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The University in Modern Life

MORE than one discussion at the recent meeting of the British Association at Nottingham raised questions about the fundamental purpose and functions of the university in modern life which went far beyond the immediate practical problems under discussion. Some of these problems—for example, the part of the university in education for citizenship—had been raised at the conference arranged by the Association for Education in Citizenship at Ashridge in July, while since the Nottingham meeting a lively attack on the inadequacy of the universities in regard to adult education has been delivered by Prof. L. Hogben in a paper "Education for an Age of Plenty" at the conference of the British Institute of Adult Education at Cambridge.

Prof. Hogben criticized the universities for not supplying directly the instruction which is immediately helpful in the task of salvaging democracy, and argued for more courses on public health, nutrition, the social services and the economics of everyday life. The university, of course, teaches the way to sources of such information, but for adult education a special technique is required and its curriculum is not necessarily that which should be followed by the university itself. As Mr. W. Spens pointed out at Ashridge, the university should be an introduction to later life and assist the initial understanding of problems rather than the formulation of conclusions or actual participation in political or economic contests.

The tribute paid to the Modern Greats course at Oxford in itself shows that even in education for democracy the universities have scarcely been so deficient as Prof. Hogben would appear to suggest. None the less, the many and diverse concrete suggestions which have been made as to the courses which a university should provide and the functions it should fill in a modern democratic society indicate that some fundamental reconsideration of their position is called for if their work is to be reorientated or planned to the better advantage of the community.

Most of the recent criticism of the universities has been concerned with their teaching functions, and a remarkable consensus of opinion has argued that this should be aimed more specifically at imparting the ideal of service and in training for citizenship and for leadership. In the discussion at Nottingham on the training of university graduates for the engineering industry, the importance of a broad training and one which stimulated participation in everyday affairs was repeatedly emphasized by different speakers. It was equally remarkable that not only was premature specialization in technical subjects recognized as undesirable, but also a definite suggestion was made, by Dr. A. P. M. Fleming, that the post-graduate instruction in the highly specialized and technical branches of engineering is a responsibility which the more progressive and larger industrial firms might well be expected to assume.

The significance of this suggestion lies, at least in part, in the fact that it was made by a representative of one of the most progressive firms in Great Britain, who himself has made an important contribution to technical training in that field. Obviously a proposal of this kind would involve very careful examination by all concerned before it could be adopted, but that it should be made at all indicates at least the existence of an atmosphere and a spirit of co-operation, in which the reorganization or reorientation of university courses to avoid overloading or excessive specialization and

to encourage all-round training, creative and independent thinking and the development of personality becomes practicable. The plea for the provision of travelling scholarships for the further training of immediate graduates, to be maintained by industrialists, which Mr. R. H. Clayton has since made in his presidential address to the Manchester Literary and Philosophical Society, is another indication of the increasing readiness of the industrialist to co-operate.

We are here, of course, once more faced with the old question as to whether a university training should be primarily to give the knowledge required to qualify men and women for some special mode of gaining their livelihood, or to equip them as members of society and as human beings. It seems to be clear from almost all recent criticism of the training of scientific workers such as engineers and chemists, however, that under modern conditions even the first objective cannot be realized if the second is neglected. Alike in industrial, commercial and civic life a sense of values and of perspective is demanded of those who hold responsible positions in management or even in the direction of research itself.

The very complexity of the problems with which leadership is confronted in society to-day emphasizes the importance of the cultural elements in a university training, not only because of the large number of those who become leaders in the national life who must have been under its discipline, but also because of the importance of critical intelligence in the rank and file of democracy. Premature or excessive specialization in any branch of science, or indeed elsewhere, is now almost universally condemned, and the dictum that the only specialization at a university should be specialization in the fundamental principles of the science as subject studied commands general support. Dr. Fleming's suggestion, if taken up, might well assist both the universities and the technical colleges to avoid some of the dangers of the past and to concentrate on the fundamental task of turning out trained minds, able to absorb knowledge later in life when left to their own resources, and to take their proper part in the life of the nation.

However important the teaching function of the university may be, the training of men is only one of these functions. Equally important is the conservation of knowledge and ideas. Under present conditions, indeed, as the report of the University Grants Committee pointed out, an exceptional responsibility rests on British universities owi to the suppression in the universities of sever European countries of all independent thoug and critical discussion of the principles of gover ment or of the meaning of life. Moreover, as Pr M. Ginsberg pointed out in a thoughtful addre in Section L (Educational Science) of the Briti Association on the functions of the universities regard to the social sciences, there are importa contributions which university study can offer the clarification of the issues involved in ma social and economic problems to-day, alike regard to methods and assumptions made by t social sciences and in regard to the problem values and moral issues. It was never mo imperative that universities should be plac where thought and disinterested inquiry a pursued on the highest level, and where the be minds of each generation are trained for intellectu achievement. The undoubted need for a r orientation of our research effort so as to secu a more equable distribution between the soci and biological and the physical sciences should n lead us to limit in any narrow spirit the fund mental researches which the university may initia in any branch of knowledge, or to seek to influen its strictly theoretical approach to such problem Never, indeed, was it more important that t fundamental research pursued in the universiti should be pursued in a spirit entirely free fro bias, prejudice or preconceived ideas.

Significantly enough, in the very address which he suggested that large-scale indust should assume some responsibility for specializ technical training in engineering, Dr. Flemi stressed the opportunities for co-operative resear which exist in the engineering departments of t universities but which at present, largely f financial reasons, are far from being fully utilize Especially is this true of research in borderli subjects which are often outside the scope of industrial research laboratory. In research no le than in teaching, the possibilities of co-operati between the universities and industry have y to be fully explored and developed, and co-oper tion in the way indicated by Dr. Fleming is like to strengthen rather than impair the independen and resources of the university in regard to lon range and fundamental research on problems t practical bearing of which cannot yet be fo seen.

Under modern conditions, however, it has be suggested that these important functions,

teaching and training men, and research for the advancement of knowledge, are by no means the only functions which are required of a university. In our swiftly changing world, instructional studies ceases at about twenty-three years of age, and a man is very liable to lose intellectual energy by the time he is forty, and so fail to keep up with advancing knowledge. Sir Richard Livingstone, speaking in Section L at Nottingham, made a powerful plea that the universities should give attention to this problem of arranging systematic refresher or vacation courses at which those especially who occupy responsible positions in industrial, commercial or professional life, whether as managers or directors, should be able to refresh, re-equip and reorientate their minds and guard against the ever-present danger which the numbing effect of routine involves.

Here again, as Sir Richard Livingstone pointed out, is another field for co-operation between industry and the universities. If the special type of adult education required, enabling the student to place his special subject against the background of modern civilization, can only be supplied by the universities, the arrangement of such courses largely depends on the extent to which industry, commerce and the professions are willing to second promising officials for such systematic study. Moreover, it is probable that such a system offers the best means of giving the training in administration and management which is now generally recognized to be so important for those destined to fill the highest positions of management and control in industry. Apart from that, the contact thus established between the university and those with considerable practical experience of industry and the world of affairs can scarcely fail to have a very stimulating and helpful effect on the study of the social sciences at the university itself.

If, therefore, the universities are being called to reconsider their exact functions in our rapidly changing modern society, there is no less insistent call to industry and to society to consider their own relations with the university. The university cannot exercise the new functions unless the society in which it lives recognizes their value and is anxious that they should be performed. Not even in the training of men, whether for citizenship or for industry and the professions, can the university realize its highest ideals unless other sections of the community are prepared to co-operate with it, both by seeing that those entering a university have received an adequate general training, including some for citizenship upon which the university can base its own contribution, and by assisting in the provision of the detailed technical training required to equip those leaving the university for some particular vocation or branch of industry. The redistribution of research effort in relation to the fundamental needs of society and the planning of the reconditioning courses visualized by Sir Richard Livingstone demand as much thought from society as a whole as from the universities. In considering, therefore, the criticism which has been levelled at the universities in recent months, it should not be forgotten, that the highest traditions of the university can only be realized in a community which is willing to co-operate generously with the university. Not even the material endowments of a university are of more vital importance than a true harmony of spirit in which the highest ideals of a university are cherished without as within its walls, and where the community no less than the university is concerned that the tradition of candid and intrepid thinking about the fundamental issues of life shall be handed on unimpaired from one generation to another.

A Life of Lord Haldane

Haldane, 1856-1915:
the Life of Viscount Haldane of Cloan, K.T., O.M. By Major-General Sir Frederick Maurice. Pp. xv + 394 + 8 plates. (London: Faber and Faber, Ltd., 1937.) 18*s*. net.

VOLTAIRE'S saying, "We owe consideration to the living; to the dead we owe truth only", would have been accepted by Lord Haldane. His autobiography was published soon after his death; and a leading article in NATURE of April 20, 1929, discussed especially his services to science and education as set out therein. But Haldane, always an exceptional man, showed a diffidence in his last testament contrasting strangely with the somewhat arrogant conceit of his years of power. The personalities of the small group of politicians who held the destiny of the Empire in their hands during the pre-War years will always be of interest. Haldane's life should be a compulsory subject of study for politicians.

Ironically, Sir Frederick Maurice's life of Haldane, who was a believer in 'wholeness', has been divided into two parts, and the biography is to be published at an interval of a year or so in two volumes. The year 1915, when Haldane's army reforms were being submitted to war's arbitrament and he himself was dismissed from office as Lord Chancellor, forms a natural line of division. To the scurrilous abuse heaped upon Haldane during this hectic year, the answer is now provided. His work in creating the Expeditionary Force is fully justified; and documentary evidence is produced that he urged its dispatch without delay to the seat of war. Some of his highly sculptured reforms proved to be 'snowmen'. His "General Staff", the brains of the Army, melted away at the outbreak of war; his Territorial Army, dubbed by Kitchener as the "Town Clerk's Army", was not used, as Haldane urged on Kitchener that it should be used, as the basis of military expansion. There were faults in his military policy—especially his failure to deal effectively with the grave question of the officering of the Army. The writing must surely have been legible on the wall of the War Office. "If there is one thing," Sir Coleridge Grove told the Military Education Committee on May 16, 1901, after the South African War, "which was shown by the war more absolutely than anything else, it is how enormously short we are of officers at the outbreak of any war. . . . In this last war, I had to get by any means that I could, over 2,000 officers additional to our usual supply in 15 months."

Two thousand officers! A bagatelle compared to the number of officers required during the Great War. Haldane's creation of the Officers Training Corps was a contribution of great value to this problem; but the role of the Corps after mobilization received no attention. The *liber aureus* concerned itself with the outbreak of war. Afterwards we followed our traditional policy of 'muddling through'. That gifted woman, Gertrude Bell, in one of her letters, remarked that "when people talk to me of our muddling through it throws me into a passion. Muddle through! Why, yes, so we do—wading through blood and tears that need never have been shed." Since the War, there has not been much disposition to brand the culprits for our sins of omission and commission. Silent and abashed we stand before the Cenotaph. In any impartial audit, Haldane's record will show a substantial balance on the credit side.

It is, however, Haldane's services to science and education with which we are chiefly concerned. He was an early convert to the idea of the civic university. Disbelieving in the federal conception as exemplified in the Victoria University of Manchester, he gave evidence before the Privy Council and assisted in its disintegration. He worked also for the Bill of 1898 which purported to create a civic university in London. His speech in Parliament on that subject is reprinted. "This speech completely changed the atmosphere in the House, and when Balfour, who had come in to help his friend, rose and appealed to the opponents to withdraw their opposition the motion against the second reading was withdrawn." In this speech, Haldane invoked the late Prof. Huxley, "who was a distinguished advocate of this Bill, and who gave evidence before the Royal Commission, in which he laid down a scheme for a university which is now practically embodied in the Bill".

If space permitted, it would be of interest to contrast Huxley's noble conception of a reorganized University of London with the reality. Haldane followed his success with a scheme for establishing a London Charlottenburg at South Kensington. This in the result took an entirely different form from the original plan. "Haldane persuaded Sir Francis Mowatt, then Head of the Treasury, to agree that they [the Royal College of Science and the Royal School of Mines] should be incorporated in his plan." These institutions, by the way, had not "grown out of" the 1851 Exhibition and were administered by the Science and Art Department, not by the Treasury. Mowatt had no more right to de-nationalize them than to give away the King's battleships. Associates and students, traditions and trusts, should not be treated as chattels, even by Parliament. The Government was defeated in 1873 on a question relating to colleges in Ireland; and Gladstone tendered his resignation to the Queen.

We should hesitate to admit that the Imperial College of Science and Technology was "one of the great monuments of Haldane's vision and skill as a negotiator". The question of the proper relation of the technical college to the university was left open. Haldane tells us in his autobiography that he had been unfavourably impressed by the divorce of technical education and university education in Germany and resolved to work for a different plan. The close association of the London Charlottenburg, as originally proposed, with the University of London was fundamental, and the first public announcement was addressed to Lord Rosebery as chancellor of the University.

If Haldane had carried through the original scheme, for which he collected large funds, no trouble would have arisen. Controversy arose under the modified scheme, leading to the appointment of the Royal Commission of 1907. The immediate object of this was to define the relationship which should exist between the Imperial College of Science and Technology and the University, but "at Haldane's suggestion the terms

of reference were widened into an inquiry into the working of the university and the development of advanced education in London".

This suggestion fostered animosities between people who should have been working together *ad majorem gloriam Universitatis*, and deflected an enormous amount of energy in order to create another 'snowman' to add to Haldane's comprehensive collection. To vary the metaphor, Haldane overlaid his own child. The new statutes had been in operation for only a few years. It was unfair to subject the nascent university to an examination only appropriate to an adult organization. The recommendations of the Royal Commission over which Haldane presided "led eventually to the preparation of new statutes". This proposition may be arguable; but the historian should have recorded that the reconstitution of the University under the Act of 1926 bore little if any resemblance to that recommended by the Haldane Commission.

Sir Frederick Maurice, not being a compost of politician, jurist, philosopher (Hegelian and Epicurean) and educationist, will not claim to be the ideal biographer of this multifarious personality. He has performed a useful task, for which readers in the present and historians in the future will be grateful. Ink is thicker than water, and it was impossible to disguise the fact that Haldane was by nature an intriguer. He must have created a new precedent in writing in 1905 to the King's private secretary to recommend his own appointment as Lord Chancellor—"The Woolsack for me"; and his disloyalty to his own leader, Campbell-Bannerman, stands revealed. "He never sought popularity, and he was not the type of man to whom it came naturally." This is a frank admission. We have to remember, on the other side, the loyalty of some of his friends, particularly Grey and Asquith and Haig. The tributes exchanged in 1915 between Grey and Asquith, reprinted in Trevelyan's "Grey of Falloden" but not published at the time, should have been included. "I cannot express to you," Grey wrote to Asquith on January 25, 1915, "how indignant I feel about the attacks on Haldane"; and Asquith in his reply, after regretting that Haldane was "very much disliked by my own political party", added, "Personally I like Haldane".

T. LL. H.

The Physical Interest of Eclipses

Eclipses of the Sun and Moon

By Sir Frank Dyson and Dr. R.v.d.R. Woolley. (International Series of Monographs on Physics.) Pp. viii + 160 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15*s*. net.

THE chief importance of this book for most readers will lie in the full discussion that it offers on the knowledge as to the physical state of matter in the outer layers of the sun that has been derived from eclipse observations. Naturally there are interesting chapters on the causes and the prediction of eclipses, on the Saros, on lunar eclipses and on the secular accelerations of sun and moon. These chapters cannot contain much new material, but they do give useful references, especially for the last-named subject. We note here one gap in the chapter on the prediction of eclipses that might well be filled in future editions: a reference, at least, might have been given to Dr. Comrie's corrections for a small difference in position in the site of an eclipse camp from the one for which complete data may have been calculated in advance. This would add to the usefulness of the book for an observer on an eclipse expedition.

As was to be expected with Sir Frank Dyson as one of the authors of the book, a full discussion is given of the deflexion of light by the sun's gravitational field. The conclusion reached that Einstein's prediction has been verified, though there may be a small additional displacement to be attributed to some other cause, will be one with which few will quarrel. That future eclipse observations of the Einstein effect should only be attempted when the sun is surrounded by a good field of stars is a sound piece of advice.

An interesting account of the older eclipse observations is given, but some of the space occupied by the account of the early controversies might have been better used, for example, in expanding for the benefit of future observers the chapter on eclipse expeditions and instruments. The most valuable part of the book lies in the account of recent published work, both observational and theoretical, on the chromosphere and corona. Very little has been missed, the most noticable perhaps being the theory of the corona by von den Pahlen and Kohlschütter (*Veroff. d. Sternw. zu Bonn*, 24). Full attention has properly been paid to the successful results obtained at recent eclipses by Grotrian and von Klüber, and also to the beautiful work on the corona carried

out without eclipse at the Pic du Midi by Lyot. It looks as though we are within sight of the day when the occasional observation of the corona will be replaced by regular daily observations, either by direct photography or by some method such as that now being tried out by the Bell Telephone Company with the aid of television apparatus. Save for the extreme ultra-violet spectrum and for faint extensions, the corona may soon follow the prominences and drop out of eclipse programmes, leaving the field clear for the eclipse observer to concentrate on the important spectrophotometric problems connected with density gradients in the chromosphere and the transition stages at the limb between absorption and emission levels.

It is to be hoped that a future edition will contain a subject index as well as the index of names. There are one or two slips to be corrected. The date of the eclipse observed by Dufay and Grouiller (p. 133) is 1932 and not 1936; the observations are the same as those mentioned two pages earlier and not a confirmation of them. The duration of totality for the observers in 1926 in Sumatra (p. 57) was 3·2 min. not 4·2 min., which was the maximum possible time of totality for the eclipse. Further, there seems no reason why the principal coronal line at 5303A. should be omitted from the list of coronal lines (p. 149) observed in RS Ophiuchi at its outburst in 1933.

