areas were sprayed with oil, partly by aeroplanes. Mosquito netting was introduced into the badly infested areas. 100 motor-cars and 260 microscopes were supplied to the malaria stations. During the summer, 500 doctors and senior students took part in the anti-malarial campaign, which was carried on by 1,800 permanent malaria organizations.

Tropical Pathology and Microbiology

OWING to the increasing number of papers in the field of special pathology and microbiology hitherto published in the *Chinese Medical Journal*, which is primarily intended for clinical contributions, this material will now be published in a Supplement to the *Chinese Medical Journal*, of which the first number was issued last February. It forms a volume of the same size and format as the *Journal*, and contains 500 pages of text with 70 plates, and is published by the *Chinese Medical Journal*, Peiping, China, price 10s. The contents are divided into the three subjects: (1) pathology, (2) bacteriology and (3) parasitology. In addition, there is a valuable paper by R. J. C. Hoepfi on "Methods of Illustrating Scientific Papers", in which the apparatus for, and technique of, drawing, and the main processes now used for reproduction of illustrations, are described.

Museum Exhibits *de luxe*

AT last the limit of the nature-group method of exhibiting museum specimens seems to have been reached, for Science Service announces that Prof.

A. A. Allen, of Cornell University, has constructed two life-groups of birds, in which by a combination of sound films and ingeniously contrived electrically driven mechanisms, the birds sing and go through natural, life-like movements. For example, in the group showing a nesting site of ruffed grouse, the turning of a switch causes the male to move his head and utter his characteristic hissing note, while the female moves to her nest and covers her eggs, and at the same time thrushes and song-sparrows in the trees and bushes sing, an owl hoots, a woodpecker calls and dives into its nesting hole, and a wedge of wild-geese honks as it flies away. These exhibits must be a revelation to the person who has not the opportunity or the flair for field observation, and, with Prof. Allen's assistance, the arm-chair naturalist will soon be able to record his impressions of life in the wilds from a museum exhibit.

Honey Research at Rothamsted

THE Agricultural Research Council has recently made a substantial grant to Rothamsted to permit beekeeping researches there to be broadened to include the investigation of various problems connected with honey. The appointment of Dr. C. R. Marshall to undertake this work has been approved, and Dr. Marshall has now taken up his duties. In view of the fact that beekeepers during the past three years have contributed towards the cost of the brood disease investigations, the Government is bearing the whole cost of this new work. The researches on honey will be physico-chemical in nature, and directed towards certain practical problems of quality and processing that affect the honey producer. Such problems are the granulation of honey, rapidity of granulation, texture of grain, 'frosting', etc., and fermentation. Dr. Marshall recently obtained the degree of Ph.D. at the University of Birmingham, where he has been working on chemical problems connected with the structure of mucilages.

International Congress on Testing Materials

THE next International Congress of the International Association for Testing Materials will be held in London on April 19-24, under the presidency of Sir William Bragg (see NATURE of October 24, p. 717). More than two hundred papers are promised from authorities in twenty different countries. The Congress will be divided into the following groups: metals (behaviour of metals as dependent upon temperature, particularly in regard to high temperatures; progress of metallography; light metals and their alloys; wear and machinability); inorganic materials (concrete and reinforced concrete; erosion and corrosion of natural and artificial stone; ceramic materials); organic materials (textiles; wood cellulose; timber preservation; ageing of organic materials; colours and varnishes); subjects of general importance (relation between results of laboratory tests and behaviour in use and service; bearing of recent advances in physics and chemistry on the knowledge of materials; properties of materials for the thermal and acoustic insulation of buildings).

Further information can be obtained from the Honorary Secretary of the Congress, K. Headlam-Morley, 28 Victoria Street, London, S.W.1.

Exhibition of Scientific Instruments

IN connexion with the twenty-seventh annual Exhibition of Scientific Instruments and Apparatus to be held at the Imperial College of Science on January 5-7, the usual well-produced and substantial descriptive catalogue of exhibits has been prepared (Physical Society, 1 Lowther Gardens, Exhibition Road, S.W.7). Trade exhibits are separated from the Research and Educational Section: apparatus and instruments being exhibited for the first time are indicated by an asterisk. Reference is facilitated by the full list of contents and an index to the Trade Section. The Exhibition is open on January 5 (2.30-9), January 6 (2-4 for members only; 4-9) and January 7 (2.30-9); admission is by ticket obtainable from the secretary of the Physical Society. Evening discourses are being given at 7.45 on January 5 by Sir James Swinburne on electrical measurements in the 'eighties, and on January 6 by Dr. Harry Moore on the influence of industrial research on the development of scientific instruments.

Announcements

THE Electrodepositors' Technical Society has decided to sponsor an International Conference on Electrodeposition to be held in London on March 3-4. The provisional programme includes discussions on electrodeposition practice abroad, electrodeposition of base metals, properties of electrodeposits and electrodeposition of precious metals. Further information can be obtained from the Hon. Conference Secretary, Mr. H. Wynne-Williams, 12A Raleigh House, Larkhall Estate, London, S.W.8.

IN connexion with the Electric Illumination Exhibition now being held at the Science Museum (see NATURE of December 19, p. 1046, and December 26, p. 1107), a series of six lectures has been arranged to be given in the lecture theatre of the Museum at 5.30 p.m. on Tuesday, January 12, and thence on Mondays commencing January 18. Admission will be by ticket obtainable from the Secretary, Science Museum, London, S.W.7.

OWING to the conditions in Spain, the eleventh International Congress of Psychology which was to have been held in Madrid (see NATURE of July 4, p. 24) will be held in Paris. So far as possible, the programme will be the same as that previously arranged for the proposed meeting in Madrid. The Paris Congress will be held on July 25-31, under the presidency of Prof. Pierre Janet, formerly professor of psychology in the Collège de France. Further information can be obtained from M. Henri Pieron, Laboratoire de Psychologie de la Sorbonne, Paris 5.

THE announcements of forthcoming appointments will appear in future at the end of each issue (see p. 42).

Letters to the Editor

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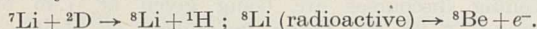
NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 32.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

α -Particles from the Radioactive Disintegration of a Light Element

WHEN lithium is bombarded with deuterons, a radioactive substance is formed which has been found to emit β -rays with energies up to 10.5 Mev.¹ We have recently found that this radioactivity is accompanied by the emission of α -particles.

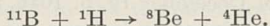
The reactions proposed to account for the β -ray activity were :



From our knowledge of nuclear masses, the expected total energy release in these two reactions should be 14 Mev., but this has not all been accounted for hitherto.

The protons liberated in the first reaction were formerly supposed to have a range of 26 cm., but the group of this range has been shown by Rumbaugh and Hafstad² to be a product of the bombardment of the separated isotope ${}^6\text{Li}$ with deuterons. We had also independently obtained the same result. We have also found, in agreement with Rumbaugh and Hafstad, that the bombardment of ${}^7\text{Li}$ with deuterons gives rise to no group of protons of range greater than 8 cm. (2 Mev.). This means that the energy release in the first reaction must be less than 2 Mev., and taking this with the β -ray energy of 10.5 Mev., we have a maximum total energy of only 12.5 Mev., which is considerably less than the expected 14 Mev.

A possible explanation of this is that the ${}^8\text{Be}$ is formed in an excited state. Dee and Gilbert³ have obtained evidence for such a process in the reaction



They concluded that the ${}^8\text{Be}$ nucleus was often formed in an excited state having 3 Mev. excess energy, and Mr. Dee suggested that we should see whether we could obtain evidence of this excited ${}^8\text{Be}$ also being formed in the radioactive disintegration of ${}^8\text{Li}$. The life-time of the excited ${}^8\text{Be}$ nucleus being negligible (10^{-21} sec.)¹, we should expect to observe α -particles resulting from its disintegration accompanying the emission of electrons from ${}^8\text{Li}$ and decaying with the same period.

This may account for the α -particles which we have observed, for we find that the period of the α -particle activity is identical with that of the β -ray activity and is $0.88 \text{ sec.} \pm 0.1 \text{ sec.}$ There is a discrepancy between this figure and that (namely, $0.5 \pm 0.1 \text{ sec.}$) given by Crane, Delsasso, Fowler and Lauritsen, who discovered the β -ray activity. Absorption measurements confirm, however, that we have observed the same β -ray activity.

We have observed both the α - and β -ray activity from a target of the separated isotope ${}^7\text{Li}$ kindly prepared for us by E. L. Yates.

Most of the observed α -particles have a range less than 1.5 cm. of air from the target, but a few (less

than 0.3 per cent of the total number) extend to a range of 5 cm. The numbers, however, are small at the higher ranges, so that the limit of range has not been determined exactly. As an illustration of the order of magnitude of the effect, it may be noted that after bombarding a thick lithium target with a magnetically resolved beam of $20\mu\text{a.}$ of deuterons at 500 kv. we observe 50 α -particles of range greater than 1 cm. after switching off the beam.

From the range distribution of α -particles it appears that ${}^8\text{Be}$ is not always formed in the same excited state, but either in a number of discrete energy states or in a continuous distribution. Owing to the small number of particles it has not yet been possible to decide between these hypotheses.

The relative number of α -particles and β -rays suggests that if the interpretation be correct, the ${}^8\text{Be}$ is formed in an excited state in a large proportion of the disintegrations of ${}^8\text{Li}$. Further, it may be noted that the energy of two α -particles of 5 cm. range amounts to 12.6 Mev. On the view put forward, the spread of α -particle energies cannot exceed the spread of β -ray energies, namely, 10.5 Mev., and it therefore follows that the minimum energy of the two α -particles is not less than 2.1 Mev. In other words, the minimum energy with which the ${}^8\text{Be}$ nucleus is left excited is not less than 2.1 Mev.

While this interpretation appears consistent, it is not the only possible explanation. In any event, it is clear that the distribution of β -ray energies must be interpreted with caution, as the radioactive disintegration is certainly not simple.

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Dec. 14.

¹ Crane, Delsasso, Fowler and Lauritsen, *Phys. Rev.*, **47**, 971 (1935).

² Rumbaugh and Hafstad, *Phys. Rev.*, **50**, 681 (1936).

³ Dee and Gilbert, *Proc. Roy. Soc., A*, **154**, 279 (1936).

Longitude Effect of Cosmic Radiation and the Position of the Earth's Magnetic Centre

THE theory of the allowed cone of electrically charged primary cosmic rays, developed in a number of recent papers by Lemaitre and Vallarta¹, is competent to account for the longitude effect if due regard is paid to the fact that the earth's centre does not coincide with its magnetic centre². Assuming Schmidt's determination³ of the latter and, with Clay, an exponentially decreasing energy distribution of primary charged particles, it has been shown that the longitude effect along the geomagnetic equator should be roughly sinusoidal with maximum at geographic longitude 12° W. and minimum at 168° E. ;

the intensity difference between maximum and minimum is calculated to be about 8 per cent. More recent calculations of the position of the earth's magnetic centre (Bruins⁴, Bartels⁵) have somewhat revised Schmidt's earlier result, but the theoretical longitude effect is not much affected thereby. The longitude of the maximum and minimum depends *only* on the co-ordinates of the earth's magnetic centre, particularly on its longitude; the intensity difference between the maximum and minimum is closely connected with the distance between the earth's centre and its magnetic centre, to a lesser extent with the energy distribution of primary particles.

In a recent important contribution, Hoerlin⁶ concludes that the calculated intensity difference between the maximum and minimum equatorial longitude effect is in good agreement with experiment, but the calculated longitudes of the maximum and minimum are not. Instead of a maximum off the west African coast at 12° W., he suggests that it probably is off the South American coast in the Pacific Ocean at about 80° W., with a corresponding minimum near the Malay Peninsula at 100° E. He concludes in this sense not only from his own measurements, but also from an examination of Compton's chart of lines of constant total intensity⁷ which, however, would locate the maximum still farther west.

That there are yet serious discrepancies between sea-level intensities measured by different observers becomes obvious if one compares Millikan and Neher's chart⁸ with Compton's, and this disagreement persists if one compares the Pasadena results with either Hoerlin's or Clay's (and his collaborators)^{9,11}, although there seems to be fairly good accord between the last two. This state of affairs is forcibly brought to the fore if one attempts to fit a continuous curve to represent the experimental data along the geomagnetic equator and then proceeds to its harmonic analysis. In particular, the half-period harmonic, which one would expect if the quadrupole component of the earth's magnetic field were important, comes out just about of the same amplitude as the higher harmonics which must be attributed to experimental errors.

There are two relevant experimental results which seem to militate against Hoerlin's conclusion. The first is derived from Bowen, Millikan, Korff and Neher's measurements¹⁰ at altitudes up to 26,000 ft. in the Philippines and in Peru (essentially along the geomagnetic equator), which clearly indicate that the intensity difference between these two points is about 4 per cent and persists up to the highest altitude. The second is the existence of a minimum of intensity off the western coast of South America and somewhat to the north of the geomagnetic equator, shown by Clay, Bruins and Wiersma's measurements of the latitude effect¹¹ and by Johnson's counter measurements of vertical intensity¹². These results agree with the theory of the longitude effect referred to above and therefore also with Schmidt's calculation of the earth's magnetic centre. Further, the former result, if confirmed, would establish the absence of photons in the primary radiation.

If, however, one accepts Hoerlin's suggestion, the conclusion seems inescapable that there is a serious discrepancy between the position of the earth's magnetic centre as determined from magnetic and from cosmic radiation measurements, particularly as regards its longitude. The former locate it at about 160° E., whereas the latter would tend to place it at not more than 100° E. Whether this discrepancy

is real is a thorny question which we cannot risk to answer. The main purpose of this letter is to direct attention to the present evidence in the hope that further intensity measurements of cosmic radiation, particularly along the geomagnetic equator, and also perhaps a careful analysis of available experimental results, may help to solve the difficulty.