The mention of these minor slips must not obscure the high value and interest of the work to those interested in eclipse observations. The physicist will find the first connected account both reasoned and critical of all recent work on the chromosphere and corona. The observer will have his attention directed to the observations needing confirmation and to the more important problems requiring elucidation. F. J. M. S.

Pond Life

Ferskvandsfaunaen, biologisk belyst: Invertebrata. Af Prof. Dr. C. Wesenberg-Lund. Bind 1. Pp. vi + 414 + 12 plates. Bind 2. Pp. iv + 415–837 + plates 13–24. (København: Gyldendalske Boghandel, 1937.)

IN 1915 Prof. Wesenberg-Lund published a volume entitled "Insektlivet i ferske Vande" in which he gave a semi-popular account of the life-histories and habits of freshwater insects, based largely on the researches of himself and his pupils. As he explained in the preface, one of his objects was to make available to his countrymen, in their own language, the results of researches that had, for the most part, been published in foreign scientific periodicals and in foreign languages. With the same object in view, he has now produced in these two handsome volumes a survey of the remaining groups of invertebrates inhabiting fresh water, omitting the Protozoa, which stand apart and would require a volume to themselves. The theme of the work is the 'biology' (in the German sense) of the animals, their habits and mode of life. Systematics, anatomy and development are considered only in so far as they bear on this subject. At the same time, the abundant and excellent illustrations should enable the student to identify, at least approximately, most of the common species found in Denmark. Since 1930, the author has been director of the freshwater biological station established by the Carlsberg Foundation at Hillerød, and while the researches carried on there have supplied much of the material for the book (including some hitherto unpublished matter) the survey has been extended to include brief accounts of the freshwater fauna of other parts of the world.

The first volume opens with a memorial notice of Otto Frederik Müller, the great Danish naturalist of the eighteenth century, who was a pioneer in the study of freshwater invertebrates. It is of interest to learn that thirty years ago Wesenberg-Lund drew much of his material from the very fish-ponds in which Müller had worked a century and a half before. Nowadays, it is sad to learn they are all filled up or so polluted as to be of no further use to the naturalist. The author of the present work has, indeed, much in common with the naturalists of the eighteenth and early nineteenth centuries, whose powers of observation he commends and whose exquisite copper-plate engravings he reproduces in many of his illustrations. Like them, he is primarily interested in the living animals, and although he takes account of the physical and chemical data supplied by modern limnology, the study of the environment is subsidiary to the study of the organism. For him, the microscope is still a more important tool than the thermometer or the photo-electric cell.

In a work of such wide scope it was perhaps inevitable that the treatment of the various groups should be somewhat unequal. The most detailed and interesting chapters are those devoted to the

subjects of the author's own special researches. Thus we have very full accounts of the life-cycles and of seasonal and local variations in planktonic Cladocera and Rotifera, of the wonderful sporocysts of *Leucochloridium*, of the post-embryonic development of Hydracarina, and of the Polyzoa. A particularly attractive chapter is that dealing with the habits of the water spider *Argyroneta*.

Naturally there are omissions and occasional errors in dealing with groups with which the author is not personally so familiar. That favourite of the amateur microscopist, the rotifer *Melicerta ringens* (which we ought now, deplorably enough, to call *Floscularia*) does not build a wonderful tube with *fæcal* pellets, although some of its congeners do. The author frequently quotes the work of British zoologists, but there are lamentable gaps, showing that he is less in touch with their work than with that of their Continental colleagues. If he had been a more assiduous student of NATURE he would not have overlooked Lowndes' remarkable discovery of *Bathynella* in England, nor would he have failed to notice Gurney's fine monograph of the British freshwater Copepoda published by the Ray Society.

Prof. Wesenberg-Lund expresses the hope that the work may be found of use by the teaching profession. It would certainly be of much use both in schools and in universities in Great Britain to any teachers who would take the slight amount of trouble necessary to acquire a reading knowledge of the Danish language. W. T. C.

Medical and Psychological Aspects of Sociology

A Social Problem Group?

Edited by Dr. C. P. Blacker. Pp. vii + 228. (London: Oxford University Press, 1937.) 15*s*. net.

IN addition to a foreword by Mr. D. Caradog Jones, who explains the interrogation mark of the title by the intention to raise questions in the reader's mind, and a masterly introduction by the editor, this volume contains nine essays dealing with various aspects of the subject.

The first article, by Dr. A. A. E. Newth, senior school medical officer of the City of Nottingham, on the mentally retarded child, is based on a study of 1,872 children attending elementary schools in the area, of whom 1,388 were feeble-minded and 484 idiots and imbeciles. In his contribution on mental disorder and the social problem group, Dr. Eliot Slater, assistant medical officer to the Maudsley Hospital, has analysed 155 cases of adults receiving public assistance, and comes to the conclusion that apart from mental disorder the social problem group includes considerable numbers of psychopathic persons.

Dr. Tylor Fox, medical superintendent of the Lingfield Epileptic Colony, in a paper based on the study of 250 epileptic children of both sexes, maintains that no answer can be given to the question whether epileptics should rank in the social problem group.

The relation between inebriety and the social problem group forms the subject of a paper by Dr. C. W. J. Brasher, illustrated by cases under his observation at Woodlands Park, where he was formerly medical superintendent. He comes to the conclusion that psychiatrists are generally agreed that parental and especially maternal inebriety has a profoundly injurious effect on the physical and mental development of the offspring, and that by some means the hereditary disposition to alcoholism is transmitted. Mrs. Sybil Neville-Rolfe, secretary-general to the British Social Hygiene Council, who writes on the biological aspects of prostitution, maintains that the prostitute is a social problem, and should be studied as such, mentally subnormal, psychopathic and over-sexed women forming a considerable proportion of those in the lower ranks of prostitution.

In his article on recidivism and the social problem group, Dr. W. H. de R. Hubert, psychotherapist to Wormwood Scrubs prison, claims that there is a definite relation between recidivism and the social problem group, although there are many gaps in our knowledge of the subject. Mr. E. J. Lidbetter's essay on the social problem group as a public charge contains a number of pedigrees showing the relation between psychological abnormality and destitution. Miss Janet Galloway, psychiatric social worker at the Maudsley Hospital, who writes on neurasthenia and unemployment, has made an elaborate analysis of 52 cases, including family histories, educational attainments, past occupations, military service, age at marriage, number of children, duration of unemployment and neurasthenia, income, housing conditions, food and treatment. The final contribution, by Mr. Caradog Jones, entitled "A Note on the Definition of the Social Problem Group", contains a survey of the previous articles.

The book may be warmly recommended to those interested in eugenics, anthropology, sociology and criminology.

Weeds, Weeds, Weeds

By Sir Charles Vernon Boys. Pp. 72. (London: Wightman and Co., Ltd., 1937.) 1*s*. net.

THIS charming little book relates the practical experiences of a very keen observer in eradicating by various methods the common weeds of his farms and gardens.

The earlier pages deal with lawns; the standard lawn sands have proved highly successful, but Sir Charles may have been a little more fortunate than other gardeners on chalk soils, where eradication of weeds from lawns is frequently difficult. A recipe for lawn sand would perhaps help readers who desire to make their own mixtures.

The author has thoroughly tested sodium chlorate as a weed killer against nettles and many other plants, and he recommends its use on drives and paths. He carefully points out the fire danger, and how it may be avoided. The reviewer has seen sodium chlorate effect a thorough clearance of some thousands of the lesser bindweed, pushing up through the surface of a newly made hard tennis-court. Care must be used to avoid any undesirable firework displays during subsequent play! By the liberal use of the hose the chlorate can be washed down below the granite chips, which dry rather slowly when the chlorate is used. Recent letters in *The Times* show the potency of this chemical in eradicating the troublesome *Aegopodium podagraria* L., well known as goutweed, or bishopsweed as it is inappropriately called, for bell, book and candle fail to exorcise it. The author well deserves to be free from such a diabolical weed; there is but brief mention of it.

There are many other practical hints of great value to the gardener concerning humus, monkey jacks and tools. Only a few generic names, for example, *Plantago*, escape a capital letter. This book is truly wonderful value at the price. M. A. H. T.

Borderlands of Language in Europe: and their Relation to the Historic Frontier of Christendom.

By Vaughan Cornish. Pp. x+105. (London: Sifton Praed and Co., Ltd., 1936.) 6*s*. net.

As an exponent of human geography, Dr. Vaughan Cornish is always stimulating. In the present study, he deals with the debatable borderlands of Europe. As the result of an examination of linguistic frontiers, in which he has traced their history backward, he has in almost every instance been able to arrive at a definite date of origin for such borderlands. This he finds falls within the period when the district under investigation was situated on the frontiers of Christendom. In the west, these linguistic boundaries perpetuate conditions in the political geography of Europe at the time of the collapse of the Western Empire. Thus, for example, the line of demarcation between French and German near Belfort follows the line of the political frontier between Christian Burgundians and heathen Alamannians in the fifth and sixth centuries; while an even more striking instance of the politico-religious frontier is to be seen in the German-speaking population of the Italian province of Alto Adige, who are the survivors of heathen Bavarians who crossed Rhaetia and retained their pagan customs in the mountains until 730. The like argument is applied to the linguistic frontiers of eastern Europe. For these studies the author stresses the importance of the ecclesiastical map of medieval Europe, which is brought out most clearly in his examination of conditions in Bosnia, as a borderland of nationality and race, where peoples of the same language joined different churches.

Biology for Medical Students

By C. C. Hentschel and Dr. W. R. Ivimey Cook. Pp. xii + 664. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 18*s*. net.

THE second edition of this well-known text-book has been modified to cover the joint syllabus of biology for medical students adopted by the Universities of Oxford and Cambridge, as well as to satisfy the students in the University of London. This has involved descriptions of *Fucus* and several green algæ, *Peronospora* among the fungi and the cockroach as an example of an insect.

Apart from these additions, the whole text has been revised and brought up to date.

In spite of the syllabuses, however, the text seems to contain too much for a medical student to grasp in his first year, for he is not studying the subject as a biologist but rather as an aspirant to different ends, using biology as a basic science to his more specialized and more relevant studies. This applies especially to the chapter on evolution and heredity.

The book, however, is well written and as such would form a very desirable introduction for students of biology itself. But while medical students are forced to read such (to them) detailed material in their first year, it is no wonder that the majority of them dislike the subject and ask why they should suffer it.

Systèmes de référence et mouvements (physique classique)

Par Prof. Augustin Sesmat. 5: L'Optique des corps au repos. Pp. 365–484. 18 francs. 6: L'Optique des corps en mouvement. Pp. 485–614. 20 francs. 7: L'Esprit de la science classique. Pp. 615–688. 12 francs. (Actualités scientifiques et industrielles, 483–485.) (Paris: Hermann et Cie., 1937.)

THE issue of parts 5, 6 and 7 completes the above volume in this series on classical physics; it is to be followed by one dealing with relativity physics. The present parts cover pre-Fresnel optics, the general theory of wave motion, the electromagnetic theory of Maxwell and the electronic theory of Lorentz, the influence of movement of the source or of the medium on the propagation of light, the drag of the medium, the experiments to test the theories, including those of Michelson, the origin of the idea of action at a distance, material points and their relations, physical time and simultaneity, relativity in physics. The volume concludes with a bibliography of ten pages.

The Pleistocene History of the West Midlands*

By Prof. Leonard J. Wills

THE DIFFERENT TYPES OF DRIFT AND THEIR DISTRIBUTION

THE region I propose to deal with is bounded on the west by the north-south line of hills from the Clees in Shropshire to Malvern; on the south by the Cotteswold escarpment; and on the east by the watershed surrounding the headwaters of the Avon. Its northern limit may be defined by a line from Iron Bridge to Wolverhampton, Lichfield, Tamworth, Nuneaton, Rugby. Within these boundaries there are the two great *vales of Severn and Avon*, embracing on the west, south and east a triangular plateau drained by the Cole, Blythe and Tame, which carry its waters away northwards to the Trent. In this '*Midland Plateau*' is the high ground of the South Staffordshire coalfield reaching, via the Lickey Hills, into East Worcestershire and West Warwickshire, and into the high ground of the East Warwickshire coalfield: the lower ground of the Cole and Blythe valleys between these heights is itself elevated—an upland rather than a vale.

The greatest anomaly in the topography is the valley of the Severn, which is cut, first as a gorge, through what should be a major watershed at Iron Bridge, and later as a sort of groove along the west side of the great vale-like depression the centre line of which lies a few miles to the east. It is probable that in pre-Glacial times the upper Severn went to the Irish Sea, that the watershed of England separated it at Iron Bridge from the middle and lower Severn, which then had its source where now the Worfe rises. From here it may have followed the line of the great depression now occupied by the valleys of the Worfe and Claverley Brook, the Lower Stour, the Elmley Brook and Salwarpe, and the Bow and Piddle Brooks.

A thorough appreciation of the vast extent to which erosion has gone on, and of the enormous length of time involved, at once helps us to understand the apparently anomalous distribution of Glacial drifts in this region, in which, as a rule, the vales and lower ground are free from Glacial deposits, whereas the higher country and the watershed areas are extensively and often heavily drift-covered—a disposition that is the exact converse of the usual arrangement in a glaciated region. I shall attempt to show in the sequel that the drifts formerly extended beyond the regions where they now form large outcrops, and that their absence from an area need not be taken as an indication that it was never under ice.

The drift-covered areas may be grouped in relation to the major watersheds, as follows:

(1) Watershed between the *Tern* and *Penk* on the north and the *Severn*, *Worfe* and *Smestow* on the south, and between the *Penk* and the *Shenstone Brook*. Towards the north-west it is continuous with the heavily drift-covered plain of North Shropshire.

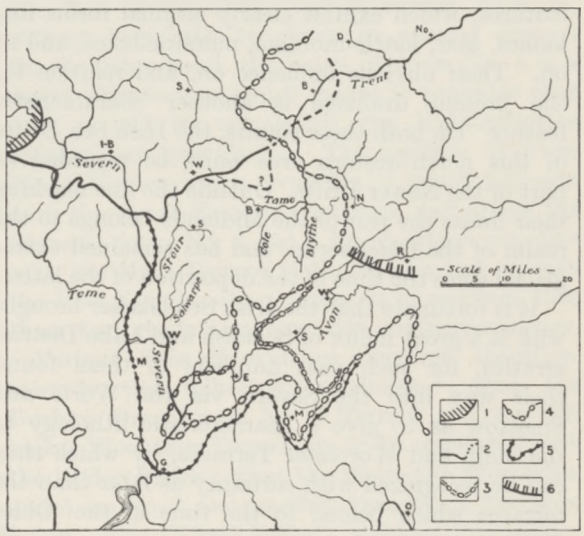


Fig. 1.

THE SPHERES OF INFLUENCE OF THE GLACIERS THAT INVADED THE MIDLANDS. 1, LITTLE WELSH GLACIER OR 'WELSH RE-ADVANCE'; 2, MAIN IRISH SEA GLACIER; 3, STRATFORD STAGE OF, and 4, SUPPOSED MAXIMUM OF GREAT EASTERN GLACIER; 5, MAXIMUM OF FIRST WELSH GLACIER; 6, POSSIBLE SOUTHERN LIMITS OF A VERY EARLY EASTERN GLACIER.

(2) Watershed between the *Tame* on the north and the *Penk*, *Severn* and *Avon*. This contains most of the Midland Plateau, as defined above.

(3) The watersheds between the *Avon*, *Anker* and *Soar*.

Each of these three areas is characterized by a particular type of drift (Fig. 1). Yet each type is by no means confined to one district, but as a rule has had a wider distribution, evidence for which may in some cases be found in the intervening vales.

In the first or *north-westerly district* the drifts belong, perhaps exclusively, to the Main Irish Sea

* From the presidential address to Section C (Geology) of the British Association, delivered at Nottingham on September 3.

glaciation. They are full of Scottish and Lake District erratics, and contain fragments of shells picked up from the floor of the Irish Sea. In addition, there is material from Wales; but this, for the most part, has probably been incorporated from the deposits of earlier glaciations. There seems very little evidence of such older deposits still in their original positions.

The Irish Sea glacier advanced inland counter to the drainage, and in our district surmounted the watershed. It is significant that its deposits occur on the watersheds and at the same time reach into the valleys. The southern limit of the Main Irish Sea drifts is shown on Fig. 1. It is generally marked by a great concentration of boulders.

It is now generally accepted that we can divide our British Glacial deposits into 'Older' and 'Newer Drifts'. The *Newer* can be recognized by reason of the freshness and unaltered state of their surface features, which exhibit clearly original forms like kames, åsar, kettle-moraine, moraine-lakes, and so on. Their obvious influence on, and relation to, the present drainage is another characteristic feature. On both these counts, the Irish Sea Drifts of this north-western area must be regarded as part of the Newer Drifts. Outside the line marking their limits the rest of the Midlands belongs to the realm of the *Older* series, and has remained extra-glacial since the time of the deposition of the latter.

It is fortunate that the Irish Sea Glacier brought with it a great influx of Scottish and Lake District erratics, for such vast numbers of them found their way into the Severn via the Worfe and Smestow as to give a characteristic lithology to the Main and Worcester Terraces, by which they can be recognized with certainty as later than the terraces which belong to the time of the 'Older Drifts'.

The other two districts belong to the domain of the 'Older Drifts'.

We may consider next the *eastern area*. Here the most characteristic drift is the Chalky Boulder Clay and its associated flinty gravels and sands. Though there are other drifts present, these deposits are proved by superposition to be the most recent. As is well known, the Chalky Boulder Clay was the product of a mighty ice sheet to which Harmer gave the title of the Great Eastern Glacier, the limits of which are indicated on Fig. 1. In the main area, which is that lying east of the Tame and lower Anker, and round Nuneaton, Coventry and Rugby, the drifts are the westward continuation of the great spreads of Rutland and Northamptonshire so clearly delineated on Harmer's famous map of English erratics. From the Soar and Anker valleys there is an extension into the Trent valley. Southwards, the 'Main Eastern' drifts (of Miss Tomlinson) near Stratford-o Avon appear also to belong to the Chalky Bould Clay Series. The same is true of the 'Moret Drift' of the same author, though this can on be linked with those of Stratford by a series hill-top occurrences in the otherwise drift-fr vale of Avon.

In the last of our three drift-covered areas, t *Midland Plateau*, it is not easy to generalize abo the distribution, composition and origin of the drif Often they consist of 10–20 feet of pebbly cla sands and coarse gravel, but there are seve districts where far thicker deposits occur. Mo of the Warwickshire Plateau has a covering clayey gravel, sand and sometimes coarse grav The high-level drifts of the Ridgeway and of t hill-tops of Worcestershire are chiefly san and gravels, 'fringe' deposits as Jerome Harris termed them, implying that they were mair periglacial in origin. On the Ridgeway there a also areas of clayey ground-moraine.

The composition of the drifts varies somewha but they always include a great deal of Bunt material, both pebbles from the Middle Bunter a quartz grains from the sandstones. Next perha in number are erratics from the coalfields and fro the Wrekin area. North Welsh rocks are oft common, many coming from the Berwyns and t Denbighshire Silurian country. Large boulde of Arenig (and ? Aran) origin are common in t district stretching from Walsall through Birmin ham and Harborne, and over the Lickeys a Frankley to Bromsgrove. North Welsh mater is therefore the most striking of the common fa travelled erratics, and for this reason it is appr priate to term these deposits the *Welsh Drif* To them, however, an Irish Sea Glacier co tributed Scottish and Lake District erratics on exiguous scale. We may perhaps infer from t distribution of the latter that they belong a later stage in the glaciation than that which w responsible for the more southerly Welsh Drif these being devoid of the northern elemen It is important to realize that various lines evidence point to the fact that it was not the Ma Irish Sea Glacier, but an earlier one that intr duced these few boulders.

Owing to its position between the spheres influence of the Irish Sea and the Great Easte glaciers, this central area with predominantly We drifts offers borderline cases where it is diffic to decide to which glaciation a particular depo belongs. The Kingswinford Esker described Boulton, and the gravels with many northe boulders at Maney near Sutton Coldfield, provi two examples where it is a question of distingui ing between a Main Irish Sea and a Welsh origi whereas the drifts of the Ridgeway in E

Worcestershire seem to be compounded of Welsh and Eastern elements.

Over much of that part of the Warwickshire-Staffordshire Plateau which is drained by the upper waters of the Tame, Cole and Blythe, the mantle of drift is comparatively intact, and frequently forms the valley floors; but on the Severn-Avon side of the watershed of England it becomes very ragged, projecting outwards as promontories or forming outliers on the highest hills. This is so far a rule that one is forced to view the capping as remnants of a more or less continuous sheet which once stretched far into the vales of Severn and Avon. Here it has in most places been completely destroyed. Evidence of its presence must be sought for on the hill-tops and not in the valleys, all of which in their present state are younger than the glaciation.

It is, I think, fair to conclude that the ice sheets at their maxima occupied the vales, and that these were far shallower then than now. This hypothesis sounds very speculative, but there are some remarkable pieces of evidence in its favour*.

The River Terraces as Evidence of the Stages in the Erosion

If we are right in claiming a former far wider distribution of the drifts than the areas where they now occur in force, the river valleys should provide a great deal of evidence concerning the way in which their destruction has been brought about. In the present case this is certainly so; for we have in the Severn and its tributaries a wonderfully developed system of river terraces and of deposits that originated under the rigorous conditions of glacial climates, the so-called taele gravels and melt-water flood gravels.

The farther we go from the plateau and from the drift-covered ground on its north-west and eastern sides the greater the number of high-level terraces. In some cases the geographical distribution and the lithological composition enable us to relate a terrace to a particular set of glacial deposits. These points are brought out by the accompanying table.

Severn	Avon*	Height at Mouth of Severn†	Upstream Limit		Composition
			Severn	Avon	
Woolridge	—	? about 200 O.D.	Tewkesbury	—	*B*, ?*W*,*M*** a few *F*
Bushley Green	No. 5	110/75 O.D.	Tewkesbury	Stratford	do.
Kidderminster	No. 4	65/35 O.D.	Bewdley (goes up Stour)	Stoneleigh near Kenilworth	do.
Main	Nos. 2 & ?3	35?/15? O.D.	Coalport (goes up Worfe)	Church Lawford near Rugby	do. and *S*
Worcester	? No. 1	?—25 O.D.	Shrewsbury	?	do., do.

* Miss Tomlinson's nomenclature. † Height of top/height of base.
** *B*, Bunter Pebbles; *W*, Welsh; *F*, Flints; *M*, Malvernian; *S*, Scottish and Lake District.

I have elsewhere discussed the extremely ambiguous evidence bearing on the question whether there was an interglacial episode between the time of the Main and Worcester Terraces, without being able to obtain an assured answer. On the other hand, the fauna of Avon No. 4 is a warm climate one, which makes it probable that both it and its correlative, the Kidderminster Terrace, are interglacial. The position of Avon No. 4 Terrace below Avon No. 5 which connects with the Great Eastern glaciation, and above the terraces, Avon No. 2 and ? No. 3, which correlate with the Main Terrace of the Severn and so with the Irish Sea glaciation, forces us to conclude that these two glaciations were not contemporaneous.

Various lines of evidence converge, therefore, towards the following conclusion: that the Bushley Green-Avon No. 5 Terrace and the still higher Woolridge Terrace are to be correlated with the 'Older Drifts'; that the Main, the Worcester, and Avon No. 2, and possibly Avon No. 3, Terraces, belong to the 'Newer Drifts'; and that the Kidderminster-Avon No. 4 Terrace records the intervening 'Great Interglacial.' The question whether the older drifts of the Midlands bridge more than one glacial epoch is dealt with in the sequel.

[*To be continued.*]

* The evidence is discussed in the printed address.

Mechanism of the Photographic Process

A GENERAL discussion on "The Mode of Action of the Photographic Plate" in Section A of the British Association meeting at Nottingham, was opened by three speakers, who treated the problem of photography from three different points of view. Mr. E. R. Davies drew a picture of the action of light on photographic materials mainly from physical evidence. Dr. S. O. Rawling gave an account of the action and theory of development. Prof. N. F. Mott described a theory of light action and latent image formation which was developed on a wave-mechanical basis and which provides an explanation for many hitherto puzzling facts and a useful working hypothesis.

The sensitive layer of any piece of photographic material consists of a thin film of gelatin in which is embedded an enormous number of minute

crystals of a silver halide. Silver bromide is most commonly used and is precipitated in the course of manufacture in a gelatin sol. After various operations which greatly affect the sensitivity to light, the so-called emulsion is spread out on a support and dried down to form a layer about 1/1000 in. in thickness.

The light-sensitive unit in the photographic layer is the individual silver halide crystal. Its sensitivity manifests itself in two ways. Sufficient exposure to light causes the crystal to darken visibly—print-out effect. Exposures smaller by a factor of $1/10^8$ produce the 'latent image', which makes the crystals developable.

The print-out effect consists of the direct production of silver by the action of light, with liberation of the halogen. If this can be taken up by the surrounding medium the process will proceed to completion. Two points were emphasized. The quantum efficiency is of the order of one silver atom formed per absorbed quantum of light. Light is absorbed all over the crystal, but the silver coagulates and forms specks.

The latent image provides the ever-new problem in photography which cannot yet be regarded as solved. No satisfactory proof of its nature has so far been offered, although the print-out effect strongly suggests that it consists of specks of metallic silver. A few to a few hundred light quanta must be absorbed to make a grain developable. It is difficult to say what effect so few silver atoms could have unless they coagulate to form a speck. Since there is so far no sufficiently sensitive physical method by which the latent image can be detected, we have to use the results of development for its interpretation. A thorough understanding of the process of development is therefore essential.

The latent image acts as a trigger or a catalyst, which enables the developer to reduce the silver halide crystal. Practically all the energy required is supplied chemically, and the latent image itself is lost in the process of development. Developers are often regarded as solutions possessing certain redox potentials. (In the physicist's language, the term redox potential may be explained by saying that the potential measures the ease with which electrons are given off by the solution, a low potential meaning a stronger reducer, giving off electrons more easily.) If the potential is too low, silver halide crystals will be reduced indiscriminately, whether they carry a latent image or not: if the potential is too high, they will not be developed at all. By preparing a series of solutions of decreasing potential it can be shown that at a certain critical potential no development takes place; below that a solution will act as a developer; above it as an oxidizer, destroying the latent image. Similar results are obtained on a partly developed piece of photographic material, which, of course, contains bigger particles of silver. At another critical potential no change occurs; above it the density is diminished, below it further development occurs. This critical potential is higher than that of the latent image. The conclusion from these experiments is that the latent image silver speck must be above a certain critical size—which cannot, however, be worked out from these data—but below the size at which it would act as solid silver.

These thermodynamical considerations do not tell us anything about the actual mechanism of development. Two essentially different processes have been suggested. One is that the silver halide is dissolved, is reduced to silver in the solution which soon becomes supersaturated with reduced silver, and the supersaturation is relieved by deposition of silver upon the latent image. From the behaviour of artificially produced silver particles it has been estimated that an aggregate of four or five atoms of silver may be necessary for this action to occur. The other suggestion is that the developer, while not being adsorbed by the surface of silver bromide, which is negatively charged, is strongly adsorbed by a speck of latent image, and from this foothold is able to reduce the rest of the crystal, either through the body or at the interface between crystal and developer. Experiments have shown that some of the commonly used developing agents, which yield negatively charged reducing ions, are indeed only feebly adsorbed to negatively charged silver bromide but are strongly adsorbed to colloidal silver, and that by this very adsorption their reducing activity is enhanced. These facts lend strong support to the second hypothesis.

It is, however, probable that both mechanisms can operate, sometimes together. With some developers, yielding positively charged ions, the deposition mechanism probably operates almost exclusively, and we then have the slow so-called physical development. With other developing solutions the adsorption mechanism with direct reduction at the interface between silver and silver bromide, may predominate. This seems to be the more likely action with ordinary commercial development.

Another mechanism is based on the fact that the negative charge on colloidal silver particles is discharged by light, when the particles become developable. A similar process may occur in the bigger silver halide crystals.

Development always takes place in two seemingly definite steps: an induction period, in which no visible changes occur, and the development

proper, which proceeds very rapidly. Unless special precautions are taken, a crystal is either found to be completely developed or not at all. The process of development seems to be an autocatalytic reaction, but the significance of this for the mechanism of development is not clear.

We are thus led to the assumption that the latent image consists of a silver speck of critical size.

The formation of this silver speck was then considered. Light is absorbed all over the crystal and forms isolated silver atoms, which then coagulate into a speck. The distinction was drawn between a primary process, the formation of silver atoms, and a secondary process, the coagulation.

The primary process in latent image formation is strongly influenced by changing the absorption of the individual silver halide crystal. This can be done by dyeing the emulsion with 'sensitizing dyes'. The natural absorption of silver bromide in the ultra-violet and the blue, and with it its spectral sensitivity, can be extended right into the red and infra-red. Silver bromide containing a few per cent of silver iodide is much more sensitive than pure silver bromide; this probably also influences the primary process. The absorption spectrum has mostly been found to coincide with the spectral sensitivity of an emulsion. Sensitizing dyes are always strongly adsorbed to silver halide: an intimate contact between dye and crystal seems essential.

The secondary processes strongly influence the sensitivity, that is, the number of quanta required to be absorbed to make the crystal developable. The sensitivity of crystals increases with their size: coarse grain materials are more sensitive. The explanation is not solely that a bigger crystal will absorb more light and thus form a bigger speck more easily, because it has been found that crystals of the same size differ widely in their sensitivity, which is also influenced by the gelatin and foreign substances generally. The active medium is found to be mainly silver sulphide. There has been much speculation as to the way it acts. Silver sulphide probably forms specks on the surface of the silver halide crystals and acts as a condensation nucleus. Much evidence, mainly of chemical nature, confirms this hypothesis.

Here the present writer would point out that, while the latent image in photographic materials cannot be detected by physical methods, there exists a seemingly strict analogy in big single crystals of silver halide. On illumination with blue light they become coloured and develop an absorption band in the red. On illumination with red light this absorption band is bleached out. This corresponds to the Herschel effect on photographic materials, where the latent image is bleached out by consequent exposure to red light. Furthermore, the spectral sensitivity of the Herschel effect coincides well with the absorption band observed in single crystals, suggesting strongly that the particles responsible in both cases must be the same. The particles in single crystals are usually regarded as colloidal silver particles, the absorption band being due to colloidal scattering. This, however, leads to impossible dimensions for the silver particles, which cannot, from photographic evidence, be bigger than a few hundred silver atoms. The absorption band observed in single crystals cannot, therefore, be due to colloidal scattering, but must be caused by a more specific absorption process arising from the intimate contact between the silver speck and the silver halide crystal.

Fig. 1.

IONIC CONDUCTIVITY IN THE SILVER HALIDE LATTICE.

The mechanism of latent image formation was then considered. The crystals are made up from silver and halide ions. In order to produce a silver atom we have to remove an electron from a bromine to a positively charged silver ion. This act is thought to constitute the primary process in photography. In dye sensitization the electron may come from the dye molecule instead. The fact that silver halides are photo-conductors shows that the electron is not very strongly attached to the silver ion, and may move about in the lattice. Calculations show that the mobility of such an electron is almost as high as in a metal.

A speck of silver in contact with a silver halide crystal was considered. There is a certain probability for some electrons to escape from the silver into the crystal, and an electron vapour pressure is set up which depends on the temperature. The speck thus becomes positively charged. The sensitivity specks of silver sulphide may behave in a similar way. Illumination with light increases

the electron concentration in the crystal. If this concentration is higher than the equilibrium concentration of the speck, electrons condense on it. The speck becomes negatively charged and tends to attract the positive silver ions. Silver halides are also ionic conductors; the conductivity is entirely due to the silver ions. A mechanism has been suggested for this ionic conductivity which is illustrated by Fig. 1. At any temperature there are some silver ions in the wrong position in the centre of the cube of four others, leaving an empty space in the lattice behind them. These silver ions have a certain mobility, and so have the holes whence they came. The ions will be attracted by the charged silver or silver sulphide speck and will increase its size, pushing it out of the grain. We are now left with a neutral bromine atom and a spare hole whence the silver ion came. There is reason to assume that the primary process mostly takes place on the surface of the crystal, so that the bromine atom escapes into the gelatin. Only a slight reshuffle of the lattice is necessary to get rid of the hole, when the crystal will be smaller by one ion pair.

The ionic movements take some time and are dependent on temperature, and it is therefore not surprising to find that the formation of the latent image depends not only on the number of quanta absorbed but also on the rate at which they are fed in, and on the temperature. Much attention has recently been paid to the 'reciprocity breakdown' of photographic materials. In Fig. 2 is plotted for various temperatures the exposure, that is, the number of quanta necessary to produce a certain density after development, against the intensity, that is, the rate at which the quanta are received. Two facts are most striking; that there is an optimum intensity where a minimum of exposure is necessary, and that with lowering of the temperature the material becomes more sensitive at low intensities—a fact which should be most valuable for spectrography. Since a critical electron vapour pressure has to be reached before the latent image can be formed, at sufficiently low intensities no latent image may be formed at all; since there is a certain chance for recombination of the electrons with the bromine atoms the critical vapour pressure may never be reached. On raising the intensity the critical pressure will be reached for the more sensitive grains in the material, but not for others; on raising it still further the optimum will be reached. At high intensities there is no difficulty in reaching a sufficiently high vapour pressure, but since the ionic processes take time, it is not unreasonable to assume that the vapour pressure has to be kept up as long as possible for the optimum effect. For too short exposures the ions have no time to move up to the speck, and recombination will take place more readily. At low temperatures the critical vapour pressure is more easily reached, and the biggest effect is obtained at low intensity when the pressure is kept up for a long time.

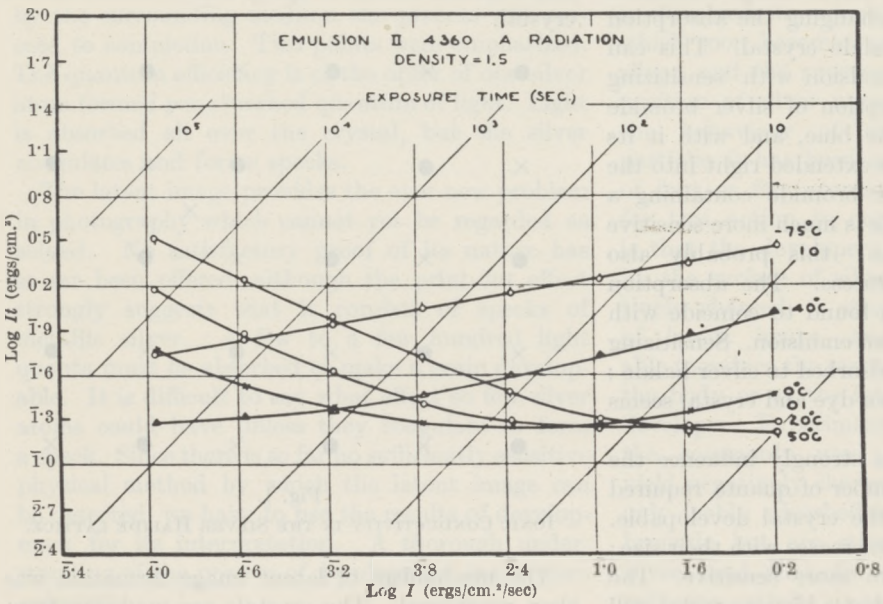


Fig. 2.