M. S. VALLARTA.

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Nov. 11.

¹ Lemaitre, G., and Vallarta, M. S., *Phys. Rev.*, **43**, 89 (1933); **49**, 719 (1936); **50**, 493 (1936). Lemaitre, G., *Ann. Soc. Sci. Bruxelles*, **54**, 162 (1934). Bouckaert, L., *idem*, **54**, 174 (1934).

² Vallarta, M. S., *Phys. Rev.*, **47**, 647 (1935).

³ Schmidt, A., *Z. Geophys.*, **2**, 38 (1926).

⁴ Bruins, E. M., *Physica*, **2**, 887 (1935).

⁵ Bartels, J., *Terr. Mag. and Atmos. Elec.*, **41**, 225 (1936).

⁶ Hoerlin, H., *Z. Phys.*, **102**, 666 (1936).

⁷ Compton, A. H., *Rev. Sci. Inst.*, **7**, 73 (1936).

⁸ Millikan, R. A., and Neher, H. V., *Phys. Rev.*, **50**, 24 (1936).

⁹ Clay, J., van Alphen, P. M., 'T Hooft, C. G., *Physica*, **1**, 829 (1934).

¹⁰ Bowen, I. S., Millikan, R. A., Korff, S. A., and Neher, H. V., *Phys. Rev.*, **50**, 579 (1936).

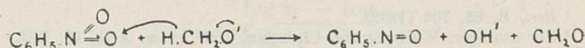
¹¹ Clay, J., Bruins, M. E., Wiersma, J. T., *Physica*, **3**, 746 (1936).

¹² Johnson, T. H., private communication to the author.

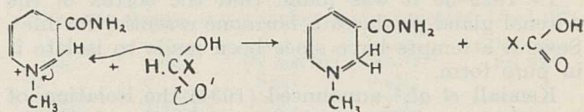
Correlation of the Yellow Oxidation Ferment with Warburg's Co-ferment

THE nature of the yellow oxidation ferment, and of Warburg's co-ferment, having been largely elucidated by the work of Warburg, Kuhn, Karrer, and others, it may be of assistance in completing their correlation if attention is directed to the precise nature of the changes in which they participate.

Some time ago¹, in a criticism of suggestions made by Haber and Willstätter, I emphasized that Wieland's dehydrogenation of alcohols and aldehyde hydrates frequently, if not always, consists in the removal, not of two hydrogen atoms, but of a proton and of a hydrogen atom associated with an electron. In illustration, the oxidation of the methoxide anion by nitrobenzene was cited:

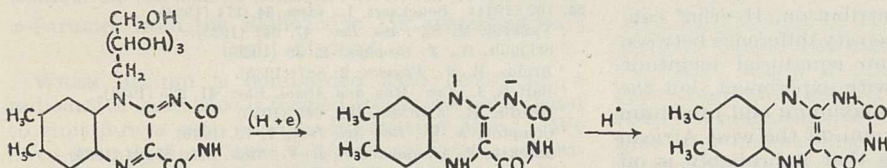


The ferment changes must evidently belong to this class since, in spite of references² to the absorption of two hydrogen atoms, the reduction of quaternary pyridinium cations to the neutral dihydropyridine derivative clearly requires addition of a hydrogen atom and an electron. The reaction between a hexose derivative and the quaternary nicotinium amide is to be formulated as follows:



A passing comment is perhaps permissible on the beauty of the pyridinium ion \rightleftharpoons dihydropyridine mechanism thus employed by Nature. The driving force towards the right is the tendency of the positively charged nitrogen atom, exhibited by all ammonium compounds, to revert to the neutral trivalent condition, whilst the resulting dihydropyridine tends to recover the aromatic condition by a return to the pyridinium state. This latter is achieved by transference of a hydrogen atom and an electron to the lactoflavin derivative, and there is a recognition of this by Karrer and his collaborators³

in their formulation of the oxidation of the dihydro-derivative by potassium ferricyanide. But whereas the change studied by them appears to take place in two stages, the formula of the lactoflavin derivative readily accommodates a single-stage process, for it is well known that $\alpha\beta$ -unsaturated ketones, $R_2C = \overset{\cdot}{C} - \overset{\cdot}{C} = O$, exhibit kationoid reactivity, for example, towards cyanide ions, at the β -carbon atom. Applying this to the $-N = \overset{\cdot}{C} - \overset{\cdot}{C} = O$, or, perhaps better, to the $-N = \overset{\cdot}{C} - \overset{\cdot}{C} = N - \overset{\cdot}{C} = O$, grouping in lactoflavin, we have



The change is completed by addition to the 1-nitrogen atom of the proton from the original hexose hydrate.

These considerations also point to a possible interpretation of the function of the methyl groups in the lactoflavin molecule, which is so far not understood. For the grouping in question might also be expected to exhibit the familiar property of nitro-groups in promoting anionoid attack in the ortho- and para-positions of the benzene nucleus. On the other hand, methyl groups in the nucleus, and obviously especially so in the para-position, militate against such an attack, and thus tend to localize it on the nitrogen atom. Accordingly, whereas 9-*d*-1'-ribitylisoalloxazine itself exhibits no vitamin B₂ effect⁴, its 7-methyl derivative does⁵. The influence of other alkyl groups or of methyl groups in other positions has not yet been recorded.

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¹ *Ber.*, B, 65, 705 (1932).

² For example, Warburg and Christian, *Helv. chim. Acta*, 19, E81, (1936).

³ *Helv. chim. Acta*, 19, 811 (1936).

⁴ Kuhn and Weygand, *Ber.*, B, 68, 166 (1933).

⁵ Karrer and others, *Helv. chim. Acta*, 18, 908 (1935).

Corticosteron, a Crystallized Compound with the Biological Activity of the Adrenal-cortical Hormone

IN 1929-30 it was found that the cortex of the adrenal gland produces a hormone essential for life¹. Several attempts have since been made to isolate it in pure form.

Kendall *et al.*² announced (1934) the isolation of crystals (m.p. 210°) which were claimed to have the activity of the hormone. They later wrote³ that the problem was more complex, that their earlier described crystals were a mixture, and that for complete hormonal activity at least two components were essential. In their latest communications⁴ they report the isolation of several compounds (A-E) one of which (compound E, m.p. 201°-208°) "showed definite cortical hormone activity when tested on the rat (Ingle's method)" but that "the quantitative activity of compound E is much less than of cortin itself".

Wintersteiner and Pfiffner⁵ described six different

crystallized compounds (A-F), all of which were inactive when tested on adrenalectomized dogs by the method of Swingle and Pfiffner⁶.

Reichstein⁷ reported the isolation of nine substances (A-I), eight of which were found inactive in doses of 0.5-2 mgm. in rats (method of Everse-de Fremery⁸). Only the ninth, substance H, has in the meantime been found to be active. This substance, however, was not quite pure. After the elimination of a small amount of a new, high melting substance (substance M, m.p. 205°-208°), a pure compound in beautiful crystals was obtained from the remainder. It shows to a large extent the biological activity of the raw material and is called corticosteron (m.p. 180°-182° (corr.), $[\alpha]_D^{25} = +223^\circ$, $c = 1.12$ in abs. alcohol). With the exception of a few details the chemical

constitution has been elucidated; the formula will be reported in the near future.

Adrenalectomized rats require a daily dose of 0.5-1 mgm. corticosteron per rat (method of Everse-de Fremery). This amount represents the approximate rat unit and is the biological equivalent of 1 c.c. of commercial 'cortin' (corresponding to 50 gm. of fresh gland) for rats. The experiments on bilaterally adrenalectomized dogs gave similar equivalent values, but since the method of testing used was somewhat different than that of Swingle and Pfiffner, the activity cannot be expressed in terms of dog units.

The curative and preventive properties were tested on four dogs (body weight ranging from 11 kgm. to 18 kgm.) which had been adrenalectomized $\frac{3}{4}$ - $1\frac{1}{2}$ years previously. During this period, they received a daily oral dose of 0.3-0.4 gm. sodium chloride per kgm. body weight and the necessary amount of commercial 'cortin' (2.5-5 c.c. per dog per day). Without the salt, about ten times as much 'cortin' was necessary. The complete withdrawal of 'cortin' caused the animals to fall into insufficiency, even if the salt dose were considerably increased. In the curative tests, three to six times the preventive doses of 'cortin' were necessary to bring the animals back to normality from their state of insufficiency. In the various experiments on dogs, an average range of 0.25-0.5 mgm. corticosteron was found to be equivalent to 1 c.c. of the standard 'cortin' solution.

These experiments show that corticosteron is a highly active cortical hormone, but the existence of other active or at least activating components is still possible.

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and
Zurich.
Nov. 28.

¹ Rogoff, Stewart, *J. Amer. Med. Assoc.*, 92, 1569 (1929). Swingle, Pfiffner, *Science*, 71, 321 (1930); *Medicine*, 11, 731 (1932); Hartman, Brownell, *Science*, 72, 76 (1930).

² *Proc. Staff Meet. Mayo Clinic*, 2, 245 (1934).

³ *J. Amer. Med. Assoc.*, 105, 1486 (1935); see also ref. 4.

⁴ *Proc. Staff Meet. Mayo Clinic*, 11, 351 (1936); *J. Biol. Chem.* 114, 613 (1936).

⁵ *J. Biol. Chem.*, 111, 599 (1935); 114, lxxx (1936).

⁶ Pfiffner, Swingle, Vars, *J. Biol. Chem.*, 104, 701 (1934).

⁷ *Helv. chim. Acta*, 19, 29, 1107 (1936).

⁸ *Acta Brev. Neerl.*, 2, 152 (1932).

Two New Chemical Plant Growth Substances

BENZOYL oxide and benzoyl peroxide, as I have found, can now be added to the list of chemicals which act on plant growth like the natural hormone, auxin. Benzoyl oxide, when applied in lanoline at concentration 1 in 200 to ten dark-grown decapitated oat coleoptiles along one side, caused negative curves the mean of which was 50° after 4½ hours at 19° C. The peroxide applied similarly caused negative curves the mean of which was 31°. Thus both substances accelerated growth strongly. At 1 in 2,000 in lanoline, the benzoyl oxide caused slight negative curves of about 5°, and comparison with the curves caused by very dilute hetero-auxin in lanoline showed that the activity of benzoyl oxide is very roughly equal to 1/400 of that of hetero-auxin. The oxide keeps well in lanoline, but the peroxide loses its activity in a few hours.

The results seem of interest since first, benzoic acid is quite inactive, and secondly, the benzoyl oxide and peroxide are scarcely soluble, if at all, in water. In spite of this, the oxide is not only active, but also is even transported downwards in coleoptiles, though much less rapidly than hetero-auxin. For when it was applied in lanoline near the tops of coleoptiles on one side, the curves extended for about 5 mm. below the lanoline after 5½ hours at 19° C. Carotene also, as Lazar¹ has shown, though insoluble in water, can produce effects which are distant from the part to which it is applied in plants.

I am indebted to Dr. E. Hope for help and advice concerning the substances tested.

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Dec. 15.

Mém. Soc. Roy. Sci. Liège, (4), 1, fasc. 2-3 (1936).

Alkaloids from *Arundo Donax* L.

DONAXINE¹, C₁₁H₁₄N₂, is according to von Euler, Erdtman and Hellström², identical with gramine from certain strains of barley, and according to a paper by Th. Wieland and Chi Yi Hsing³, to which my attention has just been directed, gramine has the constitution of β-dimethylaminomethyl-indole, (CH₃)₂NCH₂.C₈H₆N.

I have for some time been engaged in the study of the alkaloids of *Arundo Donax* L. from the shores of the Mediterranean, and find that, by joint action of alcoholic potassium hydroxide and methyl iodide in the cold, donaxine furnishes tetramethylammonium iodide and a (methoxy methyl)-indole; with ethyl iodide an (ethoxy methyl)-indole results and presumably also dimethyldiethyl ammonium iodide.

Besides donaxine, I have obtained a crystalline alkaloid, C₁₃H₁₆O₂N₂, and an amorphous phenolic base; both are indole derivatives. Their relationship to donaxine is being investigated.

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Dec. 9.

¹ Orechhoff and Norkina, *Ber.*, **68**, 436 (1935).

² *Ber.*, **69**, 743 (1936).

³ *Annalen*, **526**, 188 (1936).

Viscosity of Binary Mixtures

IN a recent communication¹, Mr. A. J. A. van der Wyk has presented a new formula for the calculation of viscosity of binary mixtures. I would point out that this problem has already been fully solved in two ways. On the base of thermodynamical considerations, the formula²

$$\log \eta = m_1 \log \eta_1 + m_2 \log \eta_2 - \int \frac{q_m}{4 \cdot 57 T^2} \dots (1)$$

has been found, where η denotes the viscosity of the mixtures, m₁, η₁, m₂ and η₂ the mole fractions and viscosities of the two components, T the absolute temperature and q_m the molecular heat of solution. The latter may be also considered as the total change in energy caused by the interaction of both components. This change in the energy being rather difficult to determine experimentally, another method³ based on the association of the molecules has been chosen. It has been found that the simple formula of Arrhenius

$$\log \eta = n_1 \log \eta_1 + n_2 \log \eta_2 \dots (2)$$

gives quite satisfactory results (as must be the case for 'ideal mixtures' where no change in energy takes place), when for the calculation of mole fractions the physical molecular weights instead of the chemical molecular weights are taken into consideration. If S denotes the number of molecules of the component 2, which in the mixture are associated, the equations

$$n_1 = \frac{m_1}{m_1 + m_2 \cdot S} \text{ and } n_2 = \frac{m_2 \cdot S}{m_1 + m_2 \cdot S} \dots (3)$$

must hold. (In the quoted paper S has been defined as "degree of solvation"; it is better defined as "degree of association".)