VARIATION OF THE RECIPROCITY CHARACTERISTIC WITH TEMPERATURE.

It seems that we have arrived at a fairly simple picture of the mode of action of photographic materials, but it should be pointed out that the picture is by no means complete and will not be regarded as correct by all workers in this field. There is space for mention only of a few more facts which seem important and which cannot or can only partly be explained by our picture. There is solarization, the fact that on prolonged exposure development leads to a partly reversed image; desensitizing by dyes, whereby the material is made insensitive to further exposure while still remaining developable; reversal by dyes, where the latent image is destroyed by subsequent exposure in the absorption band of the dye; and many more. But our picture may be useful as a working hypothesis for future experiments.

W. F. BERG.

Obituary Notices

Prof. H. B. Fantham

THE death of Prof. Harold Benjamin Fantham, Strathcona professor of zoology and head of the Department of Zoology at McGill University, Montreal, on October 26, in his sixtieth year, has removed one who was widely known for his many contributions to the subject of parasitology.

Prof. Fantham was educated at University College, London, where he was gold medallist in zoology and Derby research scholar, at the Royal College of Science, London, and at Christ's College, Cambridge, where he was twice Darwin research prizeman. He was a fellow of University College, London, and also a member of many scientific societies. In addition to some 150 research papers published in various scientific journals, he was joint author of "The Animal Parasites of Man", in which he wrote the section on Protozoa, and also published a popular book, "On Some Minute Animal Parasites", in collaboration with Dr. A. Porter.

From 1904 onwards, Prof. Fantham was mainly engaged in university teaching, first in London, where he made various contributions to protozoology, especially in connexion with Haplosporidia and the molluscan spirochætes, and afterwards in Cambridge, where he was assistant to the Quick professor of biology, and conducted work in connexion with the grouse disease inquiry. From there he joined the Liverpool School of Tropical Medicine, where he worked on trypanosomes and spirochætes, and in conjunction with Prof. J. W. W. Stephens gave the first account of *Trypanosoma rhodesiense*.

During the early part of the Great War, Prof. Fantham acted as parasitologist, and went to Egypt and Salonika where he contracted amœbic dysentery and was invalided home. In 1917 he was appointed as the first professor of zoology and comparative anatomy in the new University of the Witwatersrand, Johannesburg, where he not only organized and developed the Department, but also took a very active part in many university activities, being dean of the faculty of science and also for one year a member of the Council of the University. Whilst in South Africa he was closely associated with the South African Association for the Advancement of Science, and in 1927 was president of the Association, when his address on "Some Thoughts on Biology and the Race" was the subject of an editorial article in NATURE of September 10, 1927. In addition, he continued to publish papers, mainly on South African parasitic Protozoa and soil Protozoa.

In January 1933, Prof. Fantham took charge of the Zoological Department at McGill University, Montreal, and at once threw himself with enthusiasm into the task of reorganizing the Department. In addition, he continued research work on Protozoa and eugenics as well as on freshwater biology, and made special efforts to develop this side of zoological ecology in the province of Quebec.

From the time of his arrival at McGill University, Fantham stimulated the interest of his students, not only those doing advanced work, but also the juniors, with the result that his Department grew continuously in numbers, particularly in research workers. He knew every student personally in his large Department, and would always help in personal as well as academic matters. As a tribute of him they wrote : "The University has lost a Department head, a professor and a colleague—but the students of the University mourn the passing of a friend".

Prof. Fantham is survived by his devoted wife and former student, Dr. Annie Porter, herself a well-known biologist, who co-operated with him in many of his undertakings.

Dr. J. A. Voelcker, C.I.E.

DR. JOHN AUGUSTUS VOELCKER, who died on November 6 at eighty-three years of age, was almost the last representative of the group of men whose work in the application of chemistry to the development of agriculture was of very great importance in the second half of the nineteenth century. The son of Dr. Augustus Voelcker, himself one of the most eminent of the group of agricultural chemists referred to, he was trained to succeed his father, first at University College, London, then at Giessen, and finally at Cambridge. After this he joined the laboratory which his father had established in London. This laboratory was unique at the time, and the methods used there, to which Dr. Voelcker adhered during almost all his life, have become very largely the standards used in similar laboratories all over the world.

On the death of his father in 1884, Dr. Voelcker had, at the age of thirty, the very difficult job of succeeding to the latter's consulting practice and to a number of the public positions which were held by his father. He rose to the occasion, and was for many years the principal and almost undisputed authority on questions of the application of chemistry to agriculture. Perhaps the climax of his career came when he was invited by the Government of India to visit that country and report on the scientific improvement of Indian agriculture. His visit there, in the years 1889–90, was a great success, and his report was the basis for the foundation of scientific work in connexion with agriculture in India. It remains to this day a classic.

When Dr. Voelcker succeeded his father in 1884, he also took over the position of consulting chemist to the Royal Agricultural Society of England, which he retained until his death. His annual reports in this connexion, of which the series is almost unbroken,

will be found a unique record of the changes which have taken place in the character of the feeding stuffs and fertilizers which are used by the farmers of the country. His services towards the purification of such materials have been very great, and his investigations were of importance in leading to the passage of the Fertilisers and Feeding Stuffs Acts in later years.

Dr. Voelcker became director of the Woburn Experimental Station also in 1884, and this remained one of the chief interests of his life from that time onward. The Woburn experiments owe almost everything to his zeal and energy, and rarely has there been much more than a month since he took over charge when he has not visited the experimental station. He only relinquished his position as honorary director in 1936, just after an account of fifty years' experiment there had been published by himself and Sir John Russell. It is a source of great satisfaction that he was able to co-operate in bringing out this monument of what he regarded as, to a large extent, his life-work.

Dr. Voelcker had a special bent for applying scientific results to actual problems, especially agricultural problems. He had, in fact, an almost uncanny knack of extracting, from comparatively simple experiments, conclusions which would stand the test of practice, and, hence, he was in great demand as an adviser in agricultural difficulties. His interest in agriculture was profound, and nothing pleased him more than to spend time on a farm or to associate with those who were responsible for managing agricultural land in any capacity.

On the chemical side, Dr. Voelcker was a prominent member of many of the professional and other societies. He was an early member of the Institute of Chemistry and for long a member of its council. He was also a past president of the Society of Public Analysts, and an old member of the council of the Chemical Society. Apart from his scientific activities, he was a man of very wide interests. An athlete in his youth, when he was a well-known cross-country runner, and a sportsman later in life, he never lost his zest for the one or the other, and he could often be found on a Saturday afternoon attending the events of the London Athletic Club (of which he was twice president).

Mr. C. W. S. Crawley

WE regret to record the death of Mr. Charles William Scott Crawley, which occurred on November 9 at the Corner House, Charlbury, Oxon. Mr. Crawley was seventy-nine years of age and was a partner in the business of the well-known electrical instrument makers—now Nalder Bros. and Thompson, Ltd. He went into partnership with the well-known electrical instrument manufacturers, the late Mr. Francis H. Nalder and his brother, Mr. H. Nalder, two years after the business had started. Mr. Soames was also a partner, and the letters N.C.S. on ammeters and voltmeters are familiar to all electricians.

Mr. Crawley designed many instruments, and was an expert in their actual construction. After he retired from Nalder Bros., he became a consulting engineer and spent much of his time in the Board of Trade Electrical Standards Laboratory, voluntarily assisting Mr. Rennie. He worked chiefly in the resistance room making accurate comparisons of the standards, some of which had been made by Nalder Bros. in 1892 for the electrical standards committee of the British Association. The work was very difficult as it was known that some of the B.A. coils had changed owing to acidity in the paraffin wax used for insulation. Major Cardew and Mr. Rennie had used them for measuring resistances sent to them for calibration. Mr. Crawley recognized that the weak point in most measurements of resistance was the determination of temperature. At his suggestion, Dr. Guillaume was asked to procure a thermometer of the highest precision.

The provision of a scale of corrections to the thermometer for changes due to the barometric pressure showed Crawley's scrupulous care. He invented 'build-up' boxes for passing from 0 ohms to 10 ohms and so on to 10,000 ohms, using only two mercury cups at a time.

At the International Conference on Electrical Units and Standards in 1908 he was one of the secretaries, the others being W. Duddell, F. E. (now Sir Frank) Smith and M. J. Collins of the Board of Trade. Mr. Crawley, who could converse fluently in French and German, was of great help in explaining matters to the delegates and in showing them around the laboratory of the Board of Trade.

When he went to live at Charlbury, near Oxford, Mr. Crawley equipped a workshop laboratory. He made an instrument for tracing and recording variations of earth currents between buried earth plates. He designed and constructed several barographs for recording variations of atmospheric pressure on a scale twenty times as large as that of a mercury barometer. One of these was sent for comparison of observations to the neighbouring radio station at Leafield. For many years Mr. Crawley was a member of the Institution of Electrical Engineers and a fellow of the Physical Society. He often attended their meetings and took part in the discussions. He was the pioneer of many new methods of making high precision measurements which have greatly helped physical and electrical research.

WE regret to announce the following deaths:

Sir Charles Bright, an authority on submarine and general telegraphy, on November 20, aged seventy-three years.

Mr. Henry Crowther, formerly curator of the Leeds Museum, on November 29, aged eighty-nine years.

Prof. A. Lodge, formerly professor of pure mathematics in the Royal Indian Engineering College, Coopers Hill, president of the Mathematical Association in 1897–98, aged eighty-three years.

Dr. D. S. Macnair, known for his work in analytical chemistry, an inspector in charge of the scientific and technical instruction under the former Science and Art Department, on November 27, aged seventy-six years.

News and Views

Queen Mary College Jubilee Celebration

THE tangled tale of the foundation of the colleges of London and of their welding into one of the greatest universities that the Western world has seen is, in its revelation of a complete absence of planning, fascinatingly and characteristically British. None of these colleges has a history more stimulating to the student of social developments than that of Queen Mary College. The College, known until December 12, 1934, as East London College, when Her Majesty Queen Mary presented to the College, through the master of the Draper's Company, a Royal Charter incorporating the College under its new name, finds its origin in a bequest made by Mr. Barber Beaumont, who died in 1841. The eighties of the last century saw the beginning of the generous interest of the Drapers' Company in the movement which resulted in the People's Palace, and on May 14, 1877, Queen Victoria opened the Queen's Hall, and laid the foundation of the Technical School, a School which formed an integral part of the People's Palace. In 1892, Mr. J. L. S. Hatton, to whose almost prophetic insight the metamorphosis of the Technical School is due, was appointed director of that School, and under his wise guidance the work of the School increased so greatly in volume and in importance that in 1907 East London College was recognized as a School of the University of London. The College has indeed been singularly fortunate in its principals. Sir Frederick Maurice, who accepted the office on the death of Principal Hatton in 1933, is steering the College through a difficult period of material expansion marked by a new building scheme, the opening of a high-voltage laboratory and the acquirement of an estate to be developed as a new sports ground.

THE year 1887, which saw the laying of the foundation stone of the Technical School, may be taken as marking the birth of the College, and the College, in holding its Charter week during the week beginning December 12, is also celebrating its jubilee. The outstanding event of the week will be a Congregation on the evening of December 14. The College has now two honorary fellows—Her Majesty Queen Mary and Sir Lynden Macassey—and on the occasion of this Congregation the master of the Drapers' Company, Mr. D'Oyly Monro, and the clerk to the Company, Sir Ernest Pooley, are to be admitted as honorary fellows. The jubilee celebrations mark fifty years of almost unexampled growth, and the College will embark on its journey towards a century of achievement with the good wishes of all who are concerned for the future of university education.

Population Statistics

THE debate in the House of Commons on November 29, on the second reading of the Population (Statistics) Bill, was interesting on account of the criticism which the Bill received from both sides of the House. The adverse criticisms were chiefly directed against the requirement of information of a not obviously necessary character, and also against the ambiguous nature of the terms of the schedule. The feeling was expressed by Mr. F. K. Griffith that the public should not be worried by "intimate, irritating, and irrelevant questions". There was no general opposition to the asking of information of a definitely useful character. The report of the debate should be read in conjunction with subsequent correspondence in *The Times*. Thus, Mr. A. P. Herbert, in the issue of December 4, mentions the contention of Prof. A. M. Carr-Saunders and Dr. C. P. Blacker that "three pieces of information were essential for the proper elucidation of the trend of the population—the age of the mother and the duration of the marriage at the birth of each child, and the order of birth of each child"; and he remarks that "if this were all the Bill required the trouble would not have arisen".

PROF. MAJOR GREENWOOD, in the same issue, states that "in Germany the age of the mother, the date of marriage, and the order of birth of the child are recorded on the birth-card. Dr. Burgdörfer was therefore able to determine for 1933 the annual frequency of births to married women of different ages and durations of marriages." With this information, he was able to test the question whether fertility had remained constant in subsequent years. That is the kind of information required by statisticians in Great Britain, not now available, but intended by the Bill to be made available for the future. Unfortunately, the schedule to the Bill gave it a much wider and more indeterminate scope, and it is not surprising that objections were raised. The Minister would be wise if he were to confine the schedule to defining the few simple questions, such as those indicated above, which are really indispensable, at the same time eliminating Clause 3 of the schedule, which lays down that particulars may be required with respect to "any other matter" on which statistical information may be wanted for social investigation.

Sir Harold A. MacMichael, K.C.M.G.

THE appointment of Sir Harold A. MacMichael, Governor and Commander-in-Chief of Tanganyika Province, to be High Commissioner and Commander-in-Chief for Palestine and Commissioner for Transjordania in succession to General Sir Arthur Wauchope, who resigns on the ground of health, will be received as singularly well judged. Sir Harold is by personal qualities—which count for much in the East—by knowledge of Eastern mentality, and by long previous experience, peculiarly well qualified to cope with the difficulties of mediating between the

conflicting interests now warring in Palestine. After a distinguished career as a classical scholar at Magdalene College, Cambridge, he joined the Sudan Political Service in 1905, and served in the provinces of Kordofan, Blue Nile and Khartum. During the Great War he served as political and intelligence officer with the expeditionary force which reoccupied Darfur in 1916. A successful official career culminated in the appointment of civil secretary, which he held from 1926 until 1934, on several occasions acting as governor. In the course of his service in the Sudan he became our foremost authority on the ethnology and history of the Sudanese tribes, his published works including "The Tribes of Northern and Central Kordofan" (1912), "A History of the Arabs in the Sudan" (1922) and "The Arabs of the Egyptian Sudan" (1924). For these studies he was awarded the Burton Memorial Medal of the Royal Asiatic Society in 1928. Sir Harold's onerous duties as Governor of Tanganyika have not precluded his continued interest in scientific studies, which has been directed mainly to local archæology and the foundation of a museum at Dar-es-Salaam.

Memorial to Dr. Samuel Smiles (1812-1904)

On Saturday, December 4, a bronze tablet to the memory of Samuel Smiles was unveiled at Zion School, Leeds, by Sir James Baillie, vice-chancellor of the University of Leeds. In the course of his speech Sir James said: "Smiles had a singularly sane outlook on human life and a remarkable grasp of the simple elementary principles on which human society ultimately rests. He made himself eminent in his spare time—what we should now call his leisure moments, at the end of busy days. Part of his spare time in Leeds he gave to those who attended Zion School." Smiles's first book, entitled "Physical Education", was published in 1837 at his own expense and reprinted in 1905. Messrs. John Murray published in 1905 his "Autobiography", which contains a copy of his portrait, by Sir George Reid, in the National Portrait Gallery, and in 1857 "Life of George Stephenson", which is an engineering classic. The latter arose from his meeting Stephenson at the opening of the Leeds and Derby railway, later absorbed by the Midland. He collected material during week-ends by interviewing people on Tyneside who knew of the early work, and also he received information from Robert Stephenson and the Peases of Darlington, etc. "Self-Help" arose from lectures he gave in Leeds, particularly one on education of the working classes in 1845. It was published in 1859, after being refused by a well-known publisher. Nearly half a million copies have been printed and it has appeared in the record number of twenty-six languages. In it and in "Character and Duty" Dr. Smiles showed the British people to the world as very virile and inventive. Although trained as a physician he spent most of his working life as editor and writer of books, and from 1845 until 1866 was secretary of two railway companies. He was largely responsible for the Charing Cross railway and terminuses.

In addition to the memorial tablet in Zion School, Alderman P. T. Leigh, chairman of the Library Committee, accepted copies of Dr. Smiles's books in bookcase presented by Sir John Murray for the branch library, which has occupied part of Zion School since 1870—the first municipal free library. Sir Walter Smiles, M.P., presented a picture of his grandfather copied from the oil painting in the National Portrait Gallery, to be hung in the civic hall along with other portraits of Leeds worthies. There was an exhibition of relics concerned with Dr. Smiles: copies of first editions of his early books, autographed letters, family bible and portraits, and the *Leeds Times* of 1838 containing his first speech in Leeds on repeal of the Corn Laws.

Centenary of William Harkness, 1837-1903

On December 17, 1837, William Harkness, the American astronomer, was born at Ecclefechan, Scotland, his father being a Presbyterian minister. In 1839, the family removed to New York, and after attending private schools Harkness entered the University of Rochester and in 1858 took his degree. A short spell of journalism was followed by the study of medicine, and during the Civil War, at intervals, he served as a volunteer surgeon. In 1862, however, he was appointed an assistant to James Melville Gilliss (1865) at the United States Naval Observatory, and it was at Washington that he passed practically the remainder of his life. He observed the solar eclipses of 1869 and 1870, and in 1871 was appointed one of the original members of the Transit of Venus Commission, being concerned with the preparations for the observation of the transits of 1874 and 1882, and also with the discussion of the results. The transit of 1874 he observed at Hobart, Tasmania. In September, 1894, when new buildings had been erected for the Observatory, regulations were promulgated by the Secretary of the Navy providing for the first time for an "Astronomical Director", who was to "have charge of and to be responsible for the direction, scope, character and preparation for publication of all work purely astronomical, which is performed at the Naval Observatory". To this post Harkness was appointed, the office providing, it was afterwards said, "a maximum of responsibility and a minimum of power". To his duties were added three years later the directorship of the "American Ephemeris and Nautical Almanac". The work, however, proved too much; he broke down and in 1899 retired, being granted the rank of Rear Admiral. He died at Jersey City, N.J., on February 28, 1903. Harkness was one of the founders of the Philosophical Society of Washington and in 1893 served as president of the American Association for the Advancement of Science.

Aborigines of Australia

The petition of eighteen hundred Australian aborigines addressed to the King, and asking for representation of their interests in the Federal Parliament (see NATURE, Nov. 6, p. 798), whether it attain its end or not, has at least served to direct attention

once again to the question of their present condition and their future. Difficulties of the situation, which contribute to the failure to find a solution of a problem—for long a reproach to the Australian people—are set out with due appreciation of their weight by an Australian correspondent of *The Times* in an article in the issue of November 25. After pointing out the gravity of conditions which tolerate "tribe after tribe dying on their feet", and contrasting conditions among the natives of New Guinea, the writer refers to the mentality and character of the aborigines as in no small measure responsible for much for the failure of the Governments to check the degeneration which is taking place. Even such a beneficial, and indeed essential, provision in the organization of aboriginal protection as medical attention is rendered in a degree ineffective through the disinclination of the aboriginal to take advantage of it, owing to magical belief or misunderstanding. At the same time the nomadic habit, as well as the tendency to drift to centres of white civilization, neutralize the advantages of reserves of aboriginal lands. On the other hand, the inadequacy of the financial provision made by the Australian Governments is stressed, its most serious consequence being the lack of a trained body of special officers, such as the service organized by Sir Hubert Murray in Papua. A graver indictment of the Australian people appears in the same issue of *The Times* in the form of a report of a valedictory address by Prof. F. Wood-Jones to the Victorian Anthropological Society, which, notwithstanding a certain lack of restraint in language and certain inaccuracies, cannot be passed over by Australia as ill-founded, even though Prof. Wood-Jones, as well as the writer in *The Times*, as has been pointed out in subsequent correspondence, gives little or no credit to Federal and State Governments for what has been attempted to ameliorate aboriginal conditions.

Marconi School of Wireless Communication

QUITE early in its history, the Marconi Company experienced a need for providing its recruits to the engineering and operating staffs with some centralized instruction in the technique of wireless communication. This technique was naturally ahead of any training provided by the universities or elsewhere, and, accordingly, a residential school for the training of probationary engineers of the Marconi Company was opened in 1901. This event established a notable precedent in industrial training institutions. From this date, the School has been in nearly continuous operation, with modifications and expansion of its activities from time to time to meet the demands presented by the progress in communication. Some two years ago it was decided to make very substantial increases in the facilities provided, and on November 29 last, representatives of the technical press were invited to inspect the new buildings and equipment of the Marconi School of Wireless Communication at Chelmsford. Its premises have been rebuilt and equipped on modern lines, its curriculum has been reorganized and additional appointments have been made to the staff.

As a training institution, the School is a leading example of the higher industrial education, and provides the link between the universities and the Research, Development and Engineering Departments of the Marconi Company. All engineering and physics graduates on their appointment as probationer engineers are given a course in experimental and applied wireless communication engineering at this School, which includes in its syllabus the application of circuit theory, the practice of valve, receiver and transmitter technique and experience in the design, construction and testing of representative aerial and feeder arrangements. A series of lectures is also given during the five months' session covering the whole field of wireless communication and a further series on engineering mathematics. The new School possesses a central college building containing the main experimental laboratory, two smaller research laboratories, a standards room, lecture theatre, library, common room, and general offices ; and in the grounds are a number of detached buildings housing telephone terminal gear, direction finding plant, transmitters and television equipment. About sixty students are being trained at the present time ; the lecture theatre has a seating capacity for seventy-five students and many more than this number can be accepted for work in the various experimental sections of the School. A hostel, with a limited accommodation, is available for those students who desire to live near by. A more detailed description of the School and of the facilities which it provides is given by the principal, Mr. H. M. Dowsett, in the *Marconi Review*, No. 66, May–August 1937.

Iodine in Inorganic and Organic Chemistry

FOR his Friday evening discourse at the Royal Institution on December 3, Prof. Irvine Masson discussed "Iodine". After a reference to the important part played by Sir Humphry Davy in the discovery of iodine (1812–1814) during his honorary professorship at the Royal Institution, the first half of the discourse reviewed the functions of this element in Nature. As a component of rocks, minerals, soils, and dissolved salts, iodine is widespread but is exceedingly scanty. Even in its chief commercial source, the nitrate deposits of Chile, its compounds are present only as minor impurities. It began to be significant, however, when organic life began. Certain marine creatures are rich in it, notably kelp, and in horny sponges (bath sponges) and those corals the skeletons of which are horny, not calcareous. In them, the iodine is in the skeleton, as a well-defined organic compound, di-iodotyrosine, closely related to the fairly simple compound tyrosine, which is a frequent constituent of proteins. Whether the organic iodine is useful to the vital processes of the cell-colony has not been ascertained. The same substance is one of the two iodine compounds in the thyroid gland ; and although it there seems to have little or no direct physiological activity, it appears to serve as the chemical forerunner of the other and more complex iodine compound, which the gland evidently synthesizes from it, namely, the hormone

thyroxine. The second part of the discourse exhibited recent discoveries which show that the carbon compounds of multivalent iodine present a much more extensive field than had been realized, wherein this element is seen to be classed less with bromine and chlorine than with elements such as antimony, arsenic, phosphorus, and nitrogen, yet has specific characters of its own.

Chemistry in the Ancient World

THE fortieth Bedson Lecture was delivered on November 26, at King's College, Newcastle-upon-Tyne, by Prof. J. R. Partington, on "Chemistry in the Ancient World". The lecture dealt mainly with the period 4000–1000 B.C., and showed how the outstanding achievements in applied chemistry during this period were made in three principal regions, namely Egypt, Mesopotamia and Crete. The working of metals appears before 3500 B.C. in Egypt and Mesopotamia and somewhat later in Crete and Cyprus. The earliest metal known was probably gold, although copper was known very early in Egypt. The metals silver, lead and iron were also known in the earliest period but were scarce. Refining of gold appears about 525 B.C. An important copper industry was established in Egypt, the malachite ore being mined in Sinai. The use of iron and steel is found among the Hittites and related peoples at the time of the eighteenth dynasty in Egypt, and iron was freely used by the later Assyrians. Brass was known in Palestine about 1400–1000 B.C., and, since the brass industry was later established in Cyprus, some relation between the two regions by way of Râs Shamra seems to be indicated. The techniques of metal workers differed in different regions. The production of bronze was an important event, and the source of the early tin is still doubtful. Zinc occurs in small quantities only in the Roman period. The production of black-topped pottery in Egypt was described and also the preparation of glazes. In some cases the results have been imitated with difficulty and only recently. Glass itself was known in Egypt and Mesopotamia in 3000 B.C., the Egyptians being very skilled in its manufacture and colouring, although blown glass does not seem to have been made until the beginning of the Christian era. The dyes indigo and safflower were used in ancient Egypt, and in Mesopotamia there were the beginnings of the petroleum industry, with extensive use of bitumen for cement and asphalt.

Meteorites of the Gran Chaco

THE announcement in *The Times* of November 9 by a Buenos Ayres correspondent of the discovery of as large mass of meteoric iron in the Campo del Cielo region of the Gran Chaco in the northern Argentine is puzzling. He refers to a "legendary meteorite" long ago spoken of as the "Mesón de Fierro" (iron inn), and assumed to be the source of the iron tips of Indian spears seen by the Spanish conquerors. The discovery of a large mass of native iron in this region was made by Hernán Mexía de Miraval in 1576. This, or perhaps another large mass, was seen by Miguel Rubín de Celis in 1783, and was described by him in the *Philosophical Transactions* in 1788. The weight of this mass has been variously estimated at from 13½ to 45 tons. Another mass of about one ton, found in 1803, was transported to Buenos Ayres during the war of independence with the idea of manufacturing it into armaments; and a portion, weighing 1,400 lb., of this was presented to the British Museum in 1826 by Sir Woodbine Parish, who described it in the *Philosophical Transactions* in 1834. This is still on view in the Natural History Museum at South Kensington. More recently, a mass of 4,210 kgm. (more than 4 tons) was found in 1923, another of 732 kgm. in 1925, and several other smaller masses. These have been transported to the National Museum in Buenos Ayres. The new report may perhaps refer to the rediscovery of the larger mass seen by Rubín de Celis in 1783; or, not unlikely, still another large mass may have been found. It is suggested that the boundary between the provinces of Santiago del Estero and El Chaco is defined by the position of the "Mesón de Fierro". But as shown on a map of the region (*Geog. J.*, **81**, 238; 1933) masses of iron have been found on both sides of this boundary line. Evidently at this place there was an unusually large shower of meteoric irons. The history of the several masses has been given by Dr Antenor Alvarez "El meteorito del Chaco" (Buenos Ayres, 1926, pp. 222). But the associated meteorite craters, a group of round and shallow depressions (*hoyos* or *pozos*), still require investigation.

Iron Age Site in the Vale of White Horse, Berks

EXCAVATION of an archæological site at Frilford in the Vale of White Horse, Berks, has afforded interesting evidence of a succession of cultures during a period, which if not prolonged in archæological perspective, was at least of considerable duration, extending from the early Iron Age to Saxon times. The site lies close to the Oxford-Wantage road, where it crosses the River Ock, and is situated not more than a hundred yards from a well-known cemetery of the Roman and Saxon periods. The excavation, which was undertaken by the Oxford University Archæological Society at the suggestion of Sir Arthur Evans, was carried out during last term by under-graduate members of the Society with the co-operation of Mr. D. R. Harden of the Ashmolean Museum. The evidence of early Iron Age occupation, according to a report in *The Times* of December 6, is in the form of a series of pits, circular and irregular, dug in the limestone subsoil. These contain Iron Age *A2* pottery. In the largest found to date was a large hearth on a clay floor with, among other objects, a polished hammer-stone. In this period the district was remote and backward; but during the Roman occupation a small but well-built villa was erected on the site. This had a tiled roof and tessellated floors. Unfortunately, seekers after stone in later ages have left little of the walls but the foundation trenches, and the floors have suffered similarly. Samian pottery and coins point to an occupation from the first to the end of the fourth century. If this villa

is evidence of the advance of civilization in the area, there are also signs of disturbance, presumably tribal. In the largest pit of the Iron Age a small hoard of late Roman coins, dating from A.D. 370–380, had been buried. In the same pit was a Saxon burial of the sixth or seventh century. The skeleton was well preserved, and with it were a knife and "scramasax". Excavations will be resumed during the Easter term, when it is hoped to determine the date of the villa with greater precision, as well as its relation to the cemetery.

University Functions and Responsibilities

THREE addresses to Victorian political organizations by Dr. R. E. Priestley, when he was vice-chancellor of the University of Melbourne, have been published under the title "The University and the National Life". In the first of these addresses, dealing with the finance and objectives of the University of Melbourne, Dr. Priestley attempts to summarize the functions of a university in a democratic country. First, he considers a university should admit and, if necessary, finance by scholarships, grants and loans, the pick of every generation of the youth of the State, irrespective of the class of homes or society they came from. The university's first duty should be to provide inspiring teaching and the means of full development of body, character and mind for its undergraduate students. For this purpose, research and investigation are essential and the staff must be large enough to ensure adequate contact with students as well as leisure for investigation. The university should aim at sending out graduates whose natural and recognized place would be the front ranks of the occupations they follow and who would be the natural leaders of their generation.

DR. PRIESTLEY also urged that a university should admit interest in, and a certain responsibility for, its men and women throughout their lives, and he stressed the importance of the university extension department as a means of stimulating and satisfying the desire for knowledge which, if democracy is to survive, must become the outstanding characteristic of the average citizen of the democratic state. A university, too, should be a reservoir of liberal and progressive thought, the defender and upholder of all that is best in the thought, customs and traditions in the lives of the people and the State. In his second lecture, on the university and rural interests, Dr. Priestley outlined the ways in which a university agricultural department could assist the farmer. Besides the training of men in the sciences of special importance to agriculture and the carrying out of research on fundamental problems which assists the building up of the fundamental knowledge needed to indicate to the technical worker the most profitable line of attack on his problems, Dr. Priestley stressed the value of the agricultural department as a source of unbiased opinion on agricultural matters. In his third address, on "A Free University", he referred to the value and importance of an adequate scholarship system and to the danger in Australia that efficient representation of sectional views may cause selfish and sectional interests to prevail over national interests. An even graver danger might be the failure to secure the best possible recruits for Australian public services, and only when university graduates are freely recruited for such services is the university making its best contribution to the community.

Staff and Student Stipends in Soviet Universities

ACCORDING to the Soviet Union Year Book Press Service, on November 12 the Soviet Government published a decree changing the regulations governing the payment of the academic staff at the higher educational institutions (universities) of the U.S.S.R. and increasing the stipends granted to students at these institutions. Under the new regulations, the academic staff will be paid on a staff salary basis, instead of on the old system of payment according to the number of hours worked. They will be able to hold a staff position at one higher educational institution only, though at liberty to engage in work at other higher educational or research institutions if they so desire. The salary rates for the upper staff are: directors of chairs at universities, 1,100–1,500 roubles per month (about £42–56), in accordance with length of service; professors, 1,000–1,300 roubles per month; senior lecturers, 700–900 roubles per month. Apart from their salaries, the members of staffs have the advantages of many social services, such as free medical treatment and free school and university education for their children. The new rates of State stipends granted to students at the universities are as follows: students taking a five-year course receive 130 roubles per month for the first year, 150 roubles per month for the second year, 175 roubles per month for the third and fourth years, and 200 roubles per month for the fifth year. Students taking a four-year course receive the same amounts for the first, second and third years, and 200 roubles per month for the fourth year. Students at the teachers' training colleges receive 130 roubles per month for the first year and 150 roubles per month for the second year. Stipends for postgraduate research students will be increased to 400 roubles per month. The number of higher educational institutions in the U.S.S.R. in 1936 was 700, and the number of students in them in the educational year 1936–37 was 542,000.

Mitogenetic Rays?

AN article entitled "An Experimental Study of the Problem of Mitogenetic Radiation", which forms *Bulletin* No. 100 of the National Research Council, Washington, D.C., will be welcomed by many who have waited for an authoritative statement on the reality or otherwise of this type of radiation. The authors, Alexander Hollaender and Walter D. Claus, have spent two years in order to prove or to disprove the existence of the so-called mitogenetic rays. These rays have been defined as radiation comprised between the wave-lengths 1900 A. and 2500 A., having an intensity of 10–1000 quanta/cm.^{2}/sec., the claim

being made that they are emitted by biological substances in certain stages of development. It is difficult to see how the authors could have gone further than they have in their efforts to prove or disprove the existence of these rays. Every precaution in the avoidance of errors and a wide range of material and methods of detection have been employed. In spite of this, all the attempts have yielded negative results. Neither biological nor physical detectors gave any indication that a measurable ultra-violet radiation is given out by typical 'mitogenetic senders'. It is a sobering reflection that no fewer than six hundred papers have been published on this subject.

Potato Synonyms

THE report of the work of the Potato Synonym Committee during 1936, recently published, forms a striking contrast to those issued in the early years of the Committee's activities. Whereas in former years a considerable proportion of varieties examined proved to be no more than established varieties under new names, in 1936 all but two were found to be distinct. A great reduction is also recorded in the number of synonyms which continue to be offered in seedsmen's catalogues. The improvement in this respect has been continuous, and as a result of direct correspondence, with few exceptions seedsmen throughout Great Britain now intend to list varieties only under their established names. It should be pointed out, however, that Cherub, Early Favourite and Cleadon Park are identical with Duke of York, Sharpe's Express and King Edward VII (red type) respectively, and that although Midlothian Early and Sir John Llewellyn still appear in some catalogues, they are identical with Duke of York and Eclipse. Dr. Salaman and his Committee are to be congratulated on the outcome of their work. At one time it was not generally appreciated, but we can say to-day that seed growers and buyers alike recognize the value of the efforts made to protect their interests by reducing the many names under which potatoes have in the past been sold. Copies of the report for 1936 may be obtained on application to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

The Royal Society of Arts

THE annual report of the Council of the Royal Society of Arts refers to the establishment of the distinction of Designer for Industry (D.I.) of the Royal Society of Arts as indicating the Society's continued efforts to raise the status of the British artist in industry. Other examples of its interest in this direction are the travelling bursary of £100 offered to art teachers, and the decision to revive on new lines the annual competition of industrial designs which was held from 1924 until 1933. It is hoped that the first of the new competitions will be held in 1938 for the textile industry, and that they will in due course be extended to other branches of industry. The Albert Medal of the Society for 1937 was awarded to Lord Nuffield "for services to industry, transport and medical science". Fifteen silver medals were awarded for papers read before the Society during the current session. Entries for the ordinary examinations of the Society in 1937 numbered 75,372, and the total number of papers applied for in all the examinations was 93,497. An important innovation under the Thomas Gray Memorial Trust was the decision to award a number of prizes to stimulate and assist the education of apprentices and deck boys. Prizes to the value of £100 were awarded during the year under the Trust for essays and inventions connected with the science and practice of navigation.