It has been shown in the above-mentioned paper that the value S may be calculated from the experimental data in a very simple manner, for it is easy to show that

$$n_1 = \frac{\log \eta - \log \eta_2}{\log \eta_1 - \log \eta_2}$$

In previous papers the fitness of the above-mentioned formulæ has been shown for quite a number of examples. It will be perhaps sufficient to show it now on the mixture chosen by Mr. van der Wyk, that is, the system benzylbenzoate-toluene. The results calculated on the basis of the equation (2), where for S the value of 1.197 has been found, are shown in the accompanying table:

Viscosity of mixtures of benzylbenzoate and toluene. (S=1.197)

m ₁	n ₁	η obs. (K. and M.)	η calc. (equ. (2))	Difference per cent
0	0	0.552	0.552	0
0.2367	0.2785	1.183	1.154	- 2.4
0.4261	0.4762	2.015	1.993	- 1.1
0.6502	0.6948	3.614	3.624	+ 0.3
0.7890	0.8208	5.080	5.104	+ 0.5
0.9002	0.9170	6.660	6.707	+ 0.7
1	1	8.450	8.450	0

The results agree with at least the same accuracy as the data found on the base of the complicated formula of Mr. van der Wyk. Besides, every constant used has a definite physical meaning. Further, with the aid of the equation (1) it is possible to determine also the relationship between viscosity and temperature which is missing in van der Wyk's formula. This relationship shows that the formula of Arrhenius holds better at higher temperatures according to the

well-known fact that with increase in temperature 'real' mixtures approach in their properties to the 'ideal' mixtures. The formulæ (1) and (2) also lead to the following conclusions: in the solution of benzylbenzoate in toluene, from each six molecules of the first, four appear in the monomolecular and two in bimolecular form. The heat effect, that is, the total change in the energy of the mixtures, appears in the order 380, 318, 271, 237 and 208 calories, as presented in the table.

These results appear to show the better applicability of my formulæ, as compared with the formula of Mr. A. J. A. van der Wyk.

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¹ NATURE, 138, 845 (1936).

² Lederer, *Koll. Beih.*, 34, 330 (1931).

³ Lederer, *Petroleum*, 23, Nr. 49 (1932). I.P.K., Nr. 18664; World Petroleum Congress, London, 1933, No. 196; *Petroleum*, 31, Nr. 33 (1935).

Temperature Drop Effect in Relation to the Determination of the Molecular Heats of Gases

It has been shown in a recent paper¹ by one of us (H.S.G.) that, in the absence of convection, the loss of energy (Q) from an electrically heated wire, compensated for end effects and suitably disposed in a gas, is given by

$$\frac{1}{Q} = \frac{\log_e r_2/r_1}{2\pi \cdot K \cdot J \cdot l \cdot \theta} + \frac{A}{p \cdot \theta} \cdot \left\{ \frac{\sqrt{T_1}}{r_1} + \frac{\sqrt{T_2}}{r_2} \right\} \quad \dots (1)$$

where

$$A = \sqrt{\frac{2\pi \cdot M}{R}} \cdot \frac{1}{2\pi \cdot l} \cdot \frac{(2 - a)}{2a \cdot (\beta + 1/2)} \quad \dots (1a)$$

From the above equation, it is evident that measurements of Q and the corresponding pressure (p) over an appropriate range of pressure enable the values of the thermal conductivity (K) of the gas, and also A , to be calculated. Furthermore, it may be shown that if the observations are continued into the low-pressure region where the gas is rarefied, then the heat transfer is governed by the relation

$$Q = \frac{r_1}{2A} \cdot \frac{(T_1 - T_2) \cdot p}{\sqrt{T_2}} \cdot \frac{(2 - a)}{J \times 10^7} \quad \dots (2)$$

If the temperatures T_1 and T_2 are maintained constant throughout the whole range of pressure, then assuming independence of the accommodation coefficient a upon pressure, its value can be deduced directly from equations (1a) and (2), and hence $\beta \cdot R$, the molecular heat of the gas, can also be determined by substitution in (1a). We have carried out measurements in the case of hydrogen, and the value of β at 283° abs. was found to be 2.448 and that of the accommodation coefficient 0.31.

It should be noted that for a monatomic gas at ordinary temperatures, β has the value 3/2, and hence by using such a gas in the experimental apparatus a method is provided of checking the indications of the McLeod gauge in the region of rarefied pressure, since equation (2) may now be utilized to calculate the pressure, since β and a are known. In this manner the apparatus can be employed as an absolute low-pressure manometer, and this procedure was successfully adopted in the case of pure helium. Incidental to this calibration of the gauge, the value

of the accommodation coefficient obtained in terms of the experimental data and the assumed value of β was found to be 0.35. This result is in excellent agreement with that obtained by Mann², and the experiments have thus substantiated the use of equation (1) as an accurate method for the determination of accommodation coefficients.

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London, S.W.7.
Nov. 26.

¹ *Phil. Mag.*, 22 (Aug., 1936).

² *Proc. Roy. Soc., A*, 146 (Oct., 1934).

Origin of Uni-Polar Electrical Conductivity of Carborundum

THE *volume* rectification in carborundum, which is quite independent of any point action, has been observed by many experimenters¹. An attempt is made here to explain some features of this effect.

When a certain voltage is applied to the carborundum crystal, it causes a displacement of the photo-electrons embedded in the lattice from their positions of equilibrium. When the binding force on the photo-electrons is overcome by the applied field, these photo-electrons are set free. A certain minimum potential difference must then be necessary for any appreciable current to flow in a certain direction in the carborundum crystal. Since all the photo-electrons are not set free at a definite voltage, there must be a certain range of voltage within which all the photo-electrons are released. This will naturally cause a bend in the current-voltage characteristic curve. Beyond the bend, the curve will be a straight line, since the current through the crystal is proportional to $(V - e)$ where V is the applied voltage and e the minimum E.M.F. necessary to liberate the photo-electrons embedded in the crystal lattice. This linearity of the current-voltage curve beyond the bend has been substantiated, when the crystal is held between two electrodes of large contact area. The deviation from linearity is generally found at higher voltages and is due to the Joule heating, which reduces the resistance of the crystal.

Our experiments with carborundum crystal placed between metal electrodes of large contact area have shown that the values of the minimum voltage for any appreciable current to flow are different for the two opposite directions. Thus beyond the bend in the current-voltage curve, in one direction the current is given by

$$i_1 = k_1 (V - e_1),$$

while the current in the opposite direction is given by

$$i_2 = k_2 (V - e_2),$$

where e_1 and e_2 are the values of the E.M.F. necessary to liberate the electrons for the two opposite directions, and k_1 and k_2 are constants determining the slopes of the characteristic curve on the positive and the negative sides. The values of the rectification ratio for different voltages as determined from the ratio of the difference in the values of the currents in the two opposite directions to the larger value can then be calculated, provided we know the values of e_1 and e_2 , and k_1 and k_2 . From one typical current-voltage characteristic curve for the carborundum crystal mounted between electrodes of large contact

area, the slopes of the curve beyond the bends are given by

$$k_1 = \tan 83^\circ = 8.0 \text{ and } k_2 = \tan 72^\circ = 3.0.$$

Putting $e_1 = 0.4$ volt and $e_2 = 0.8$ volt, we have calculated the values of the rectification ratio for voltages beyond the minimum voltage where the bends appear. The calculated values are shown in the accompanying table side by side with the values obtained from the same characteristic curve for which $k_1 = 8$ and $k_2 = 3$. The observed value for $v = 6$ volts has been made equal to the calculated value of the rectification ratio at that voltage.

Voltage	Rectification ratio	
	observed	calculated
2 volts	0.70	0.71
4 "	0.68	0.67
6 "	0.65	0.65
8 "	0.60	0.64
10 "	0.57	0.63

The experimental and the calculated values of the rectification ratio agree well considering that the values given for e_1 and e_2 are only approximate. The current-voltage curve constructed from the calculated data does not, however, fit well with the experimental curve.

That the values of the minimum potential difference are different for the two opposite directions of the current-flow seems theoretically plausible in a crystal having no centre of symmetry.

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Nov. 15.

¹ Tissot, *L'Electrician*, 39, 331 (1910). Pierce, *Electrician*, 69, 66 (1912), Khastgir, *NATURE*, 135, 148 (Jan. 26, 1935). Khastgir and Das-Gupta, *Ind. J. Phys.*, 9, Part III, p. 258. Deaglio, *Atti. R. Acad. delle Scienze*, 70.

Some Polarization Data of the Solar Corona

THE polarization of the solar corona was determined from plates obtained in the 1932 and 1934 total solar eclipses. These eclipses were observed under perfect atmospheric conditions. Polarigraphs, equipped with quartz Wollaston prisms and colour filters of narrow transmission ranges, were used. Intensity squares were printed on each corona plate for photometric reduction. The plates were measured with the Hartmann microphotometer of the Lick Observatory and the Zeiss microphotometer of the Physics Department, University of California.

Fig. 1 shows the polarization values obtained at wave-lengths 420, 447, 482, 668 $m\mu$. These curves represent the polarization in the eastern part of the 1934 corona. The curves are the result from the reduction of plates obtained by two polarigraphs. The curve in the green region is of less weight than the other curves because of the use of non-backed plates.

It is very interesting to note that the slope of the polarization curves in the red is much steeper than it is at smaller wave-lengths. The violet curve passes through a maximum and then decreases. The curves intersect at about 4' distance from the sun's limb. The polarization in the red reaches very considerable values, going up to 57.5 per cent at 6' distance from the sun's limb.

The results obtained indicate that scattering of sunlight in the corona by free electrons cannot be responsible alone for the light emitted by the corona. Bound electrons seem to be present in the corona, and the corona itself seems to emit unpolarized light.

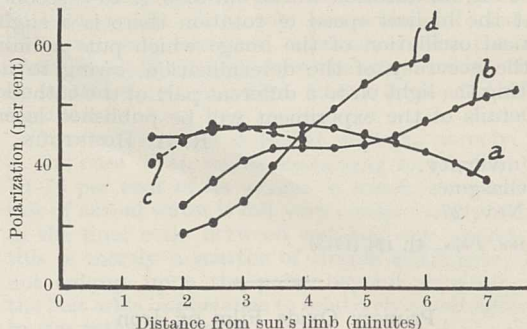


Fig. 1.

POLARIZATION OF THE EASTERN PART OF THE SOLAR CORONA, FEBRUARY 14, 1934.

Curve	Plates	Wratten Filters No.	Maximum transmission
a	Agfa Astro, backed	36	420 $m\mu$
b	Agfa Astro, backed	47	447
c	Eastman I-H	75	482
d	Agfa Superpan, backed	29	668

Detailed results of the reduction will be published later.

Part of the work was supported by grants from the Rumford and Permanent Science Funds of the American Academy of Arts and Sciences. Many friends and institutes helped in carrying through this investigation; see the acknowledgment in the preliminary report¹. The Imperial Japanese Government furnished the transportation to Laol Island, and made the observations and work possible there.

WILLI M. COHN.

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Nov. 13.

¹ Cohn, W. M., *Pub. Ast. Soc. Pacific*, 46, 177-185 (1934).

Time Lag of the Vacuum Photo-Cell

IN a well-known experiment, Marx and Lichtenecker¹ swept the image of a narrow slit across the cathode of a photo-cell by means of a mirror that could be rotated at speeds up to 170 revolutions per second, and found that the photo-electric current was constant, no matter at what speed the mirror was rotated. The shortest duration of illumination at any point on the cathode was 1.46×10^{-7} sec. The experiment was taken to mean that the cell had no time lag or period of induction comparable with this interval.

I have recently repeated the experiment with two G.E.C. cells, a *KMV 6* and a *KV 6*, using a faster mirror and a sharper image, and find that, while the law of proportionality between quantity of light and photo-electric current still holds for the *KMV 6* cell, there is an appreciable breakdown in the case of the *KV 6*. If the periods of illumination are decreased from 1.59×10^{-6} sec. to 7.4×10^{-8} sec., the time required to charge the electrometer to a

given potential is increased. My last three determinations give an increase of 0.30 ± 0.50 per cent, 0.70 ± 0.31 per cent, and 0.85 ± 0.59 per cent, the mean of which is 0.62 per cent. If we make the assumption that this increase is due to there being a period of induction before the electrons start to come off, its duration works out at 5×10^{-10} second.

At the highest speed of rotation there is a slight vertical oscillation of the image which puts a limit to the accuracy of the determination, owing to its shifting the light on to a different part of the cathode.

Details of the experiment will be published later.

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Nov. 27.

¹ *Ann. Phys.*, **41**, 124 (1913).

Primary Oxide Film on Iron

DURING the course of an electron diffraction study of oxide films formed on iron, I have found it rather difficult to obtain surfaces the initial diffraction pattern of which can be attributed to iron alone. In particular, if the surface of a piece of clean Armco or electrolytic iron is abraided by rubbing it lightly over dry 0000 emery paper, the resulting pattern consists of the usual rings of α -iron plus two diffuse rings or bands the mean radii of which correspond to spacings of 2.6 Å. and 1.5 Å.

The belief that these rings might be due to a thin film of oxide (Fe_3O_4) has been confirmed by a series of experiments with films of electrolytic iron evaporated and condensed *in vacuo* on glass, iron, platinum and quartz surfaces. The evaporation was carried out in the diffraction camera with the receiving surface mounted in the sample holder. Reflection pictures taken immediately after evaporation yielded only iron rings. If, however, the sample is exposed to dry air at room temperature and atmospheric pressure for a brief interval, the resulting diffraction pattern is markedly different. The iron rings are considerably fainter, while two diffuse bands appear in the same positions as found on the abraided iron. In some of the pictures other fainter rings appear which, together with the bands, are in good agreement with the pattern to be expected from a thin film of Fe_3O_4 overlying the iron.