A New Garden Periodical

THE first number of *Gardening* made its appearance on October 15. It ministers well to the increasing popularity of the small garden, and scientific processes are portrayed in simple language. Mention may be made of "Secrets of Dutch Bulb Raising" by Kurt Lubinski, and "Wild Trees in the Garden" by Richard St. Barbe Baker. There are, in addition, more general articles on garden design, plant pests and beneficial insects, the storage of vegetables and fruit, manuring, and many other practical problems. *Gardening* is a fortnightly journal, price 4*d*., and is published by Messrs. Condé Nast Publications, Ltd., 1 New Bond Street, London, W.1.

Aerial Protection in Belgium

THE Ministry of the Interior in Belgium has organized a graduate school of aerial protection in Brussels for physicians, pharmacists, chemists and engineers. A library has been formed to collect international documentation on the subject, and it is anticipated that practical research laboratories will be established. The programme comprises the following features: international legislation, general and special chemistry, general and special pathology, therapeutics, procedures of identification and dosage, principles of individual and collective protection and general organization for protection.

Ramsay Memorial Fellowship

THE following awards of new memorial fellowships for the year 1937–38 have recently been made: A. E. Alexander, a British fellowship of £300, tenable for two years, at the University of Cambridge; T. P. Hughes, a British fellowship of £300, tenable for one year, at the University of Cambridge; Dr. E. de Salas, a fellowship of £300, tenable for one year, at University College, London; Dr. E. C. Stathis, a Greek fellowship, tenable at University College, London; Hazime Oosaka, a Japanese fellowship, tenable for two years, at University College, London; Dr. M. C. F. Beukers, a Netherland fellowship of £300, tenable for one year, at the Imperial College of Science and Technology, London; Dr. J. J. Hermans, a Netherland fellowship, tenable at University College, London. The Glasgow fellowship held by Dr. R. R. Gordon at University College, London, has been renewed.

Finney-Howell Research Foundation

AT the death of the late Dr. George Walker of Baltimore his will provided for the formation of a corporation to be known as the Finney-Howell Research Foundation, the purpose of which was to be the support of "research work into the cause or causes and the treatment of cancer". The will directed that the surplus income from the assets of the Foundation together with the principal sum should be expended within a period of ten years to support a number of fellowships in cancer research, each with an annual stipend of two thousand dollars, "in such universities, laboratories or other institutions, wherever situated, as may be approved by the Board of Directors". Fellowships will be awarded each year on the second Wednesday of March, beginning March 1938. These fellowships will be awarded for a period of one year with the possibility of renewal up to three years. Further information can be obtained from the secretary of the Foundation, Dr. William A. Fisher, Medical and Chirurgical Faculty Building, 1211 Cathedral Street, Baltimore, Maryland.

Meteors

ON November 9, about $21^h\ 25^m$ G.M.T., Mr. J. E. Daly, in North London, saw a meteor of magnitude equal to that of Jupiter, moving from the direction of the planet Saturn towards the west. Its motion was nearly parallel to the ecliptic, and its path was over 30°. No other observations of this meteor were reported, so it is impossible to give any details of its real path. On November 20, at $8^h\ 23^m$, a bright fireball was seen by two observers in Rathmines and Mullingar, travelling from south-east to north-west. The body of the fireball gave out an intense bluish-white light, and it had a trail two to three times the apparent diameter of the moon. As it was quite light at the time, it was impossible to describe its path with sufficient precision to enable its height, etc., to be computed. If it had been dark at the time, it is certain that the fireball would have been a very imposing sight.

World Power Conference: Vienna Sectional Meeting

A SECTIONAL meeting of the World Power Conference will be held in Vienna next year on August 25–September 2, by invitation of the Austrian National Committee. The meeting will be followed by one or more 'study tours' of approximately a week's duration. We understand that the British Government has received an invitation to be represented by official delegates at Vienna. The British National Committee, 36 Kingsway, London, W.C.2, has copies in English of the technical programme of the Vienna Sectional Meeting. It is divided into five sections, dealing with the supply of energy for agriculture, small-scale industries, household purposes, public lighting and electric railways. The term 'small-scale industries' is used to cover both handicrafts and industries employing a relatively small number of workmen, about twenty or thirty; in addition, hotels, cafés, restaurants and shops. The kinds of motive power used should be mentioned: solid and liquid fuel, gas, water power, wind power, steam or electricity, and stress should be laid on those of special importance. Information should be included on the use of human and animal as compared with mechanical power, and the influence of the latter on civilization and health. Technical and economic comparisons between the supply of energy from public electric or gas mains and from private plant would be welcome. Data about lighting power and heat in small-scale industries with special reference to the tools and the drive of the appliances employed, and in particular, room heating, air conditioning, cooking (on a large scale) in restaurants, bakers' ovens and welding. Under the section for the supply of energy for public lighting is included the energy used in traffic lighting, as on railways, for shipping, in air transport, and in traffic control signals.

Announcements

MR. E. HARRISON, director of agriculture for Tanganyika, has been appointed professor of agriculture at the Imperial College of Tropical Agriculture, Trinidad.

DR. JULIAN HUXLEY will deliver the Christmas Lectures (a course of six lectures adapted to a juvenile auditory) of the Royal Institution on December 28, 30, January 1, 4, 6 and 8. The subject of the lectures will be "Rare Animals and the Disappearance of Wild Life". Further information can be obtained from the Secretary, Royal Institution, 21 Albemarle Street, London, W.1.

ON the occasion of the eightieth birthday of Bernhard Nocht, founder of the Institute of Tropical Medicine at Hamburg, the Bernhard Nocht Medal has been awarded to the following, in recognition of their services to tropical medicine: Prof. J. Rodhain (Belgium), Prof. E. Brumpt and Dr. W. Fourneau (France), Profs. E. Martini and E. Reichenow (Germany), Dr. P. Manson-Bahr and Prof. G. H. F. Nuttall (Great Britain), Profs. E. P. Snijders and N. H. Swellengrebel (Holland), Prof. G. Bastianelli and Sir Aldo Castellani (Italy).

MESSRS. E. P. GOLDSCHMIDT AND CO., LTD., of 45 Old Bond Street, W.1, in their latest catalogue, No. 45, offer a selection of important books in the history of science, and also a few early microscopes. Noteworthy items are the astronomical classics, Copernicus' "De Revolutionibus Orbium" (1543), and Kepler's "Astronomia Nova" (1609). They also catalogue that bibliographical rarity, the original edition (1669) of Nicholas Steno's "De Solido intra Solidum", described by Sir Archibald Geikie as "one of the landmarks in the history of geological investigation". The interest of the catalogue is enhanced by many informative notes, and also by reproductions of title-pages and illustrations.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1017.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

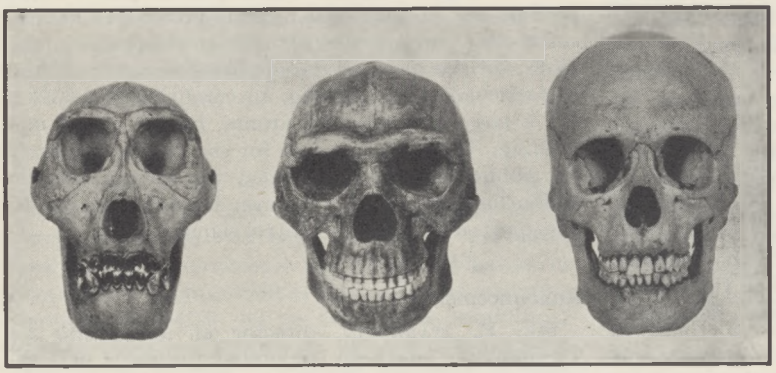


Fig. 1.

RECONSTRUCTION OF THE ENTIRE SKULL OF AN ADULT FEMALE *Sinanthropus pekinensis*. NORMA FRONTALIS. $\frac{1}{3}$ NAT. SIZE. FROM LEFT TO RIGHT: ADULT FEMALE GORILLA—*Sinanthropus*—ADULT MALE NORTH CHINESE.

Reconstruction of the Entire Skull of an Adult Female Individual of *Sinanthropus pekinensis*

DURING the last days of our spring excavations in Choukoutien this year, the left side of an upper jaw of *Sinanthropus pekinensis* with six teeth *in situ* was recovered. A preliminary description of this fragment is contained in my publication on the *Sinanthropus* dentition which will be available for distribution towards the end of this year. This specimen, together with other fragments of the facial skeleton of Skulls I, II and III of Locus *L*, which have already been described in NATURE[1], have made it possible to restore the entire face in connexion with the brain case.

Fig. 2.

THE SAME AS IN FIG. 1. NORMA LATERALIS SINISTRA. $\frac{1}{3}$ NAT. SIZE.

Since the last discovered maxilla fragment, according to its teeth, apparently belongs to a female individual, the brain case of the female Skull II of Locus *L* was used as a basis, but the nasal bones, the lateral border of the orbit, the frontal process of the maxilla with the upper lateral part of the nasal aperture and the zygomatic bone which were unearthed together with Skulls I and III, respectively, belong to male individuals. The reconstruction, therefore, was only a matter of adapting the various parts and of reducing them to the size and proportions given by the brain case—with the preserved supraorbital ridges and the deeper interorbital parts—and the above-mentioned maxilla.

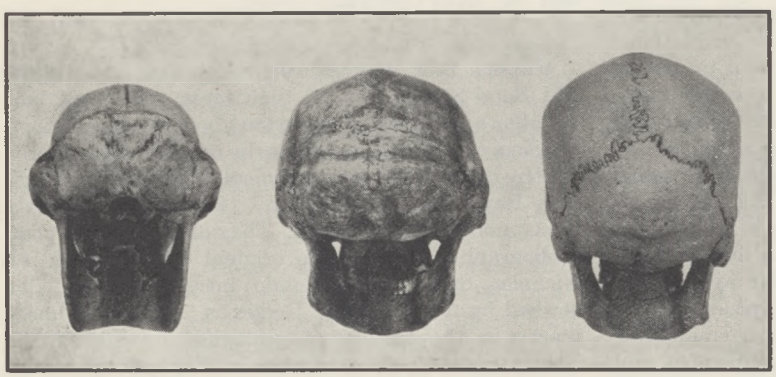


Fig. 3.

THE SAME AS IN FIG. 1. NORMA OCCIPITALIS. $\frac{1}{3}$ NAT. SIZE.

Since the fragments found all happened to be of the left side of the face only, the entire right side was restored on the basis of the left one. The reconstruction of the mandible required very little effort

since the *Sinanthropus* mandible *H* 1 was available for use[2]. The only alteration consisted of adapting it to the breadth of the brain case.

Thus, practically the entire facial skeleton was available, with the exception of a small part of the maxilla between the upper border of the infra-orbital foramen and the lower border of the orbit, and the zygomatic arch from its origin at the temporal bone to the origin of the temporal process of the zygomatic bone. Since the teeth of the female maxilla used for the reconstruction are much worn, no attempt was made to restore them in their unworn condition, and the lower teeth were adapted to approximately the same state of wear. The interior of the left orbit is only partly restored.

The effect of the reconstruction may be gathered from the accompanying reproductions. In order to demonstrate more distinctly the similarities and differences between *Sinanthropus* on one hand and the anthropoids and recent man on the other, *Sinanthropus* in all three views is flanked by the skull of an adult female gorilla and that of a male adult North Chinese. All skulls are orientated in Frankfort plane (orbitale-porion).

With regard to the details, the reader is referred to my study on the facial skeleton of *Sinanthropus* which is now in preparation. For the present, I only wish to point out that *Sinanthropus* is much more ape-like in appearance than any of the known Neanderthal skulls, and than has been expected by any of the investigators who have attempted to reconstruct the face of *Sinanthropus* on the basis of brain cases only. There is in addition one characteristic difference. In the Neanderthal man the lower border of the zygomatic process of the maxilla declines gradually from the zygomatic bone toward the alveolar process, as in the gorilla (see Fig. 1). In *Sinanthropus*, however, a deep notch separates the maxilla from the cheek bone. This notch is very common in recent man and also in the orang. That we are not dealing with an individual variation as regards *Sinanthropus* follows from the fact that the two maxilla fragments which are at our disposal display exactly this same feature.

The facial fragments of male individuals and the male mandible available suggest that the face of the male *Sinanthropus* may be heavier and the upper jaw more protruding than is evident in the reconstruction of the female individual.

Since the entire reconstruction with regard to all essential parts is based on actual findings and not a single detail is imaginary, the skull can be considered as a real standard type of a *Sinanthropus* woman of advanced age.

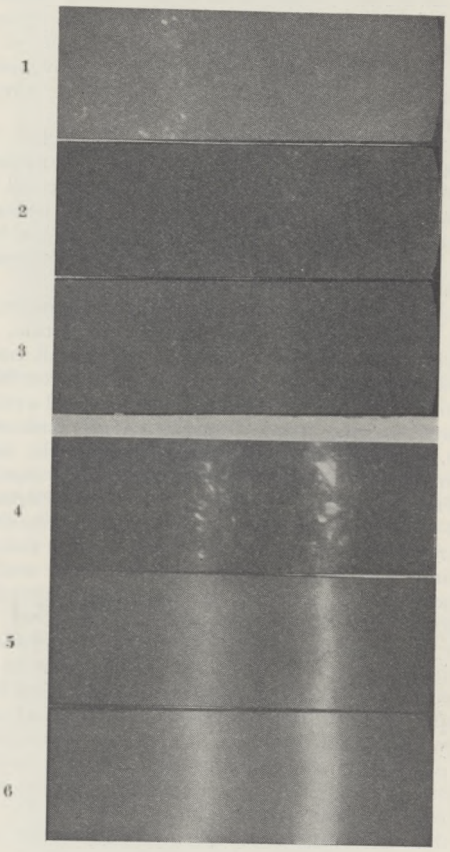
The reconstruction was carried out with the kind assistance of the sculptor Mrs. Lucile Swan.

FRANZ WEIDENREICH.
Peiping Union Medical College,
Peiping.

[1] NATURE, **139** (Feb. 13, 1937).
[2] See Weidenreich, "The Mandibles of *Sinanthropus pekinensis*", 1936.

Structure of Metals

THIS note describes some rather unexpected facts observed when nickel and gold are investigated at high dispersion with X-rays. In these experiments the distance between the film and the specimen is either 20 cm. or 30 cm. The primary X-rays after passing through a pin-hole of about ½ mm. diameter reach the specimen, a flat disk of approximately 1–1·5 sq. cm. surface, and are scattered back to the photographic film. The β_1 line of iron (wave-length 1·75301 A.) gives with the (400) crystal plane of nickel a glancing angle of 85½° at room temperature. A lattice change of 1/1,000 produces a shift of more than 7 mm. of the line on the film, and since the position of a sharply defined line can easily be measured to 1/10 of a millimeter, lattice changes of the order of 10^{-5} are observable. No such reflexions are ever obtained when the material is examined in bulk even with the purest and most carefully annealed substances. This is well known. With annealed powders or filings it is different, as is shown for example in the investigation of Owen and Yates[1] on pure nickel.



1, 2, 3. NICKEL FILINGS, HILGER H.S. BRAND, PURITY 99·97 PER CENT. RADIATION, IRON β_1. CRYSTAL PLANE (400). GRAIN SIZE, BETWEEN 120 AND 200 TO 1 INCH. ANNEALED FROM 700° TO 500° C. FOR 3 HOURS TWICE IN SUCCESSION. DISTANCE, SPECIMEN TO FILM, No. 1, 20 CM., Nos. 2 AND 3, 30 CM. No. 3 SPECIMEN ROTATED DURING EXPOSURE.

4, 5, 6, GOLD. No. 4, HILGER H.S. BRAND, TOTAL IMPURITIES LESS THAN 0·001 PER CENT, FILINGS NOT PASSED THROUGH SIEVE; ANNEALED FROM 600° TO 320° C. FOR TWO HOURS. No. 5, PRECIPITATED PURE GOLD, HEATED AT 600° C. FOR TWO HOURS. No. 6, SAME AS No. 5, BUT SPECIMEN ROTATED DURING EXPOSURE. RADIATION, α_1 AND α_2 NICKEL. CRYSTAL PLANE (422). DISTANCE SPECIMEN TO FILM, 30 CM.

When reflexions are observed under high dispersion as in the present work, very sharp reflexions from the individual crystal grains are obtained, but the surprising fact is that they are scattered over a

comparatively wide range of say about 3–5 mm. on the present photographs, thus indicating lattice variations of the individual crystals of the order of 1/1,000–1/2,000. Extremes are not infrequently found 10–15 mm. from the average position. This average position is found by rotating the specimen in its plane during the exposure. A smooth line now appears on the film, the centre of which is measurable with good accuracy. The lattice constant for pure nickel (Hilger H.S. Brand, 99·97 per cent) thus obtained agrees to 1/10,000 with Owen and Yates' figure.