Traces of oxide on evaporated films have been found on pictures taken after brief exposure to air pressures not exceeding 10^{-3} mm. of mercury. Exposures to atmospheric air longer than four minutes produce very little change in the pattern. Heating the specimens in air for 3–7 min. at temperatures of 150° – 200° C. is sufficient to cause the disappearance of the iron rings and greatly to strengthen those due to the oxide.

The possibility that a definite orientation relationship exists between the iron and the oxide lattices has been tested by forming thick evaporated films on various surfaces under conditions which yield a high degree of preferred orientation of the individual iron crystals. Such a film all the iron crystals of which have their [111] directions mutually parallel (within 5°) exhibits an equally high degree of preferred orientation of the Fe_3O_4 film after brief exposure to air. The observed orientation relationship is one in which a $[01\sqrt{2}]$ direction of the cubic oxide crystals is parallel to the [111] direction of the iron. This parallelism does not, of course, determine the

complete space orientation relationship between the two lattices. It must be pointed out, however, that the observed orientation is exactly satisfied if the Fe_3O_4 cube planes (100) lie parallel to iron cube planes, and the [110] directions in the (100) planes of the oxide are parallel to the [100] directions in the (100) planes of the iron.

Mehl, McCandless and Rhines¹ have found the same orientation relationship existing between "FeO" grown at high temperature on single iron crystals. More recently, Mehl and McCandless² have reported that "FeO" grown by reduction on a single magnetite crystal has the same orientation as the underlying Fe_3O_4 . In the light of these results, the present experiments can be interpreted by saying that the primary oxide film on iron consists of Fe_3O_4 oriented as if "FeO" were formed first and then oxidized to Fe_3O_4 . Such is probably not the actual process, because there is no evidence of "FeO" in the diffraction patterns and furthermore it is unstable below about 575° C. As has been pointed out by Mehl and McCandless, there is a striking similarity between the positions of the Fe atoms in the iron lattice and their positions in the "FeO" lattice, and this similarity can be traced through to the Fe_3O_4 lattice when it is oriented as described above.

Electron diffraction pictures of Fe_3O_4 films grown on highly oriented Fe_3O_4 films by heating at 200° C. in air show no trace of orientation. Continuous rings of the randomly orientated Fe_2O_3 crystals appear superimposed on a fading but still well-oriented Fe_3O_4 pattern. Long after the Fe_3O_4 pattern has disappeared, the Fe_2O_3 rings begin to show evidence of a preferred orientation which seems to be independent of the nature and degree of orientation in the underlying layers.

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Nov. 11.

¹ *NATURE*, **134**, 1009 (Dec. 29, 1934).

² *NATURE*, **137**, 702 (April 25, 1936).

Distortion and Yield Point of Molybdenum

IN a recent communication¹, Dr. E. W. Fell refers to a letter from us² and comments on the yield point of molybdenum wires after a certain heat-treatment in hydrogen followed by nitrogen, as shown in Fig. 1 (No. 2) of our letter. He points out that in Fig. 1 (No. 1), which shows the load-extension curve for wires treated in hydrogen only, no such yield point is present, and attributes the difference in the shape of the two curves (that is, No. 1 and No. 2 in our letter) partly to the different heat-treatment affecting the crystal size of the two samples.

While admitting that, in general, the crystal size may have an influence on the yield of the wire, we must point out that, in the particular case dealt with, the crystal sizes of the two samples were exactly identical. Notably the sample No. 2 was pretreated in hydrogen at $1,400^\circ$ C. for 2 min., and during the second treatment at $1,300^\circ$ C., which was done for 20 sec. in nitrogen, no further change in the crystal structure occurred at all. Thus it is quite clear that the remarkable yield shown is entirely due to the presence of nitrogen sorbed during nitriding at the second treatment.

Incidentally, this can also be demonstrated very convincingly by the following two methods. If

nitrided wires treated in the same way as those to which Curve No. 2 of our previous letter relates are reduced in hydrogen, say, at 1,000° C., they revert entirely to a stage which is identical with that represented in Curve No. 1. There is no yield. On the other hand, if wires are heated in the same manner as in that of Curve No. 2, the only difference being that the second treatment at 1,300° C., continued for 20 sec., is carried out in *hydrogen* instead of nitrogen, the resulting wire is exactly like that of Curve No. 1. Again there is no yield.

If, during nitriding, changes in the crystal structure are also taking place, the conditions are somewhat more complicated, and the behaviour of the wire is then dependent on the resulting crystal size as well as on the *quantity* and *distribution* of nitrogen sorbed.

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Nov. 16.

¹ NATURE, 138, 760 (Oct. 31, 1936).

² Túry, P., and Krausz, S., NATURE, 138, 331 (Aug. 22, 1936).

Water and Fat Contents of Tsetse Flies

A CONSIDERABLE amount of work has recently been carried out or is in progress concerning the physiological responses of tsetse flies to environmental conditions. These studies have been largely concerned with the effect on the water and fat content of the flies.

There is a point to which attention may be directed as it has not been taken into consideration in any paper of the above nature which has as yet come to my hand. In estimating the water content, it seems to be the practice to utilize the gross wet and gross dry weights of the flies. It is to be pointed out, however, that the ether soluble 'fat' contains no water, and is very variable in quantity in different circumstances. It is obvious that, with the same quantity of water, the water content, expressed as percentage of the wet weight, will vary inversely with the fat content.

In the course of our work with *Glossina morsitans*, one hundred and fifty unfed flies, killed within two hours of emergence, have furnished a mean water content, based on gross weights, of 70.8 per cent. If the weight of the 'fat', the mean of which is near 1.70 mgm., is subtracted from both wet and dry weights, however, the mean water content is 76.4 per cent. There is practically no difference between the sexes in this connexion.

The distribution of the respective percentage water contents shows the following ranges in round figures :

- (1) With 'fat' included: 66-74 per cent.
- (2) With 'fat' excluded: 72-79 per cent.

Unfed flies which have been under starvation for any considerable period have naturally consumed a large portion of their fat reserve, and the loss of fat tends to raise the final percentage of water if the latter is reckoned on gross wet and dry weights. On this basis, in fact, it may appear that no significant disturbance of the water balance has taken place during an experiment, whereas if the 'fat' is excluded a significant difference may be revealed.

A single instance will illustrate this point. A group of unfed flies, which had been exposed to certain

conditions, returned the following mean figures :

Wet weight	19.6 mgm.
Dry	5.7 mgm.
'Fat'	0.60 mgm.

Using gross weights, the proportion of water is 70.9 per cent, practically the mean of the control. Excluding the 'fat', the proportion of water is 73.2 per cent, which is definitely below the mean of the control calculated on the same basis. Tested by *t*, this result has been found to be statistically significant.

One further point is rather obvious, namely, that, in the case of an insect containing in the first place 70-76 per cent of its weight in water, a considerable loss of actual water is not very conspicuously reflected in the final ratio between wet and dry weights. As this is merely a matter of simple arithmetic, I will not enlarge upon the point beyond remarking that the fact adds importance to relatively small differences in the ratios recorded.

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Four Molluscs rarely recorded from the Red Sea

As an example of the way in which the distribution of marine animals is complicated by ecological factors, I quote four species of nudibranch mollusc, all of which are large and conspicuous, and which, though common in Zanzibar, have been rarely recorded from the Red Sea. I have myself only lately seen specimens, though twenty-three out of the last thirty-five years have been spent on this coast :

Asteronotus hemprichi Ehr. One specimen on Sudan coast, 1905; one specimen by Dolfuss, in Gulf of Suez, 1927-29; two here in 1934.

Chromodoris (Glossodoris) annulata Eliot, fairly large for its genus and so strikingly marked that if seen it could not be missed. Colour white with distinct yellow spots. Mantle border violet, with large rings of the same on the back, one enclosing the rhinophores, the other the gills. None seen until 1934, when two were collected (there is another species here of exactly the same colour except that the characteristic rings on the back are missing. This might be taken for a local variety, but in *C. annulata* the gills are laid horizontally, in the other they are vertical, and kept in motion).

Ceratosoma cornigerum Adams and Reeve. Two specimens by Dolfuss, two here in 1936.

Thordisa crosslandi Eliot, another large form not seen again anywhere until one specimen was taken here this year.

None of these species was found by the Cambridge Suez Canal Expedition.

C. CROSSLAND.
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Ghardaqa,
Red Sea District.
Nov. 30.

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Colloids and the Biological Effect of Radiation

SOME eight years ago there came to my notice a phenomenon which I now think must have been of the same type as that described in the letter from Dr. F. Ellinger, published in *NATURE* of December 12, p. 1014.

It was desired to demonstrate by means of a projection microscope the Brownian movement in certain colloidal solutions. Messrs. Zeiss kindly placed at our disposal a projection microscope in which the demonstration substance was subjected to very powerful illumination. It was found that when a colloidal calcium oleate protected by gelatine was placed in the cell, the particles, which showed very active Brownian movement, were rapidly brought to rest in the illuminated area. If the cell was moved slightly, the particles which had been unilluminated

were seen to be in active movement, but within some forty seconds all had come to rest. The sol in question contained small quantities of sodium chloride and other electrolytes, and it is suggested that the illumination decreased the stability of the colloid sufficiently for these salts to bring about precipitation.

The phenomenon observed was not due to heating or drying up of the solution, since a water cell was interposed between the source of illumination and the slide, and also when a titan white suspension was substituted for the colloidal calcium oleate the particles remained in active movement during many hours of continuous illumination.

R. T. M. HAINES.

British Colloids, Ltd.
Dec. 16.

Points from Foregoing Letters

DR. W. B. LEWIS, W. E. Burcham and W. Y. Chang report that α -particles accompany the radioactive disintegration of lithium atoms (mass 8) into beryllium atoms of the same mass, with emission of an electron. These α -particles are attributed to the disintegration of excited ^8Be nuclei formed in the above reaction. It appears that the ^8Be is always formed in an excited state, and the lowest excess energy is not less than two million electron volts.

Attention is directed by Dr. M. S. Vallarta to a lack of agreement in the observed data concerning the intensity variation of cosmic rays with longitude. Some determinations show a maximum off the West African coast at long. 12° W., in agreement with the theory of Lemaitre and Vallarta (assuming the position of the magnetic centre of the earth to be at about long. 160° E., as calculated by Schmidt). Hoerlin and Clay, on the other hand, find a maximum at long. 80° W., in the Pacific Ocean, which would place the magnetic centre at 100° E.

The changes brought about by the yellow oxidation ferment and Warburg's co-ferment consist, according to Prof. J. Kenner, in the removal of a proton and a hydrogen atom associated with an electron. He gives several examples of such reactions and suggests that they may likewise throw light on the function of methyl groups in the lactoflavin molecule in connexion with the activation of vitamin B₂.

The biological activity of corticosteron, a crystalline substance isolated by Reichstein from the cortex of the adrenal gland, is reported upon by a group of investigators from Amsterdam, Oss and Zurich. They find that its curative action upon dogs from which the adrenal glands have been removed, is about 2,000 times that of a standard 'cortin' solution, or 100,000 times that of fresh gland.

Benzoyl oxide and benzoyl peroxide have the property of stimulating growth in the same manner as the growth-hormone 'auxin'—according to experiments by R. Snow. The stimulation of growth was noted after applying the substances, mixed with lanoline, to one side of oat coleoptiles from which the tops had been removed.

Dr. E. L. Lederer compares his equation for the viscosity of binary mixture and that of Arrhenius with the equation recently suggested by A. J. A. van der Wyk, and states that the former two are to be preferred.

An equation for determining the molecular heat of a gas at a known pressure from the loss of energy of an electrically heated wire is given by Prof. H. S. Gregory and R. W. B. Stephens. Alternatively, taking as known the 'molecular' heat of a monatomic gas, it is possible to check the pressure readings of a McLeod gauge in the region of rarefied pressures.

A comparison is given by Dr. S. R. Khastgir of the observed values for the volume rectification ratio of carborundum with those calculated by means of a hypothesis which postulates that photo-electrons are set free when a voltage exceeding their binding force is applied. The values of the minimum potential differences needed are different for the two opposite directions of the current flow.

Curves showing the polarization of light of several wave-lengths in the solar corona, from photographs taken during the eclipse of 1934 by means of a specially equipped polarigraph, are given by Dr. W. M. Cohn. The author deduces that both 'bound' and free electrons are present in the solar corona.

The time lag of the vacuum photo-cell has hitherto not been measured, but it is usually assumed to be less than 3×10^{-9} sec. By a refinement of the rotating mirror method, Dr. R. A. Houston has managed to measure it for one cell, and finds it to be 5×10^{-10} sec.

Surfaces of pure metallic iron, if they have been at all exposed to air, show the presence of a film of oxide, Fe_3O_4 , when analysed by means of the X-ray diffraction method. H. R. Nelson has investigated the orientation of the oxide lattice structure in relation to that of the underlying iron crystals and finds it similar to that which has been observed at higher temperatures in the case of 'FeO'.

While admitting that crystal size may have an influence on the yield point of heat-treated molybdenum wires, as suggested by Dr. E. W. Fell, it is stated by P. Túry and S. Krausz that in the particular case described by them the crystal size of the two samples was identical and the difference in the yield point must be attributed to the presence of nitrogen sorbed during nitriding.

R. W. Jack points out that changes in the fat content of tsetse flies should be allowed for when estimating variations in the 'water balance' of these insects, otherwise significant differences may be overlooked.