Photographs made from 99·5 per cent nickel give a larger average spacing. The appearance of the picture is not altered and the spreading of the individual reflexions seems to be the same. Different ways of annealing seem to have little effect upon the appearance of the photographs; on none of the films is there any sign of the narrowing down of the reflexion range. The same holds at higher temperatures near and above the Curie point.

These observations, first made with nickel, hold also for pure gold. Here the α_2 line of nickel as radiation source happens to give high dispersion with the (422) plane in the gold lattice. The reflexions are more irregular in shape, the material not being passed through a sieve. The amount of spreading is of the same order as that of nickel.

It is scarcely to be expected that gold and nickel should in this respect differ from other metals. The conclusions drawn are likely to hold for all metals. The first conclusion is that precision data on lattice dimensions have to be regarded as statistical averages of figures varying over a comparatively wide range of, say, 1/1,000. The reproducibility of the lattice constant of an individual crystal grain is far less than that of the average. It is difficult to see why impurities should be responsible for the effect, since both the less pure and the purest nickel seem to give the same spreading, and that the same should occur with the extremely pure gold with a total impurity of less than 0·001 per cent. The grains themselves must consist of a large number of atoms, otherwise no sharp images could be obtained. This seems to eliminate surface effects. In addition, the nickel filings are kept fairly uniform in size. The crystal grains having different lattice constants cannot possibly all be in equilibrium at a given temperature, and this suggests that the ordinary annealing process is not capable of producing equilibrium.

Further investigations on a considerably larger scale are in progress.

I wish to express my appreciation to Mr. H. Smith for his very efficient help in this work.

ALEX. MÜLLER.

Davy Faraday Laboratory
Royal Institution,
London, W.1.

[1] *Phil. Mag.*, 21, 809 (1936).

An X-Ray Investigation of the Cause of High Coercivity in Iron-Nickel-Aluminium Alloys

IT was discovered by Mishima[1] that very good permanent magnets could be produced by the suitable heat-treatment of iron-nickel-aluminium alloys, of compositions near Fe_2NiAl. In search of an explanation, we have made a comprehensive X-ray examination of slowly cooled iron-nickel-aluminium alloys. The results show considerable divergences from Köster's diagram[2] (see Fig. 1), and shed new light on the results of earlier X-ray work on the magnetic alloys[3,4,5].

Köster's diagram is here reproduced in a simplified form to facilitate comparison with the new results. The nomenclature has been tentatively changed to

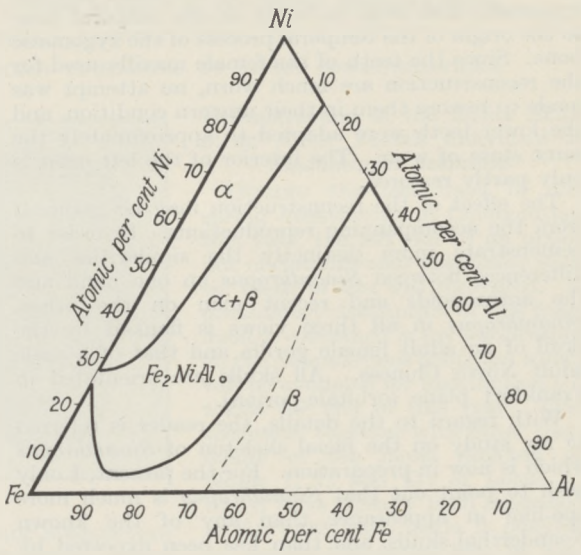


Fig. 1.

FE NI AL BASED ON KÖSTER'S DATA.

one based on crystal structure. Face-centred cubic structures are α, body-centred cubic structures β.

The β area shrinks with falling temperature. An alloy such as Fe_2NiAl, which is single phase just below the melting point, passes into a two-phase

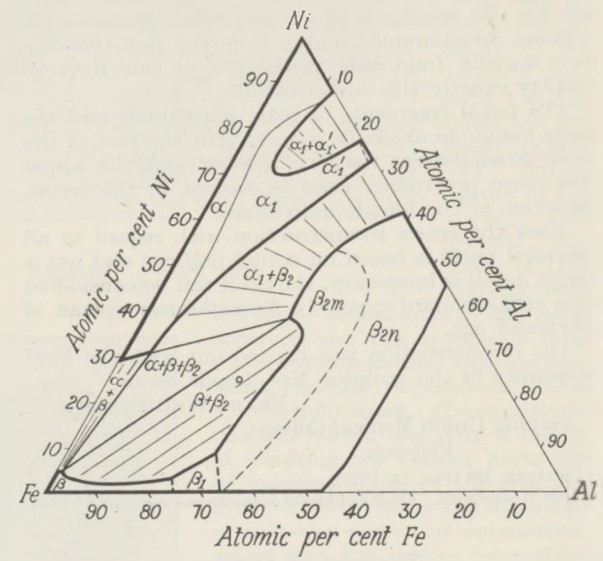


Fig. 2.

FE NI AL FROM X-RAY DATA.

region on cooling. According to Fig. 1, the face-centred cubic phase would be precipitated in this process, but this is not in agreement with X-ray work. We have therefore modified the diagram to agree with our X-ray photographs.

The new diagram (Fig. 2) contains the same single phase areas as Fig. 1, but Köster's two-phase area is seen to consist of four separate fields, $\alpha + \beta$, $\alpha + \beta_2$, $\beta + \beta_2$ and $\alpha + \beta + \beta_2$. The suffixes 1 and 2 indicate the presence of superlattices and m and n distinguish the magnetic and non-magnetic regions at room temperature. It will be seen that Fe_2NiAl lies in the $\beta + \beta_{2m}$ area after slow cooling. Both constituents are body-centred cubic and ferromagnetic; they differ in atomic arrangement and lattice spacing. In the iron-rich β constituent the atoms are distributed at random; in the β_{2m} constituent there is a superlattice in which cube corners are distinguished from cube centres. The lattice spacing of β is 0·3 per cent less than that of β_{2m}.

Burgers and Snoek have shown that the highest coercivity is obtained if Fe_2NiAl is cooled at a given rate. This permits the initial stages of the decomposition to take place without allowing it to proceed to completion. The original body-centred cubic lattice is preserved, but the distribution of the atoms is no longer uniform. We can now make a concrete picture of this intermediate state. Distributed throughout the parent lattice are little 'islands' of the iron-rich β-phase on the point of separating out. In a state of equilibrium they should have lattice dimensions 0·3 per cent less than the parent lattice, but this is not permitted. So long as the structure remains coherent, the iron atoms are held apart in a condition of immense strain. This is the essential cause of the high coercivity.

Further work on this subject is proceeding in co-operation with the Permanent Magnet Association and the Electrical Research Association.

We are greatly indebted to Prof. W. L. Bragg for his kind interest.

A. J. BRADLEY.
A. TAYLOR.

Physical Laboratories,
University,
Manchester.
Sept. 20.

[1] Mishima, T., *Stahl u. Eisen*, **53**, 79 (1931).
[2] Köster, W., *Archiv. Eisenhutt.*, **7**, 257 (1933–34).
[3] Werestchiagan, L., and Kurdjumov, G., *Tech. Phys. U.S.S.R.*, **2**, 1 (1935).
[4] Glocker, R., Pfister, H., and Wiest, P., *Archiv. Eisenhutt.*, **8**, 561 (1934–35).
[5] Burgers, W. G., and Snoek, G., *Physica*, **2** (10), 1064 (1935).

Double Structure of Chromosomes

THE structure of chromosomes has been a matter of such diversity of opinion and interpretation that it is desirable that certain points at least, which can be definitely settled, be removed from the region of doubt. *Trillium* is a plant genus with chromosomes so large that their component threads are far above the limits of resolution with the microscope. They are therefore not subject to the doubts and criticisms sometimes expressed concerning observations on the structure of chromosomes which are much nearer the limits of visibility.

Recent observations in my laboratory, of chromosomes in the root tip mitoses of *Trillium sessile* from preparations of Mr. S. V. Mensinkai, show undoubtedly that the metaphase chromosomes (Fig. 1) consist of four strands twisted about each other in pairs, while the anaphase chromosomes (Fig. 2) contain two spiral chromonemata clearly embedded in a matrix, and cannot by any stretch of the imagination be regarded as single. At the ends of the chromosome the two chromonemata generally converge so as to meet end-to-end and form a rounded tip to the chromosome. This can be seen at several places in the accompanying figures. In other cases, as at the points marked *a* in Fig. 2, the uncut end of a chromosome shows the two chromonemata diverging or running parallel.

Fig. 1.
METAPHASE CHROMOSOMES OF *T. sessile* (× 3000).

Whether these chromonemata are themselves double, as some cytologists hold, remains to be determined by further observations. It can, at any rate, no longer be reasonably contended that anaphase and telophase chromosomes are single structures and that the split in the threads must therefore occur

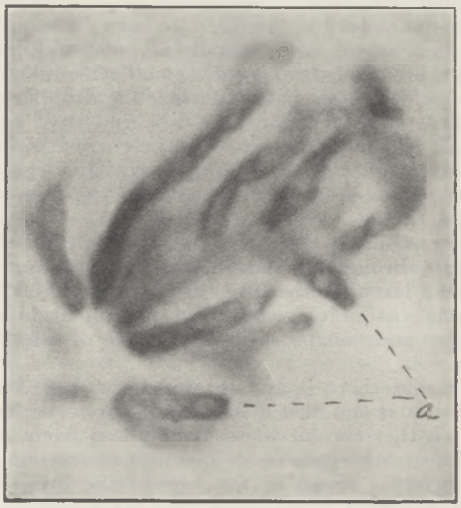


Fig. 2.
ANAPHASE CHROMOSOMES OF *T. sessile* (× 2200).

invisibly in the resting nucleus. This being the case, the hypotheses which Darlington[1] and others have put forward on the assumption that the anaphase chromosomes are single structures are invalidated. This includes Darlington's view of the relations between meiosis and mitosis. This hypothesis,

involving the single nature of the leptotene thread, is also contrary to other recent critical observations of the early meiotic threads in *Trillium* and various other plants.

The attempts made by various investigators to use the results of X-ray fragmentation of chromosomes as crucial evidence for the time at which the somatic chromosomes split have resulted in failure. This appears to be because each investigator has been able to interpret his results as supporting the ideas he previously held, so that the method is not discriminative.

R. RUGGLES GATES.

King's College,
London, W.C.2.
Nov. 11.

[1] "Recent Advances in Cytology" (1937).

Blindness in Freshwater Fish

THE cause of blindness in freshwater fish is frequently sought by owners of fishing waters and fish farmers. Usually the blind fish are old fish and have lost the gift of sight in one eye or both due to some growth behind the eyeball or some accident to the front of the eye.

Recently a number of yearling rainbow trout were received from a trout farm in which some fish were blind in both eyes. Apart from the blindness, the fish were in very good condition as regards colour and weight. Investigation revealed the cause of blindness as being due to the presence of about forty living forms of the larvæ of the trematode *Diplostomum volvens* Nord. in the lens. The life-history, or as much of it as is known, is recorded in Plehn's "Praktikum der Fischkrankheiten" and taken from trout, whereas in America it has been taken from Black bass, etc.

So far as I am aware, it has not been previously recorded in Britain.

The life-history is, briefly, as follows: The principal host is a water bird, usually a gull, and inhabits the gut of the bird, where its sexual cycle takes place. The fertilized eggs pass out with the droppings and, if taken up by a freshwater fish, find their way via the gut to the blood stream to be carried ultimately to the lens of the eye, where the eggs give rise to the larval stages of the worm, causing the lens to lose its function.

In some cases the lens becomes so swollen up as to burst through the outer coat of the eye, and liberates the larval forms into the water. If the fish or the lens is eaten by a water bird then the bird becomes infected and can be a further source of infection to other fish.

Whether there is any intermediate stage between the fish and the bird does not appear to be known; and whether the larval form liberated from the fish can infect other fish is not given in the records.

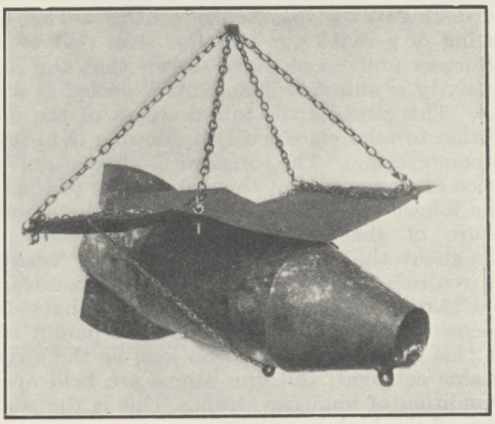
The larval forms in the lens of the infected fish were of varied shape, and only when about to be liberated had they the well-known fluke form. Sizes up to 0·3 mm. were seen.

W. RUSHTON.

Biological Department,
St. Thomas's Hospital Medical School, S.E.1,
and
Salmon and Trout Association,
Fishmongers Hall, E.C.4.
Nov. 1.

A Plankton Collector for Fast Towing

DURING the course of an investigation of the *Sagitta* population in a portion of the Irish Sea, it became desirable to sample the waters over a large area. An attempt was made to devise a tow-net which could be used on coasting boats, the speed of which is approximately eight knots. An instrument was designed (Fig. 1) on a similar principle to Hardy's model[1] but with several modifications. It consists of a diving fin to which is attached the plankton collector with an internal conical silk net.



PLANKTON COLLECTOR FOR FAST TOWING. The rear chains were shortened for photographing. (PHOTO. BY P. BOND.)

The body of the plankton collector is a cylinder ten inches long and seven inches in diameter with cones on each end. The front cone is 6½ in. long with a mouth opening 2¾ in. in diameter. This size mouth opening gave a ratio of one to 6·5 between the cross-sectional areas of the mouth and cylinder. The front cone is detachable, fitting into the cylindrical body by means of a wide collar. The inner end of this collar is tapered slightly and rimmed. The mouth of a small conical, coarse silk net 10 in. long is fitted over this rim and tied; at this point the incoming water is slowed down to its minimum rate of flow. A small wide-mouth jar was fastened to the end of the net to hold the filtered plankton. The cylindrical body of the instrument is bolted along the short axis of the diving fin, which is 22 in. long and 11 in. wide. To each corner of this rectangular sheet iron fin a chain is attached; all four chains fastening through a shackle by means of which the device is towed.

An early model with two side fins was successfully tested, through the courtesy of Prof. T. B. Abell, in the tanks of the School of Naval Architecture at Liverpool. In use, the instrument made from this model was unsuccessful. It was unstable and would dive only for very short periods. The side fins were later discarded, and a sheer-board was substituted, as described above. In this form it was successfully towed from a motor-boat at about five knots. Catches of living *Sagitta* and additional plankton were taken in the small jar fastened to the end of the net. These catches were comparable to those made at the same time in a coarse silk tow-net.

Owing to lack of time for further tests at increased speeds, the instrument was at once used from a cargo boat running at about eight knots between Liverpool

and Whitehaven. During this trial the diving fin was found to be too light in construction; it bent under the increased pressure, and the body was lost.

It is hoped to continue experiments with this type of collector in the future. The instrument can be made inexpensively, and may be of great service for collecting uninjured living plankton quickly over a wide area in the sea or in lakes. I am indebted to Prof. J. H. Orton for assistance and advice in this work.

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Nov. 15.

[1] Hardy, A. C., *J. Mar. Biol. Assoc.*, **21**, 147–177 (1936); "Discovery" Reports, **11**, 457–510 (1936).

Refractive Indexes of Helium I and II

THE refractive indexes of liquid helium I and II have been measured by the use of a Wollaston cell as previously described[1].

The values obtained for the index for λ 5461 A., with their estimated errors, were as follows:

	Temp. (° K.)	Critical angle	Refractive index	$\frac{\mu^2-1}{\mu^2+2}\cdot\frac{1}{\varrho}$
He I	4·22	78° 28′ ± 20′	1·0206 ± 0·0012	0·109
He I	2·26	76° 51′ ± 5′	1·0269 ± 0·0004	0·122
He II	2·18	76° 51′ ± 5′	1·0269 ± 0·0004	0·122

These values agree with the preliminary value 1·028 ± 0·006 obtained by Wilhelm and Cove[2] for the index for helium II. The value of μ^2 at 2·18° K. is 1·0545, which corresponds closely to the dielectric constant $K = 1·0558$ [3].

In order to ascertain whether there was any difference in the molecular refractivities of helium I and II, the observing telescope was set on the critical edge in He II at 2·18° K. Then the temperature was raised through the λ-point to 2·26° K., where the density is the same to within 0·00005. In passing from one temperature to the other several times no change in the position of the critical ray resulted. A change of one minute of arc could have been detected easily in this way. Therefore the index changes by less than 0·00007 in passing from a point in He II to a point with the same density in He I.

The work was carried out by Prof. J. O. Wilhelm, Mr. H. E. Johns and Prof. Grayson Smith.

E. F. BURTON.
(Director).

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Nov. 4.

[1] Johns, H. E., and Wilhelm, J. O., *Canadian J. Research*, **15**, 101 (1937).
[2] Satterly, J., *Rev. Mod. Phys.*, **8**, 347 (1936).
[3] Wolfke, M., and Keesom, W. H., *Leiden Comm.*, 192 A.

Natural Activation of Papain

WORKING with latex of *Carica papaya*, we were able by different methods (dialysis, precipitation, etc.) to separate the natural activator from the enzyme system.