Research Items

Palaeolithic Portraiture

DR. HERBERT KUHN has assembled all known reproductions of the human form in the Franco-Cantabrian school of palaeolithic art with the view of studying how the artist of this school represented himself and his fellow men and women as a type (*Z. Rassenkunde*, 4, 3). These representations, more numerous than is appreciated, fall into three classes: (1) sculptures and reliefs; (2) engravings in which the figure is masked; and (3) engravings in which there is no mask. In (2) and (3) the masked figures predominate, owing to the preoccupation of the period with magic. In (1) statuettes of Aurignacian age in ivory, bone, or other material number fifty-nine from sixteen sites, distributed over an area extending from Italy-Spain-France to Siberia. All but two are female. Of reliefs there are five, all from Laussel, Dordogne. Two of the female figures hold horns in one hand. Of the statuettes of Magdalenian age there are four from four sites, all situated in France. They are of slender type, whereas the Aurignacian statuettes and reliefs are full-fleshed, with the sexual characters strongly marked, thus pointing to connexion with a fertility cult centring in the female. These statuettes, like the masked figures of (2), throw little light on physiognomy in the period. Of the masked figures of (2) there are seventy-one from twenty-four sites. With two exceptions (Klause bei Neuessing, Bavaria, and the Pin Hole Cave, Derbyshire), all the sites are in France. The masks include birds, lion, buck, goat, bison. A number show no features or are unrecognizable. They afford evidence of a cult of magic. The figures without masks (3), from this point of view the most interesting, number nineteen. Of these, eight, including hunting scenes, show no features; but the remaining eleven, with features either in full face or profile, show how palaeolithic man saw himself, though at times in so grotesque a form as to suggest caricature. It is to be noted that the head is always short and round. The nose is prominent but broad. A beard is indicated, and the bodies of both sexes are hairy, even on the female breast.

Ætiology of Goitre

GOITRE is a disease, with enlargement, of the thyroid gland, which has a high content of iodine. The results of an investigation by the Committee on Iodine and Thyroid Disease, jointly appointed by the Medical Research Council and the Agricultural Research Council, are contained in a report issued by the Medical Research Council entitled "The Relationship of the Iodine Contents of Water, Milk, and Pasture to the Occurrence of Endemic Goitre in two Districts of England" (Special Rep. Series, No. 217. London: H.M. Stationery Office, 1936. 6d. net). Two former studies upon this subject have already been published (Nos. 123 and 154), but revealed discrepancies which made this further work desirable. The accurate determination of minute quantities of iodine met with in the materials examined was carried out by a method devised by Mr. C. O. Harvey, and contained in a report in this series (No. 201). The results embodied in the present report give general confirmation of previous work that environ-

mental deficiency of iodine, as indicated by the iodine content of the local water, is once more shown to be associated with a high incidence of goitre. At the same time, the actual amount of the iodine in the environment is not simply and directly related to the intensity of the incidence of goitre. It is suggested that some factor other than the mere iodine content, such as variations in the availability of the iodine present, may be responsible for the discrepancies met with.

Caddis Flies of India

VERY few species of Trichoptera or caddis flies have been described or collected in India. A recent contribution to this subject is to be found in a paper by Prof. A. B. Martynov, the well-known authority in Leningrad (*Rec. Ind. Mus.*, 37, 93-209; 1935). The paper forms the first part dealing with the suborder Annulipalpia. The material studied by Prof. Martynov was from the Indian Museum, and numbered about 93 species. It is significant that 77 of these species constituted new records for continental India and that 61 of them were previously undescribed. This paper brings the number of Trichoptera-Annulipalpia known from continental India up to about 134 species. From the points of view of zoogeography and ecology, caddis flies are an interesting group. It is very desirable that further investigations should be undertaken, including the larvæ and the exact nature of their habitats. Prof. Martynov's paper, which is very fully illustrated, is one of special importance to students of this order of insects, who will doubtlessly welcome further contributions from the author dealing with the Indian forms.

Corpuscles in Cœlomic Fluids of Invertebrates

A SERIES of four communications by Toshio Ohuye (*Sci. Reports, Tôhoku Imper. Univ.*, Oct. 1936) continues the author's investigations on corpuscles in the cœlomic fluids of invertebrates. The previous papers dealt with a holothurian and an earthworm and the present papers include the examinations of four ascidians, another holothurian, an echinoid and a brachiopod. The papers are well illustrated, and the value of the survey is enhanced because a similar technique is employed throughout and the same person is responsible for the interpretation. In the ascidians and the holothurian, nine different types of corpuscles, and in the echinoid and the brachiopod, six different types are recognized. Some of these corpuscles exhibit considerable variation in the body of the animal and some undergo marked changes when they are removed from the body. Amœboid corpuscles are present in all species examined, and in the echinoid the hyaline amœbocytes may run together to form a plasmodium.

Crossing-over and Chiasmata

THE mechanism of crossing-over is still the subject of much investigation, based on both cytological and genetical data. Dr. K. Mather (*J. Genetics*, 33, No. 2) has applied the chiasmotype theory to the knowledge that crossing-over is not constant per cytological unit distance along the chromosomes,

particularly in *Drosophila*, and is able to draw various conclusions from the mathematical discussion. If crossing-over is more frequent at certain points, there must evidently be some localized determining mechanism. The spindle fibre attachment appears to be the site of this mechanism, and in the V-shaped chromosomes of *Drosophila* the two arms are known to be independent in their crossing-over. This is less surprising as it is evident that these were originally separate chromosomes. The frequency of crossing-over and chiasma formation in any region is then a function of its distance from the spindle attachment. Owing also to interference, the frequency of crossing-over at any point depends on (1) its distance from the spindle attachment, (2) the length of the chromosome arm. It is concluded that, in *Drosophila*, crossing-over and chiasma formation begin at the spindle attachment and proceed regularly along the arm.

Internal Cork of Apples

'INTERNAL CORK' of apples, which has for some years been a prevalent source of loss in certain areas of New Zealand, has recently been effectively controlled by the injection of boron compounds. H. O. Askew and E. Chittenden (*J. Pom. and Hort. Sci.*, 14, 3, 227; 1936) have found that hydrated borax applied as a top dressing will rapidly increase the boron content of certain soils to a depth of eighteen inches, and is readily absorbed by Jonathan and Dougherty trees. The boron content of apples from a healthy area and free from internal cork was similar to that of fruits from unhealthy soil receiving 100 lb. borax per acre. The treatment was effective in reducing the incidence of internal cork on trees previously affected, and no definite effect on the size or dry weight of the fruits was observed. It was estimated from the boron content of healthy leaves and fruits that the annual boron requirement is approximately 44 gm. per acre, which is amply supplied by a top dressing of 50 lb. of hydrated borax per acre to the soil. Complete control of internal cork was obtained by injecting individual branches of Jonathan and Delicious trees with 0.25 per cent hydrated borax solution. A total quantity of 2.5 gm. was effective, though 15 gm. could be given without injury. Control was also achieved by spraying the trees with 0.1-1 per cent borax solution, and as the addition of lime did not diminish the control, it is suggested that borax may be applied along with routine lime-sulphur sprays.

Cereal Rusts on Incompatible Hosts

DR. THEODORA B. HANES has studied the important problem of what happens when a rust fungus attacks a host upon which it does not normally occur (*Trans. Brit. Mycol. Soc.*, 20, pts. 3 and 4, Nov. 1936). Uredospores of *Puccinia triticina*, *P. glumarum* *Triticici*, *P. anomala*, *P. coronata* and *P. graminis* *Secalis* were inoculated upon a wide variety of cereals, and many 'inappropriate hosts' were included. The fungus usually initiated invasion of these unsuitable host plants, but was soon checked by local death of the mesophyll, or even of the stomatal guard cells. Experimental results are set forth in great detail in the paper.

The Refractivity Intercept

THE value of investigations of refractivity in the examination of hydrocarbons and mixtures of hydrocarbons is emphasized in a paper by S. S. Kurtz, jun.,

and A. L. Ward (*J. Franklin Inst.*, 222, 563; 1936). The authors have used the accurate data available for the isomeric heptanes to examine the additivity of the molecular refractivity, and come to the conclusion that too much is demanded of the classical refractivity equations of Lorenz-Lorentz, Gladstone and Dale, and Eykman. Such equations cannot be expected to give the effect of both variation of temperature and constitution on refractive index and density. A graph of refractive index (n) against density (d) for the homologous series of paraffins confirms the fact that a linear equation expresses the relationship between these two quantities. It is therefore proposed to use the equation $b = n - d/2$ where b is a constant, and is referred to as the refractivity intercept. The latter is characteristic of each homologous series. The refractivity intercept is of greater use in the study of hydrocarbons and hydrocarbon mixtures than the classical refractivity equations, since it is practically independent of boiling point and molecular weight. It is of value in the selection of reliable data concerning the properties of hydrocarbons, and for confirming the structure of new hydrocarbons and establishing their purity. It is of use also in the qualitative analysis of organic liquids. The refractivity intercepts of organic compounds other than hydrocarbons are usually less than unity, whereas hydrocarbons themselves (except in a very few cases) give a value greater than 1.01. In the case of mixtures of hydrocarbons, the intercept may be used to distinguish between saturated cyclic and aromatic hydrocarbons. It is possible, by a graphical method, to analyse quantitatively mixtures containing two or three different types of hydrocarbons. The authors discuss briefly the electronic interpretation of the refractivity intercept.

Development of Radio Receiving Valves

At a meeting of the Wireless Section of the Institution of Electrical Engineers held on December 2, a paper entitled "Modern Receiving Valves: Design and Manufacture" was presented by Messrs M. Benjamin, C. W. Cosgrove and G. W. Warren of the M.O. Valve Co., Ltd., and the G. E. C. Research Laboratories. This paper discusses the main features in the geometrical design of the types of valve in common use to-day and the various factors, mechanical and chemical, which impose limitations in manufacture. Attention was directed to the fact that the minimum tolerances of the dimensions of the electrode systems must be of the order of one per cent if reasonable similarity of characteristics is to be obtained in the mass production of valves of the same type. The paper includes a brief historical survey of the recent improvements in thermionic emitters and gives details of the precautions necessary in the production of modern highly efficient oxide-coated cathodes and insulated heaters. A brief description of the pumping and activation processes employed in modern manufacture is given, and the main factors affecting the life of a valve are discussed. The authors conclude with some observations on possible future developments of the receiving valve. The reading of the paper was accompanied by demonstrations, illustrating, first the improvement attained in the past five years in making the receiving valve free from microphone noises, and secondly the use of the very small 'acorn' valve for the transmission and reception of telephony on a wave-length of about one metre.

Lobster Research in Norway

DR. ALF DANNEVIG in a recent paper* gives a general review of the lobster industry and lobster culture in Norway. For about twenty years lobsters have been investigated at Flødevigen. Yearly grants have been made for this purpose, and much has been done in studying the lobster in all aspects, especially by fishery statistics, marking experiments and rearing the young to the bottom stage after which they are freed into the sea. The results of these researches have been published in various reports and journals, and here a collected view of the whole problem is given and discussed.

Beginning with the history of the fishery from early times to the present day, the author passes on to details of legislation and shows that there has been a big improvement in the fishery since a size limit and a close season were enforced.

Early researches on lobsters were made by Rathke, G. O. Sars, G. M. Dannevig, Appeløf and Sünd leading to the present author's work, which is chiefly concerned with the rearing of the young. The foundation of our knowledge of the life-history and development was laid down by G. O. Sars, who in 1875 described the post-embryonic development for the first time. The newly hatched larvæ he found in the well of a fishing boat and later collected them in the surface waters of the sea by means of a fine net. In this way he distinguished three larval stages and prophesied that the fourth would probably be on the bottom, which was later found to be true. Even in these early years, Sars advocated summer protection and inspection, both of which have now been in force for some time.

Lobsters were first artificially reared from the egg to the bottom stage by G. M. Dannevig, who showed that the young were very sensitive to salinity and, more especially, to temperature, and also found out the proper way to feed these young. Appeløf did much in the way of biology and studied specially the growth of the lobster and instituted marking experiments. It was on the basis of his work that special rearing experiments were begun in 1912 by O. Sünd, who carried out systematic measurements of lobsters on various parts of the coast. Later the rearing experiments were continued by Alf Dannevig, and are still going on at Flødevigen.

It is shown that males are mature at a length of about 16 cm. at Flødevigen and females at between about 21–23 cm. The eggs are extruded in the summer and development takes about a year, during which time the female keeps the eggs under its abdomen attached to the pleopods. Hatching usually takes place in June or July according to the temperature of the water. A spawning lobster of 23 cm. may have about five thousand eggs. The larval development through three free-swimming stages to the bottom stage takes about fourteen days with favourable conditions and normal summer temperature—about 16–18° C. in the Skagerak.

The natural food of the youngest stages consists of small planktonic animals, but in captivity they

thrive on crab meat and ox liver. They seize almost anything but throw it away if not liked. In the rearing experiments in the Isle of Man which have been going on for some years, the larvæ are fed with fresh plankton in which copepods predominate, and they thrive on this. Adult lobsters are not naturally carrion eaters, although they will eat dead fish and crabs. Dannevig has observed that in Nature, sea-urchins, chætopods and thin-shelled mussels take a prominent place as food and he has also found remains of fish. Little is eaten in cold weather, the appetite rising with temperature. No food is taken just before and during the period of shell casting, which takes place usually in late summer and autumn when the reserve food is consumed. During the first few days after casting, the lobster does not eat, but as the new shell hardens the appetite grows and soon is normal again. The best quality lobsters are those with a thick shell which has not been cast for some time; thus the best lobsters are usually those caught in the late winter and spring. In captivity, it is essential to feed the lobsters if they are to be in good condition for eating, otherwise they are watery. Temperature and food are of great importance with regard to shell casting, and lobster growth depends on the casting of the shell.

Growth measurements in captivity compare favourably with those in Nature obtained from marking experiments, and the reared lobster young at Flødevigen grow in much the same way as those reared at Port Erin, Isle of Man. The young at Flødevigen reach a length of about 30 mm. in the first growth period and about 60 mm. in a year, the shell casting, practically speaking, being limited to the time when the temperature is above 10° C.

Marking experiments have shown that there is little sign of wandering far, although the lobsters come into shallow water when the water is warm and go down into the deeper water when it becomes cold, or in stormy weather. On most of the Norwegian coast the wandering is probably limited to about a hundred metres in a horizontal plane. There may then be said to be a stationary stock and, usually, about 44 per cent of the marked lobsters are caught again the year after marking. For example, a hundred lobsters, 19–20 cm., were released in the autumn and 44 were taken again the next autumn, the average size being 22 cm.

The present minimum size is 21 cm., and since it is known that hens are normally not ripe until 22–24 cm., it is clear that raising the minimum size to 22 cm. would save many which will breed the next year, especially as the greater part of the fishermen's present catches consists of those of less than 22 cm. This would also be of advantage eventually to the fishermen, for the catches though smaller would be more valuable. It is calculated that, if the minimum size is raised a centimetre, after two years there will be an increased lobster stock, and this with no lasting expense to the fishery.

Since 1879 there has been a protection period to prevent fishing of lobsters which have just cast their shell. This is from July 15 until the first weekday after September 15, varying slightly in different

*Hummer og Hummerkultur. By Alf Dannevig. (Fiskeridirektoratets Skrifter. Serie Havundersøkelser. Report on Norwegian Fishery and Marine Investigations, 4, No. 12. (Copenhagen: Director of Fisheries, 1936.)

districts. An earlier protection time in spring would save many breeding lobsters, and extension to later in autumn would bring with it a better quality of fish.

The breeding experiments at Flødevigen are carried on in view of the fact that by increasing the number of young by enclosing a mother lobster, hatching the eggs in captivity and rearing the young to the bottom stage, an increase of lobster stock will be effected, for in this way the larval stages which are the most exposed to dangers are protected for the most susceptible time of their life. The lobsterlings when they have attained the bottom stage are set free into the sea. A technique has now been evolved which is very sure, and one can reckon on an output

of 20-40 per cent. It is now possible to bring lobster young from the egg to the bottom stage in so great numbers that it is undoubtedly valuable in increasing the stock. This technique has been described in Dannevig's former paper "The Rearing of Lobster Larvæ at Flødevigen" (1928). The technique being established, it is now only a question of how cheaply the whole of the rearing and transport can be effected. There is every ground for believing that it is possible to bring working expenses of production down to a fractional part of the present amount. The plans for the immediate future include still further research in those areas where the young are released. So far, the rearing experiments have prospered. Important results should follow these successes.

Petroleum and Petroleum Products

THE group of papers on conservation of petroleum and natural gas given at the third World Power Conference forms the subject of a report by H. C. Fowler (Section IV, Paper No. 12). Mr. Fowler stressed the principle enunciated by Sir John Cadman that petroleum should not be produced without adequate need, having regard to the vital part played by crude petroleum in the life of civilized communities to-day, and the view held by technicians that resources of crude petroleum are not unlimited. The problem of conservation presents a different aspect in each oil-producing country, and it is difficult to assess it from the point of view of world resources. In the case of the United States of America, the problem is unique and the ultimate policy adopted there will probably have a greater influence on the world petroleum industry as a whole than that of all other oil-producing countries combined.

Before effective measures for world conservation can be adopted, however, there are certain preliminary investigations to be made. The extent and character of waste production in countries having relatively large portions of known oil resources should be determined and note taken of methods employed to conserve resources under specific conditions. In those countries which depend chiefly on imported supplies of oil, the problem should be regarded from the point of view of conservation of utilization. Further, organization of the industry in different countries should be surveyed from the point of view of the effect of property laws, State regulations, etc. Finally, the uses of petroleum should in every case be justified or otherwise, and decisions on this point taken only with full cognisance of all possible substitutes for petroleum and a knowledge of their specific uses. These and other economic factors which are bound to affect utilization and conservation of petroleum should be carefully weighed before judgment is passed on the whole problem of how best to use or conserve this commodity, which now seems indispensable to modern industrial life, but is at the same time believed to be capable of exhaustion.

In his general report (Section II, Paper No. 6) on papers submitted at the Conference on the organization of the production, transportation and distribution of natural and manufactured gas, E. R. Weaver directed attention to the marked contrast between European and American practices within

the gas industry. The contrast is chiefly attributable to the greater abundance and variety of fuels obtainable in America, and to different legal and financial factors within the industry. Moreover, in practically every European country, distribution of adequate gas supplies is undertaken by public bodies, whereas in the United States of America public interest is for the most part not represented on the boards and councils of gas concerns. Large holding companies, therefore, compete with each other for areas of supply and are not responsible for their policies to any higher authority. This fact cannot be said to further ultimate national conservation of this commodity in America.

In the case of European countries, a strikingly similar development of the gas industry appears to have taken place in each of them, and such differences as exist are rather differences in stages of development than fundamental dissimilarities. Germany is at present pursuing an advanced policy of consolidation, the professed ideal being delivery of gas to every station at every moment as economically as possible, and also at the same time withdrawal from each producing unit of an allotted quota. To achieve this, not only daily but also hourly load of every pipe has to be calculated and attention given to weather reports and other factors likely to influence gas sales. The question now being debated by technicians is whether fundamental conditions exist in other European countries which will prohibit a similar national programme of gas economy to that aimed at by Germany.

E. B. Swanson gave a general report (Section II, Paper No. 5) on papers in connexion with present-day organization of the petroleum industry. The industry may be said to comprise five structural components: exploration, production, transportation, manufacturing and distribution. The degree of economic stability attainable by an individual country or company is dependent largely upon the extent to which it is possible for it to enter into all five branches of the industry's activities. Papers descriptive of the organization of the petroleum industry in the Argentine, Austria, Canada, China, France, Germany, Great Britain, Hungary, Poland and the United States, substantiate this fact, and at the same time facilitate classification of these countries into four categories: producer; producer-refiner-marketer; purchaser-refiner-marketer; and purchaser-marketer.

The ultimate aim of each country is to engage in all branches of the industry and to attain a balanced degree of activity in each branch.

Several factors, however, determine the status of individual countries and/or units within the industry. The most important of these are the extent to which the indigenous supply of crude petroleum is capable of fulfilling the demand for petroleum products within a country; problems of general industrial organization and the extent and influence of governmental

control or assistance. In turn, the degree to which governmental influence is exerted or withheld is based on the particular growth of the industry within each country. Far-reaching governmental control and stringent legislation will be found to operate in those countries where there has arisen progressive lack of balance between indigenous supply and home demand, lack of stabilization of markets through non-participation of lesser units, or other economic maladjustments.

The Bushman Skull

IN the course of a discussion of the significance of the Bushman skull (*Soölogiesa Navorsing v. die Nas. Mus., Bloemfontein*, 1, 3-4), Dr. T. F. Dreyer contends that the genus *Homo* at a very early date evolved along three independent lines—Neanderthal, the Eurasian and the Bushman. The Bushman, in the smallness and orthognathism of the face, the steepness of the forehead, and the flatness of the dorsal profile, shows features, in which it resembles the juvenile skull. It is here suggested that this 'foetalization' (Bolk) is not due to an adult retention of juvenile features, but is a precocious assumption of the adult. This explains the fact that a Bushman baby of about twelve months is already a Bushman, and differs distinctly from the babies of other races, as does the adult Bushman from other adults. This difference is thus due to the projection of adult features into the earlier ontogenetic stages.

The typical orthognathism of the Bushman skull, after a period of prognathism which lasts for some months after birth, is extreme up to six years and then is less pronounced in maturity. This is a result of two growth processes, the peak of jaw formation falling within the foetal period, while the upper face, correlated with the growth of the base of the brain, grows more rapidly during the first six years after birth. The cranial form, with characteristic bulging

of the forehead and flatness of the dorsal profile, is due to the differential growth of the roof and floor of the brain; there being a lack of growth of the anterior end of the base, while the roof grows very slowly during foetal life, very rapidly during the first two years after birth, and then keeps pace with the floor of the brain until maturity is reached.

Modern miscegenation with Bantu produces a small brain and a long face (Baralong), but early crosses of Bushman with a Hottentot-like race (Matjes River) produced a large brain with a small face. In both cases the proximate cause appears to be a disturbance in the functioning of the pituitary gland. The sella turcica in the Bush-Bantu is abnormally large—the first case recorded of hypertrophy of the pituitary in an African—while in Bush skulls the sella turcica is abnormally small.

Hybridization with the Bushman would thus seem to set up a disturbance of hormonal control, with the result that one or other set of racial characters becomes exaggerated. It remains to be determined whether the differences between the Bushman and other groups of *Homo sapiens* are of such a degree of importance that most important physiological disturbances result from hybridization, and are of sufficient weight to demand the separation of the race from *H. sapiens* as a distinct species.

Work of the Rothamsted Experimental Station

IN studying the annual report for 1935 of the Rothamsted Experimental Station*, it is impossible not to be impressed by the number and value of the experiments carried out at this institution in co-operation with various bodies and individuals. If the British farmer and his trading associates are averse to co-operation in commerce, they have not proved to be so in the field of research directed from Rothamsted. One of the fruits of bringing together producer and expert buyer has been progress in the direction of understanding 'quality', as applied to some agricultural products.

A series of fertilizer experiments, carried out with the help of the sugar-beet factories, and planned at the Statistical Department at Rothamsted, has the object of putting the manuring of this crop on a

* Rothamsted Experimental Station: Lawes Agricultural Trust. Report for 1935. Pp. 279. (Harpenden: Rothamsted Experimental Station, 1936.) 2s. 6d.

sound and more accurate basis. Trials carried out in Great Britain indicate that this crop does not give the response to various manures that might be expected from Continental experience. In the trials directed from Rothamsted, not only is the effect of fertilizers carefully assessed, but also an elaborate examination of the soil is in progress, in order to correlate soil properties and fertilizer responses. This crop is also the subject of trials at Rothamsted and Woburn, arranged under the aegis of the Ministry of Agriculture and of the sugar-beet factories. These trials are designed to measure the effects of spacing, and of sulphate of ammonia applied at different spacings; the results at both centres indicate that nitrogen produces a greater effect in the narrower rows.

Useful information was gathered from conferences of growers of malting barley; these took the form

of exhibitions of samples sent from various parts of the country, and valued by the Barley Valuation Committee of the Institute of Brewing. One of the most interesting facts gleaned is that the results of the experiments made by Rothamsted in the last ten years on the manuring of barley have passed into practice; these results indicated that barley is not a starvation crop, and that, provided the danger of lodging is kept in mind, the crop repays manuring.

The expanding acreage of vegetable crops grown in Great Britain is reflected in the increasing attention given them in the Rothamsted scheme of experiments. The expansion in this branch of work was made possible by the investigation into the value of dried poultry manure, put in hand by the Ministry of Agriculture and controlled from Rothamsted. Although the standard errors proved to be rather higher than the average of large-scale root-crop trials, a number of statistically significant fertilizer effects were found for some crops. More work was done on Brussels sprouts than on other crops. Comparing poultry manure with sulphate of ammonia providing the same amounts of nitrogen, the results indicate that, in the more favourable growing season of 1935, as compared with 1934, sulphate of ammonia proved more effective. Another interesting feature is that the manurial responses showed up more in the first pickings—an important consideration in the marketing of this crop.

The report has also something of interest for hill farmers. In the Bacteriological Department, the

work on clover organisms continues, and it appears that the soils of certain hill districts contain harmful strains that do not themselves benefit the clover plant, and also prevent most beneficial strains from forming nodules. Some beneficial strains, however, can overcome the harmful effects of the bad strains, and enable the plant to make normal growth. Promising results have been obtained from experiments on the inoculation of these beneficial strains into soils containing the harmful ones.

The Report includes a review by Dr. W. Brenchley of thirty years' work of the Botanical Department (1906-36). The problems tackled by this Department have been many and varied. The work on boron in relation to plant growth is one of many interesting landmarks in this survey. A chance observation directed attention to the possibility that this element might be essential for plant growth, and it was established conclusively by later work that boron is essential for the growth of many plants, the meristematic tissues being affected in its absence. Dr. Brenchley is perhaps best known in the agricultural world for her researches on weed eradication, work that demanded a number of surveys to ascertain how far weed species, or groups of these, are associated with particular soils or crops.

The survey concludes with an account of the work on the Park grass plots, in which various aspects of grassland management have been studied, such as the influence of season and manuring upon the botanical composition of the herbage from year to year.

Separation of Isotopes

AN interesting report by G. Champetier (*Bull. Soc. Chim.*, (5), 3, 1701; 1936) deals with the separation of the isotopic forms of elements.

The proportion of the isotopes in an isotopic mixture is very variable. In hydrogen, the atomic ratio is ${}^3\text{H} : {}^2\text{H} : {}^1\text{H} = 7 \times 10^{-10} : 1/5750 : 1$; bromine is a mixture of approximately equal parts of ${}^{79}\text{Br}$ and ${}^{81}\text{Br}$. Apart from the well-known case of the isotopes of lead produced by the radioactive changes of uranium (${}^{208}\text{Pb}$) and thorium (${}^{208}\text{Pb}$), slight differences in the atomic weights of different specimens of natural elements have been found. A difference of 0.000108 in atomic weight between atmospheric oxygen and oxygen from the water of Lake Michigan has been reported. Small differences in density of water from the surface and from the depths of the sea in various localities are probably due to separation of light and heavy water by gravity. The first quantities of water collected in rain are heavier than the following, whilst snow and glacier water is lighter than ordinary water. These separations are due to differences in vapour pressure and melting point. Water from the wood or dry leaves of a tree is heavier than normal water. All these differences are very slight.

The artificial separation of isotopes has been achieved in various ways. Neon has been separated by fractional diffusion; mercury, zinc, potassium and chlorine (as hydrochloric acid) by distillation at very low pressure; minute quantities of the lithium isotopes, ${}^6\text{Li}$ and ${}^7\text{Li}$, and more appreciable amounts of the potassium isotope, ${}^{39}\text{K}$, by the mass-spectro-

graph; and neon, hydrogen, water, ammonia, carbon tetrachloride and oxygen by fractional distillation.

The diffusion method gives better results. If x_0 and y_0 are the volumes of the two constituents in the original mixture, and x and y the volumes remaining after diffusion, the enrichment coefficient $r = \frac{y}{y_0} \div \frac{x}{x_0}$ is related to the isotopic masses m_1 and m_2 by the equation

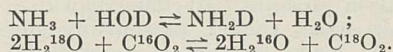
$$r = a\sqrt{V_0/V}$$

where $a = (m_1 + m_2)/(m_1 - m_2)$; $V_0 = x_0 + y_0$; $V = x + y$. The values of a for HD and H_2 is 5, for neon 21, and for ${}^{18}\text{O}^{16}\text{O}$ and ${}^{16}\text{O}^{16}\text{O}$, 33. The diffusion method has been particularly used by Hertz, who has used batteries of porous clay tubes in series, and also by diffusion into mercury vapour of the pumps circulating the gas. In the first method, pure ${}^{20}\text{Ne}$ has been obtained, and in 8 hours 1 c.c. of pure D_2 from a mixture containing only 1 in 1000 of D_2 . Recently, a partial separation of the carbon isotopes ${}^{12}\text{C}$ and ${}^{13}\text{C}$ has been achieved by diffusion of methane. Diffusion of hydrogen and deuterium through heated palladium has also been used.

The electrolytic method is the one most successfully used in the separation of hydrogen and deuterium from water. A slight separation of the oxygen isotopes is also effected, but it has been calculated that, to obtain 1 c.c. of H_2^{18}O by this process, it would be necessary to electrolyse more water than is found on the surface of the earth. In an attempt to separate the tritium isotope, ${}^3\text{H}$, from water, 75 tons of water

have been reduced to 0.5 c.c., when the ^3H content rose from 7×10^{-10} to 7×10^{-6} .

Separation of isotopes has also been achieved by chemical means. These generally make use of the so-called exchange reactions, of which the following are typical:



The photochemical method is probably capable of extension. Phosgene, COCl_2 , containing the chlorine isotopes 35 and 37, is exposed to light, when the molecules containing only ^{35}Cl are preferentially decomposed (in presence of a trace of iodine). The free chlorine is absorbed by mercury and has an atomic weight lower than normal. Preferential photochemical oxidation of the mercury isotopes has also been achieved.

University Events

BIRMINGHAM.—The degree of D.Sc. has been conferred on the following: Donald Parkinson (geology) for papers on "The Faunal Succession in the Carboniferous Limestone and Bowland Shales at Clitheroe and Pendle Hill", "The Carboniferous Succession in the Slaidburn District of Yorkshire", and other papers published in the *Quarterly Journal of the Geological Society* and elsewhere; Robert Anthony Robinson (chemistry) for "Investigations on the Thermodynamic Properties of Aqueous Solutions of Electrolytes" published in the *Transactions of the Faraday Society* and for other papers; Horace Augustus Thomas (electrical engineering) for papers on the "Frequency Stabilisation of Valve Oscillators" and "Developments in Rotating Radio Beacon Transmitters and Receivers", published in the *Journal of the Institution of Electrical Engineers*.

CAMBRIDGE.—The Clerk Maxwell scholarship has been awarded to E. Bretscher of Fitzwilliam House.

DR. SIMON FLEXNER, emeritus director of the Rockefeller Institute of Medical Research, has been appointed Eastman visiting professor in the University of Oxford for the academic year 1937–38. The professorship was founded by the late George Eastman of Rochester, U.S.A., to provide for scholars in American universities to go to Oxford as visiting professors for terms of one to five years.

THE Rhodes Trust has issued a statement for 1935–36 showing the distribution of the Rhodes scholars (95 from the British Empire, 90 from the United States and 5 from Germany) among the various subjects (either in the final honour schools or for research degrees) chosen by them. It shows a large majority under the headings natural science and medicine (62), philosophy, politics and economics (41), and jurisprudence and B.C.L. (32). Next come modern history (14), English (13), mathematics (8), Litt. Hum. (7), economics (6), geography (3), modern languages (2), theology (1) and education (1). Of the 16 who obtained honours in philosophy, politics, and economics, 12 were from the United States, 2 from Canada and 2 from Africa.

Science News a Century Ago

J. D. Forbes's Work on Terrestrial Magnetism

ON January 3, 1837, in a letter to Arago, J. D. Forbes said: "I write to mention some results respecting terrestrial magnetism at which I have lately arrived. In 1832 I made an extensive series of experiments with Hansteen's Intensity Apparatus in the Alps, and in 1835 in the Pyrenees. One principal object was to ascertain the influence of heights. I doubt extremely whether any decided result can be drawn from preceding observations. . . . Those of M. Kupffer seem to be of little value. They were not made at the summit of the Caucasus. . . . I have referred the positions of my stations in the Alps and Pyrenees to the three co-ordinates of latitude, longitude, and height, and deduced the influence of each. . . . I have in the first instance confined my calculation to horizontal intensities. From three different series of observations, made with two needles, I find always a negative co-efficient of the height, indicating, at a mean, a diminution of .001 of horizontal intensity for 3,000 feet of vertical ascent. If, as Humboldt states, the dip diminishes in ascending, the diminution of total intensity will be somewhat greater. You will judge of the extent of the inductions upon which this is founded when I mention that the sum of the heights to which I have carried Hansteen's apparatus exceeds 160,000 feet, or thirty vertical miles, twelve *lieues*".

Airy at Greenwich Observatory

IN his review of the events of 1837, Airy in his autobiography said: "My connection with Cambridge Observatory was not yet finished. I had determined that I would not leave a figure to be computed by my successor. In October [1836] I had (at my private expense) set Mr. Glaisher to work on reducing the observations of Sun, Moon, and Planets made in 1833, 1834 and 1835; and subsequently had the calculations examined by M. Hartnup. This employed me at times through 1837. I state here, once for all, that every calculation or other work in reference to the Cambridge Observatory, in this and subsequent years, was done at my private expense".

"On Jan. 3rd," Airy wrote, "I gave notice to the Admiralty that I had finished the computations of Groombridge's Catalogue, and was ready to print. The printing was authorized and proceeded (the introduction was finished on Nov. 22nd) but the book was not quite ready till the beginning of 1838". For furthering the magnetical work at Greenwich more ground was necessary. When the Visitors met in 1836, a suitable site was chosen and in 1837 "on Jan. 3 I was informed unofficially by Mr. Wood (Admiralty Secretary) that the addition of the Magnetic Ground was sanctioned".

Among other entries relating to 1837 is that in which Airy says "In the month of July the Admiralty wished for my political assistance in a Greenwich election, but I refused to give any".

Botany of Battersea Fields

AT a meeting of the Botanical Society held on January 5, 1837, a communication was read by the curator, Mr. Daniel Cooper, author of "Botanical Rambles within Thirty Miles of London", on the distribution of the localities of wild plants in Battersea Fields. It was accompanied by a map of the

district to a scale of 2 feet to the mile, with the locality of the plants shown. Mr. Cooper said that the Battersea Fields had been for years past famous for the profuse supply of specimens of interest to the naturalist, particularly to the botanist. Of the 104 natural orders of British flowering plants mentioned in Dr. Lindley's first edition of his synopsis of the "British Flora", "61 are found in this locality; of the 503 genera, 214 are here distributed; lastly, out of the 1500 estimated species of British flowering plants 406 are here dispersed".

Cooper, who was trained in medicine and became an assistant in the zoological department of the British Museum, died at Leeds on November 24, 1842, at the early age of twenty-five years.

A Stephenson Locomotive in Russia

QUOTING from a letter from St. Petersburg dated December 14, 1836, *The Times* of January 6, 1837, said: "The locomotive engine made by Mr. Stephenson of Newcastle-upon-Tyne was tried on the 11th on the iron railroad from Paulowsk to Kouzmino. Notwithstanding the extreme severity of the weather a crowd assembled to witness the experiment, the interest of which was increased by the fact that an apparatus of four brushes had been affixed to the engine, for the purpose of clearing the snow from the rails; the apparatus succeeded completely. The engine drew eight waggons or carriages, containing 256 persons, from Paulowsk to Kouzmino, a distance of 7 wersts, or a full German league in 17 minutes, and returned in the same time. . . . On this occasion birchwood was used as fuel, in order to prove that coal is not indispensable, although there is no doubt that with coal the velocity would be considerably increased".

Societies and Academies

Edinburgh

Royal Society, December 7.

A. M. HAIN: Microphthalmia and other eye-defects throughout fourteen generations of albino rats. The affected rats were healthy, vigorous animals, but the female parent of such rats rarely littered again after giving birth to young with defective eyes. Analyses of selected matings showed that, out of a total of 154 defectives, only 8 were born to defective parents, whereas 132 were born to normal parents with defective antecedents. The mode of inheritance was not straightforward; the data are consistent with the existence of a dominant factor with a poor expression which is conditioned by genetic and physiological modifiers.

H. P. DONALD and MISS ROWENA LAMY: Ovarian rhythm in *Drosophila*. In *Drosophila pseudo-obscura* an ovarian rhythm is present which is characterized by the ripening and laying of eggs in batches with long periods of rest between bursts of oviposition. The form of the rhythm varies according to age and to absolute fecundity as measured over a period of days. In *D. funebris* and *D. melanogaster* no rhythm has been observed, but in the former there is a distinct tendency to lay during the daytime. Examination of the ovaries provided consistent results.

R. A. SAMPSON: Studies in clocks and time-keeping. (6) The arc equation. In 1930, the clock "Shortt No. 4" showed evidence of the mutual effect

of variations of pressure, arc and rate. Observation revealed that the effect of pressure upon arc increased as pressure diminished; ultimately a balance obtained, and further reduction of pressure made the clock go slower in place of faster. The experimental question of the effect of arc upon rate is indeterminate at any one mean pressure. At full exhaustion, the whole circular error should presumably appear. Investigation is made whether it appears full at other pressures, with comparison with the experiments of other authorities.

J. SMALL and I. K. JOHNSTON: Quantitative evolution in *Composita*. The frequency distribution of generic sizes in *Composita* agrees reasonably well with the calculated frequency distribution, using Yule's formulæ. The ages in doubling-periods for the subtribes within tribes show a clear seriation with previously suggested order of origin. The Dp -ages of both tribes and subtribes show a complete seriation with suggested times of origin when averages are taken for each of the geological periods concerned, and this seriation extends to the subdivisions of both Pliocene and Miocene.

Moscow

Academy of Sciences (*C.R.*, 3, No. 7; 1936).

S. SOBOLEV: Limited fundamental problem for polyharmonic equations in a domain of indefinite contour.

M. POLJAKOV and K. GRJANENKO: Role of the solid phase in the ignition of combustible mixtures.

A. POLESICKIJ and P. TOLMAČEV: Solubility and activity of the halogenates of some bivalent metals. (3) The solubility and activity of $Ra(IO_3)_2$ in water and in solutions of electrolytes.

M. T. LINDTROP and J. M. TOLMAČEV: Spectral analysis of mineral waters.

M. F. NEIBURG: Stratigraphy of the Trias in the Kuznetsk basin.

V. A. ZILBERMINZ and E. M. BONSTEDT: The diamond from the new deposit in the Syuren River basin (Bashkiria).

G. M. PCHAKADZE: New data on chromosome number in domestic sheep.

R. L. DOZORCEVA: (1) Sex-linked heredity in *Pteromalus puparum*. (2) The morphology of chromosomes in the ichneumon, *Pteromalus puparum*.

V. M. KATUNSKIJ: (1) The causes of pre-floral and post-floral movements of peduncles and scapes (in the genera *Papaver*, *Crepis* and *Tussilago*). The movements are due to a growth-promoting hormone developed in the growing ovules of flower buds. (2) The development of the female gametophyte and the production of the growth-promoting hormone by flower buds.

G. G. KOLUMYCEV: Winter hardiness and earliness of wheats.

(*C.R.*, 3, No. 8; 1936).

W. K. TURKIN: Quasi-normalizers of the elements in finite groups.

D. IWANENKO and A. SOKOLOV: The law of force between heavy particles.

G. S. LANDSBERG and V. J. MALYŠEV: The rays of second order in the Raman spectra.

V. VEKSLER and B. ISAYEV: Measurements of intensity of X-ray radiation with a proportional amplifier.

F. M. ŠEMIĀKIN and A. I. LAZAREVA: Undulating cracks and periodic crystallization in gelatine gel in the formation of mercury carbonate.

I. A. SMORODINCEV and N. V. NICOLAEVA: Modification of cathepsine in the case of autolysis of muscular tissue.

I. A. LEDIKAS: The *Oncophora strata* in the Dnieper region.

N. VEDENEJEVA and S. GRUM-GRŽIMAJLO: The spectrophochrometer and investigation of dichroism in minerals.

A. A. MENIAJLOV and S. I. NABOKO: The question of the occurrence of platinum in the Far East.

N. G. CHOLODNYY: The theory of vernalization.

V. E. ŠESTAKOV: Frost resistance of winter crops during the light stage.

V. E. ŠESTAKOV and A. D. SMIRNOVA: Temperature hardening and the differentiation of the embryonic spike in winter wheats during the light stage of development.

Rome

Royal National Academy of the Lincei

(*Atti*, 23, 543-641; 1936).

A. RUSSO: Chemical nature, increment and reversibility of chondriome.

W. BLASCHKE: Integral kinematics.

L. CAMPEDELLI: An observation on the plurigenera of the elliptic surfaces of genus $P_g=0$.

G. PALAMÀ: Generalization of the formulæ of Newton and of Waring.

G. SCORZA DRAGONI: Regarding a theorem of Cacciopoli on the conformal representation of surfaces.

G. ANDREOLI: 'Flutter' in wings.

A. GALLI: Vibrations of an elastic system with inert and elastic links.

M. MANARINI: Vectorial homographies with kinematic applications in S_n spaces (2). Homographies which are the product of two axials.

E. PISTOLESI: Problem of the rotating wing.

E. VOLTERRA: Plane elastic arches (2).

L. GIALANELLA: Moment of the quantities of motion of the planetary system, and the cosmogonic hypothesis of Laplace.

P. GUARESCHI: Viscosity of gases.

G. BERGAMI, E. BOERI and P. BAER: Colorimetry during the period of development of colour.

G. CENTOLA: Hydration and structure of starch.

A. GALAMINI: Alcoholæmic curve and experimental beriberi (1). Course of cardiac activity during asphyxia (2).

V. ZAGAMI: Behaviour of creatin bodies and of urinary sulphur and chlorine during fasting and subsequent feeding (1).

V. ZAGAMI and V. CAPRARO: Behaviour of creatin bodies and of urinary sulphur, phosphorus and chlorine during fasting and subsequent feeding.

Vienna

Academy of Sciences, October 15.

LEO POLLAK and GABRIELE FEHÉR: Influence of insulin on the distribution of injected galactose among the organs of the body.

ALFRED EBEL and HANS MAUTNER: Action of glyecocol on normal guinea pigs and those poisoned with diphtheria toxin.

OSKAR PECZENIK and LUDWIG POPPER: The posterior lobe of the pituitary and the thyroid gland.

JULIUS PIA: Survey of the chalk Algae of the carboniferous limestone.

HERMANN TERTSCH: Abrasive hardness of barytes.

FRANZ KAHLER: The peri-Adriatic region east of Villach.

KARL RINNER: Wiener's imaginary projection.

W. J. MÜLLER and E. LÖW: Theory of corrosion phenomena (5). Application of the pore theory of corrosion to the phenomenon of Thiel and Eckell's difference effect.

W. J. MÜLLER: (1) The local current theory of metal potentials and its application to the behaviour of metals in oxygen-free solutions. (2) Theory of corrosion phenomena (6). Experimental determination of the potential of a working anode and the potentials and resistances responsible for the local elements.

E. ABEL, H. SCHMID and F. POLLAK: Kinetics of the oxidation of ferrous ions by nitric acid.

OTTO REDLICH and JOSEFA ZENTNER: Latent heat of fusion of mixtures of heavy and ordinary water.

ROBERT SANDRI: Measurement of the heat of reaction of slow reactions.

A. and R. SKRABAL: Dynamics of the formaldehyde-bisulphite reaction.

A. ROLLETT, R. BIRKNER and K. R. POSSELT: Azo-colours.

A. FRANKE and A. KROUPA: Cyclic ethers from glycols.

K. FREUDENBERG: Determination of the constitution of natural substances of high molecular weight.

W. N. HAWORTH: Size of polysaccharide molecules.

H. HOLTER and K. LINDERSTRÖM-LANG: Distribution of enzymes in protoplasm.

E. PHILIPPI, F. HENDGEN and F. HERNLER: Synthesis of doubly substituted 6,6-dihydroureil.

ST. J. v. PRZYLECKI: The properties of proteins as a function of their fine structure.

R. SEKA and G. PROSCHE: A new synthesis of chrysin and other oxyflavones.

E. SPÄTH: Natural coumarin and its action on fish.

G. F. HÜTTIG: Reactions involving solid substances.

G. JANTSCH and K. KLEIN: Halides of the rare earths (10). Melting points, with particular reference to the bromides.

G. JANTSCH and E. WIESENBERGER: Compounds of the rare earths involving high valencies (2). Dysprosium oxide.

R. KREMANN and O. FRUHWIRTH: Ultra-violet absorption and orientation polarization of binary mixtures. Allyl mustard oil and piperidine.

W. LOTMAR and H. H. MEYER: Fine structure of crystallized caoutchouc.

W. J. MÜLLER and E. NACHTIGALL: Passivity (30). Anodic passivity of magnesium in acid solutions.

W. PAULI and A. BACZEWSKI: Preparation of a platinum sol (2). Platinum hydrosol.

I. N. STRANSKI: Calculation of the specific surface, edge and corner energy of small crystals.

KARL SCHWARZ and RÜDIGER STOCKERT: Diffusion constant and valency of silver in liquid silver amalgams.

G. BREUER and J. SCHNITZER: Cyclohexylamine and *N*-dimethylcyclohexylamine.

F. LINDMAIR: Accuracy of trichromatic colour measurements.

F. SEIDL: Electrical conductivity of solidified melts of Rochelle salt crystals.

PH. FURTWÄGLER and O. TAUSKY: Skew circles.

PH. FURTWÄGLER: A theorem on determinants.

Forthcoming Events

Wednesday, January 6

INSTITUTE OF WIRELESS TECHNOLOGY (LONDON AND HOME COUNTIES SECTION).—H. J. Barton Chapple: "High Definition Television".

Thursday, January 7

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—B. L. Goodlet: "Lightning".

Friday, January 8

ROYAL SOCIETY OF ARTS, at 3.—Prof. G. T. R. Hill: "How We Fly" (Dr. Mann Juvenile Lectures. Succeding lecture on January 13).

Saturday, January 9

BRITISH ECOLOGICAL SOCIETY, at 10.30.—Annual General Meeting to be held at University College, Gower Street, London, W.C.1.

Dr. W. H. Pearshall: "The Soil Complex in Relation to Plant Communities" (Presidential Address).

CONFERENCE OF EDUCATIONAL ASSOCIATIONS, January 4-11.—Twenty-fifth Annual Conference to be held in University College, Gower Street, London, W.C.1.

January 5, at 5 p.m.—The Right Hon. W. Ormsby-Gore: "Some Educational Problems of our Colonial Empire" (Presidential Address).

MATHEMATICAL ASSOCIATION, January 4-5.—Annual meeting to be held in the Institute of Education, Southampton Row, London, W.C.1.

January 4, at 3.15.—Prof. A. R. Forsyth, F.R.S.: "Applied Mathematics in School Training: Some General Considerations" (Presidential Address).

PHYSICAL SOCIETY, January 5-7.—Annual Exhibition to be held at the Imperial College of Science, South Kensington, S.W.7.

January 5.—Sir James Swinburne: "Electrical Measurements in the 'Eighties, particularly those associated with Ayrton and Perry".

January 6.—Dr. Harry Moore: "The Influence of Industrial Research on the Development of Scientific Instruments".

SCIENCE MASTERS' ASSOCIATION, January 5-8.—Annual Meeting to be held at the University of Manchester.

Dr. J. S. B. Stopford, F.R.S.: "Aims of Biology in Education" (Presidential Address).

CONFERENCE ON MECHANIZED FARMING, January 5-8.—To be held at Rhodes House, Oxford.

GEOGRAPHICAL ASSOCIATION, January 5-7.—Annual Conference to be held at the London School of Economics, Houghton Street, Aldwych, London, W.C.2.

January 7, at 10.—Sir Josiah Stamp: "Geography and Economic Theory" (Presidential Address).

Appointments Vacant

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

PROFESSOR OF PHYSICAL CHEMISTRY in the University of Cambridge—The Vice-Chancellor (January 30).

UNIVERSITY DEMONSTRATOR IN PATHOLOGY in the University of Cambridge—Dr. F. J. W. Roughton, Physiological Laboratory (March 1).

Official Publications Received

Great Britain and Ireland

Sale of Food and Drugs: Extracts from the Annual Report of the Ministry of Health for 1935-36 and Abstract of Reports of Public Analysts for the Year 1935. Pp. 16. (London: H.M. Stationery Office.) 3d. net. [1412]

ULAWS (The University of London Animal Welfare Society). Tenth Annual Report, 1st October 1935 to 31st July 1936. Pp. 48. (London: The University Union.) [1412]

An Experiment in Co-operative Research in the Cotton and other Textile Industries. By Dr. Robert H. Pickard. (Eighth Gluckstein Memorial Lecture, 1936.) Pp. 19. A Chapter in the Chemistry of Essential Oils. By Prof. John Read. (Nineteenth Streetfield Memorial Lecture, 1936.) Pp. 34. (London: Institute of Chemistry.) [1412]

University College of Wales, Aberystwyth. Survey of the Work of the Agricultural Departments, submitted to the Court of Governors of the College on 21st October 1936. Pp. 135. (Aberystwyth: University College of Wales.) [1512]

Other Countries

Svenska Hydrografisk-Biologiska Kommissionens Skrifter. Ny Serie, Hydrograf 12: Interne Wellen im Kattegatt. Von Börje Kullenberg. Pp. 17. Ny Serie, Hydrograf 13: Untersuchungen von Trägheitsströmungen in der Ostsee. Von T. Gustafson and B. Kullenberg. Pp. 28. Svenska Hydrografisk-Biologiska Kommissionens Fyrskottsundersökning. År 1933. Pp. 45. (Gåseberg: Svenska Hydrografisk-Biologiska Kommissionen.) [1412]

Bulletin of the Central Meteorological Observatory of Japan. Vol. 5, No. 2: The Second Polar Year Report, No. 2: Magnetic Observations at Toyohara. Pp. iii+170+28 plates. (Tokyo: Central Meteorological Observatory.) [1412]

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 39, Part 3: Studies on the Young Fruit-Rot of Apple-Tree. By Yoshihika Shima. Pp. 143-270+plates 3-9. (Tokyo: Maruzen Co., Ltd.) [1412]

Report of the Institute of Scientific Research, Manchoukuo. Vol. 1, No. 1: *Ostercium* and *Angelica* from Manchuria and Korea. By Masao Kitagawa. Pp. 28+10+3 plates. Vol. 1, No. 2: Studies on Mongolian Sheep Wool, I. By Dr. Michio Saito. Pp. 29-62+11-17. (Hsinking: Institute of Scientific Research.) [1412]

Publikace Pražské Státní Hvězdárny. No. 9: Observations photographiques de la planète Eros en 1931. Par V. Nechvíle, en collaboration avec V. Guth, J. Štěpánek et feu J. Kaván. Pp. 10. No. 10: Sur les méthodes de réduction des observations astrophotiques et le calcul des positions d'Eros en 1931. Par V. Nechvíle. Pp. 34. (Prague: Pražské Státní Hvězdárny.) [1512]

U.S. Department of Agriculture. Circular No. 409: The Effect of Thallium on Plant Growth. By E. E. Horn, Justus E. Ward, James C. Munch and F. E. Garlough. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents. [1612]

Bulletin of the Experiment Station of the Hawaiian Sugar Planters' Association. Agricultural and Chemical Series, Bulletin No. 50: Soil and Plant Material Analyses by Rapid Chemical Methods. By Francis E. Hance. Pp. 187-300. (Honolulu: Hawaiian Sugar Planters' Association.) [1612]

Cornell University: Agricultural Experiment Station. Bulletin 652: Storage and Germination of Seeds of Aquatic Plants. By W. C. Muenscher. Pp. 17. Bulletin 653: Soils in relation to Fruit Growing in New York. Part 9: Tree Behavior on Important Soil Profiles in the Newfane-Olcott Area, Niagara County. By Joseph Oskamp. Pp. 20. Bulletin 656: Use and Value of Highways in Rural New York. By W. M. Curtiss. Pp. 30. Bulletin 657: Local Government in Tompkins County, New York. By T. N. Hurd. Pp. 44. Bulletin 658: Variations in Town Taxes in New York. By M. P. Catherwood. Pp. 44. Bulletin 659: Receipts and Expenditures of 876 New York Towns in 1934. By M. P. Catherwood. Pp. 50. Bulletin 660: The Vitamin-G Requirement of Poultry. By L. C. Norris, H. S. Wilgus, Jr., A. T. Ringrose, Victor Heiman and G. F. Heuser. Memoir 190: Some Factors influencing Growth and Fruit-Setting in the Pepper (*Capsicum frutescens* L.). By H. L. Cochran. Pp. 39. Memoir 191: Effect of Relative Humidity on the Growth of Mold on Eggs in Storage. By Paul F. Sharp and George F. Stewart. Pp. 12. (Ithaca, N.Y.: Cornell University.) [1612]

Zoologica. Vol. 20, No. 3: Deep-Sea Fishes of the Bermuda Oceanographic Expeditions. No. 3: Family Serrivomeridae. By William Beebe and Jocelyn Crane. Pp. 53-102. (New York: New York Zoological Society.) [1612]

Catalogues, etc.

Neue Bücher für naturwissenschaftlich Gebildete. Pp. 16. (Jena: Gustav Fischer.)

Calendar for 1937. (London: British Museum (Natural History).)

Modern Gas Equipment for Laboratories. (GT 1167.) Pp. 12. Toxic Gases Detection Apparatus. (GT 1165.) Pp. 2. (London: Griffin and Tatlock, Ltd.)

A Catalogue of Rare and Valuable Works. (No. 528.) Pp. 160. (London: Bernard Quaritch, Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 2, No. 11, December. Pp. 31-44+iv. (London: Wild-Barfield Electric Furnaces, Ltd.) Caxton Head Bulletin No. 20. Pp. 30. (London: James Tregaskis and Son.)

Catalogue of Watson Microscopes. Parts 1 and 2: Microscopes and Accessories for all the Biological Sciences. Thirty-sixth edition. Pp. 260. (London: W. Watson and Sons, Ltd.)

Calendar for 1937. (London: The Chemical Trade Journal.)