When solutions containing the activator were added to a latex preparation ('centrifugate') which split up gelatin, but not peptone, peptone hydrolysis was induced; with commercial papain, again, the otherwise small peptone hydrolysis was considerably enhanced. No increase in the hydrolysis of gelatin on addition of the natural activator solutions was observed; in many cases a decrease in activity was actually produced. The activator solutions showed *inter alia* strong sodium nitroprusside and ninhydrine reactions and gave the characteristic cuprous salt on treatment with cuprous oxide in acid solution. The solid residue obtained on decomposition of the cuprous salt showed the properties of glutathione. The admixture of this product with pure glutathione did not produce a pronounced depression of the melting point.

On adding pure glutathione to 'centrifugate' or to commercial papain, the induced or, respectively, enhanced peptone hydrolysis observed even at comparatively low concentration of glutathione reached the value attained on activation by prussic acid. Hydrolysis of gelatin by the same enzyme preparations, on the other hand, was decreased by addition of small quantities of glutathione. When, however, greater quantities of the latter were added, the primary inhibition was annulled, and with comparatively large amounts of glutathione, stimulation of gelatin splitting was observed.

The chemical behaviour of the natural activator, and the corresponding action of the natural activator and of glutathione on the hydrolysis of peptone and gelatin, make it probable that the natural activator is glutathione. A decisive proof on this question must await complete chemical analysis. For seasonal reasons, some months must elapse before the large amount of latex required for the preparation of sufficient material for a full chemical analysis will become available to us. A final and detailed report will be published elsewhere at a later date.

MAX FRANKEL.
R. MAIMIN.

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Nov. 2.

Standardization of Potato Slopes for Bacteriological Tests

IT is common to find differences in the growth of sub-cultures of the same bacterium on potato slopes, and it also frequently happens that there is a percentage of unsatisfactory slopes in a batch of potato medium after sterilization. Possibly our experience in trying to standardize this medium for work in this laboratory may be of use to other microbiologists.

Thirteen varieties of potato have been tested, and all of them have been used fairly soon after lifting. The cut blocks are washed in running water for at least 12 hours, and then put in test tubes resting on a small wad of cotton wool, and the tube is filled with distilled water until the potato wedge is completely covered; this water is poured away after sterilization just before the tube is inoculated. The substitution of normal saline solution does not improve the final character of the slope. We have tried various methods of sterilizing to see whether this effects the condition of the wedge: steaming on three successive days, autoclaving once for fifteen minutes at three different pressures, namely, 5 lb., 10 lb. and 15 lb., and autoclaving for five minutes on each of two successive days at the same three pressures.

The results from these different methods are not conclusive. In every case the sterilization has proved adequate, since no contaminations have occurred, at least within a period of six weeks, but, on the whole, the wedges remain in better condition after two short

periods of autoclaving rather than after one longer one. The varieties of potato tested which make 100 per cent good slopes after all treatments are Majestic, Epicure, Red King and King Edward; those which are definitely bad are Katriona, Sharpe's Express and King George; while Arran Banner, Duke of York, Dunbar Cavalier, British Queen, Arran Comrade and Great Scot are variable. It is possible that the degree of ripeness of the potato may be one factor which determines the character of the slope in these variable cases.

The bacterial growth obtained on the varieties used is also variable, especially in the case of pigmented species. There is no question in these experiments that Majestic promotes the greatest and most typical growth, while Epicure, British Queen and Arran Comrade are also good. Among the other varieties there is little to choose from the point of view of amount of growth, but the type of growth may be different. The following descriptions of cultures of a soil species of *Flavobacterium* when grown on potato slopes emphasize this point:

Dunbar Cavalier. Scanty, pale yellow streak, just raised, smooth, glistening, dry.
Great Scot. Moderate, cream to yellow, raised, slightly nodular, glistening, slightly moist.
Arran Banner. Moderate, pinkish, raised, slightly nodular, glistening, moist.
Sharpe's Express. Moderate, canary yellow, slightly raised, smooth, glistening, dry.

It seems that for comparative work it is essential to use the same variety of potato, and from all points of view Majestic is a very satisfactory variety.

D. Ward Cutler.
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Nov. 4.

Axial Spin and Weapons of the Ancients

As one interested primarily in linguistic studies, I should like to suggest two points, one in confirmation and to amplify, the other a query, arising from Sir Gilbert Walker's article on "Mechanics of Sport" in Nature of October 2.

That the ancients were aware, at least empirically, of the steadying influence of a movement of rotation about its longitudinal axis on an object also endowed with the motion of translation, is beyond doubt. This spin can be communicated by the thumb and fingers (as in throwing the assegai); or by a cord (the 'becket') which unwinds and is left in the hand. The becket corresponds to the Roman *amentum* and the Greek ἀγκύλη, which are often mentioned in connexion with the throwing of spears. Sir Gilbert cites becket and *amentum*; but one can go further. In Latin it is curious how constantly the verb *torqueo* ('twist') and its derivatives are used of *throwing* a spear. Virgil alone employs *torqueo* and its compounds about sixty times of hurling projectiles. This was pointed out by R. F. T. Crook[1], who convincingly deduced that the choice of the verb *torqueo* implied the imparting of an axial spin. The imposing array of evidence which he adduces makes this view much more likely than the older interpretation, that *torqueo* referred to a preliminary 'flourish' or brandishing. Last year[2] I attempted to develop this idea, showing that πάλλω was used in Greek of communicating precisely the same twirl to a spear; an explanation which, if true, incidentally provides a very simple etymology for πάλλω.

The flight of the arrow raises the question to which I should be glad to receive an authoritative answer. Did the ancients, by feathering their arrows with truncated wing feathers, arranged in cyclic regularity of bias, impart a slight rotary spin to the arrow? Illustrations on vase paintings suggest this arrangement. So, too, the modern practice, apparently. "The fletcher selects feathers from either one wing or other of the bird."[3] There is also in Duff's practical manual a diagram of a transverse section of a feathered arrow, showing the screw-like relation of the tips of the feathers (p. 128). A correspondent to *The Times* (Feb. 17, 1936) writes: "It is essential that the feathers should curve the same way, to impart a slight rotary motion to the arrow in flight, and therefore, since the feathers curve differently on each wing, all three (feathers) should be from the same one." On the other hand, I have often heard it stated that the feathered arrow flies steadily—on an even keel, so to speak—like a miniature aeroplane. Sir Gilbert Walker writes of the function of the feathers as merely providing resistance at the rear end (to prevent the arrow slewing round to fly with its length at right angles to its path). This, too, is, I think, the popular idea of an arrow's flight—compare "as straight and steady as an arrow". Does an arrow rotate?

L. J. D. Richardson.

Department of Latin,
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Cardiff.
Nov. 3.

[1] *Classical Rev.*, **30**, 46–8 (1916).
[2] *Trans. Philolog. Soc.*, 101–5 (1936).
[3] Duff, J., "Bows and Arrows".

Boron in Agriculture

The importance of boron in agriculture is now well recognized, and in the recently published monograph on the subject, R. W. G. Dennis and D. G. O'Brien[1] have made an excellent survey of the information available up to the present time. The rapidity with which knowledge on the subject has accumulated may be judged by the fact that only six years have elapsed since the matter was of purely scientific interest, whereas now it has become one of economic importance. New plants for which boron is essential are constantly being discovered, and this year it has been established at Rothamsted that carrots should be added to the list. According to Bertrand and de Waal[2], carrot contained 25 mgm. boron per kgm. dry matter compared with 2·3–5 mgm. in cereals and 75·6 mgm. in beet, all plants being grown in the same soil. This relatively low boron content of carrot possibly indicates that its need for the element is not great, and that in consequence, disease due to its deficiency is not likely to be widespread.

K. Warington.

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[1] *West of Scot. Agric. Coll. Res. Bull.*, No. 5 (1937).
[2] *Ann. Agron.*, **6**, 537–541 (1936).

Products formed during the Preparation of Ketene

TRACES of naphthalene have been detected in the acetone condensate obtained during the preparation of ketene by passing acetone vapour over electrolytic copper heated in a silica tube.

The naphthalene was isolated from the acetone condensate by distilling off the acetone and a colourless pungent liquid boiling up to 120° C. The remaining brown tar was steam distilled giving a pale yellow solid which sublimed to colourless crystals, m.p. 79–80° C. These crystals were identified as naphthalene by picrate (m.p. 140–143°; 147°) chlorodinitrobenzene (m.p. 75–76°) and trinitro toluene (m.p. 92–95°) derivatives.

As evidence against the possibility that the naphthalene may have been due to impurities, naphthalene was again detected in similar quantity when extra care had been taken to exclude any such impurities.

It would be interesting to know whether any other investigator has detected such a product.

R. W. HALE.

Fort Dunlop,
Birmingham.
Oct. 22.

Why Do Stranded Whales Die?

WHEN a school of whales was stranded on an Australian coast, much to the discomfiture of local health authorities, I put to various colleagues in the University of Melbourne the simple query: Why do stranded whales die? I received the following answers, and it was amusing to note that in most instances the explanation was coloured by the special study of the colleague interrogated.

(1) The blood now being acted on by gravity collects in the dependent parts and produces anæmia of the brain.

(2) The weight of the body impedes breathing.

(3) Vital organs are crushed by the great weight.

(4) The unaccustomed warmth, especially if there is direct insolation, induces heat stroke.

(5) The unaccustomed temperature interval between night and day gives rise to internal chills and probably pneumonia.

(6) The whales do not die because they are stranded; they are stranded because they are dying.

Perhaps the list can be extended by readers of NATURE.

W. A. OSBORNE.

University, Melbourne.
Nov. 1.

Points from Foregoing Letters

A COMPLETE skull of *Sinanthropus pekinensis* (female) has been reconstructed by Prof. Franz Weidenreich by means of a recently discovered upper jaw with six teeth together with other fragments of the facial skeleton previously found, belonging to the same species, so that all the essential parts are based on actual findings. Photographs are submitted showing a comparison of the reconstructed skull with that of a female gorilla and an adult male Chinese.

X-ray photographs obtained by Dr. A. Müller from nickel and gold disks under high-dispersion conditions (using the β-line of iron and the α_2-line of nickel, respectively, as incident radiations) show that the X-rays are scattered over a comparatively wide range. The author concludes that precision data on lattice dimensions have to be regarded as statistical averages of figures varying within, say, 1/1,000. The lattice 'constant' of an individual crystal is less reproducible than that of the average.

An X-ray study of iron-nickel-aluminium alloys has led Dr. A. J. Bradley and A. Taylor to put forward a new explanation of the properties which enable them to be used as permanent magnets. On slow cooling, these materials break up into two body-centred cubic lattices of widely varying compositions, but in the permanent magnetic state the two lattices remain coherent.

Prof. R. Ruggles Gates submits photomicrographs showing that anaphase chromosomes of *Trillium sessile* are double. The demonstration of this fact has important consequences for hypotheses of chromosome structure and behaviour.

Cases of blindness in fish (rainbow trout) are reported by Dr. W. Rushton, due to the presence in the eye lens of the larvæ of the trematode, *Diplostomum volvens*. The life-history of this parasite indicates that part of its existence is spent in the gut of water birds.

A plankton collector suitable for towing at a relatively high speed is described by E. Lowe Pierce. It consists of a metal cylinder with cones at each end and an internal conical silk net, the whole being attached to a diving fin.

According to new experiments by Prof. J. O. Wilhelm, H. E. Jones and Prof. Grayson Smith, reported by Prof. E. F. Burton, the refractive index of liquid helium I at 4·22° K. is 1·0206 and at 2·26° K. it is 1·0269. The latter value is identical with that for liquid helium II at a temperature of 2·18° K. when it has the same density. There is no abrupt change in refractive index at the transition point.

The natural activator of papain has been separated from the enzyme system of the latex of the papaw by Prof. Max Frankel and R. Maimin. Its chemical properties and influence on gelatin and peptone cleavage respectively make it probable that this activator is glutathione.

The unequal development of bacterial cultures grown on 'potato slopes' from different varieties of potatoes is described by D. Ward Cutler and Mabel Dunkley. Experiments with *Flavobacterium* indicate that the varieties 'Majestic', 'Epicure', 'Red King' and 'King Edward' give the best results.

"Does an arrow rotate?" inquires L. J. D. Richardson, who points out that the Latin word *torques* may have implied the imparting of an axial spin.

Miss K. Warington directs attention to the growing list of plants for which boron is an essential constituent. The latest addition to the list is the carrot, though its relatively small boron content (25 mgm. per kgm. of dry weight) indicates that disease due to boron deficiency is likely to be rare in this plant.

Research Items

Crystalline Preparations of Viruses

Two papers which describe the preparation and properties of liquid crystalline substances from virus-infected cucumber and tobacco plants have recently been published by Messrs. F. C. Bawden and N. W. Pirie. The first (*Proc. Roy. Soc.*, B, 123, No. 832, 274–320; Aug. 1937) shows that such substances cannot be isolated from healthy plants and that crystalline preparations of tobacco mosaic are infective at a dilution of 1 in 10^{10}. Many physical properties of virus mixtures are discussed, and it is interesting to note that filters which pass an infectious filtrate from plant juice will not allow the passage of purified preparations, thus suggesting that the purified aggregates are larger than those which occur naturally in the plant. The other paper (*Brit. J. Exp. Path.*, 18, 275; 1937) considers the relationships between crystalline preparations of cucumber viruses 3 and 4, and strains of tobacco mosaic virus. All such preparations have similar chemical composition, and have many physical properties in common. Precipitation tests and X-ray measurements, however, can distinguish between the cucumber viruses and tobacco mosaic preparations. A reasonable similarity between the chemical and physical properties of a crystalline virus preparation and its pathological behaviour is noticeable.

Invertebrates of Dybsø Fjörd

DR. KNUD LARSEN'S paper "The Distribution of the Invertebrates of the Dybsø Fjörd, their Biology and their Importance as Fish Food" (Report of the Danish Biological Station 41; 1937) is an attempt to link up the number of animals found on the sea bottom with the numbers eaten by the fishes on the same grounds. The *Macoma balthica* community is specially studied for this purpose. The work is in three sections, dealing with (1) the composition of the animal community; (2) the biology of the individual species, and (3) the importance of the species in the diet of the fishes in the fjord. By means of the first and second sections, the author can calculate the proportion between the percentage quantities of the individual species on the sea bottom and in the fish stomachs. *Idothea viridis*, the commonest isopod of the fjord, comes first in numbers as fish food, being eaten by all the fishes investigated (7), except the roach. Next comes *Gammarus locusta* and the third *Leander adspersus*. The roach is entirely a mollusc-feeder and its extremely rapid growth is attributed to its diet, for molluscs are of high nutritive value. *Mytilus edulis*, *Cardium exiguum*, *Hydrobia* sp. (called here *ulvæ*), *Littorina rudis*, *Neritina fluviatilis* and *Limnaea ovata* are all eaten. There is a great preponderance of molluscs in the community which make up about 88 per cent of the average weight per square metre, the remaining 12 per cent consisting of crustaceans, worms and insects. It is interesting to find that the *Hydrobia* of the fjord, still unnamed, although placed under the heading of *H. ulvæ*, has no pelagic larval stage, "the whole development taking place in the egg from which the animal enters the bottom stage directly". This suggests that it is another species and not the true *H. ulvæ*.

Fossil Insects from the Permian Rocks of Kansas

THE *American Journal of Science*, **33**, 81–110 (1937), contains a paper by the late Dr. R. J. Tillyard which forms Part 17 of that author's series on Kansas Permian insects. Under the name of *Elmoa trisecta*, there is described what is claimed to be the first known Megasecopteron from these rocks, the author not accepting the view that the contemporaneous Protohymenoptera are specialized members of the same order. The new genus *Kansasia* is erected for the third known Palædictyopteron from the same beds. An apical fragment 8 mm. long of an early dragonfly wing is named *Camptotaxineura* and made the type of a new family of Protanisoptera. In the new family Permembiidæ there is brought to light what is described as an early group of Psocid affinities. The remainder of the paper deals with Neuropterous fossils and adds considerably to knowledge of that order in Lower Permian times. Most of these appear to be allied to the recent family Berothidæ, of which archaic living types still remain in Australia. The basal half of a wing of Sialoid affinities is named *Promartynovia* as the type of a new family of ancient alderflies. It is pointed out that the relationships of these early Sialioidea are obscure, and better material is needed before they will be understood.

Embryology of the Crustacean *Anaspides*

IN *Papers and Proceedings of the Royal Society of Tasmania* for 1936 (1937; pp. 1–35, pls. i–xiii), Mr. V. V. Hickman contributes an important article on the embryological development of *Anaspides tasmaniæ*. It forms the first account yet published of the development of any of the Syncarida. *Anaspides*, it appears, shows, in its development, a close resemblance to the Leptostraca as exemplified by *Nebalia*. The early stages, however, bear some resemblance to those of certain of the Entomostraca. Thus the holoblastic segmentation, followed by the formation of an evident blastocœle and the development of an invagination-gastrula giving rise directly to the mesenteron, are cases in point. In certain other respects, *Anaspides* also resembles the Branchiopoda. These are evidenced in the mode of origin of the maxillary gland, the long persistence of yolk granules, the prolonged dormancy of the embryo in the winter egg and in the mode of hatching. A further resemblance is seen in the habit of movement in an inverted position (when young) on the underside of the surface film in calm water. The author states that it is hoped to supplement this paper by further examination of the post-embryonic development.

Herbage and Forage Seeds

THE last three bulletins of the series of six on the production of seed of herbage and forage crops have now been published by the Imperial Bureau of Plant Genetics (Herbage Plants), Aberystwyth. Bulletin 22 (price 5*s.*), by Gwilym Evans, describe the technique which has been evolved at the Welsh Plant Breeding Station for producing seed from their various strains of hay and pasture grasses, special consideration being given to the time and rate of sowing, isolation, manures and fertilizers,

harvesting, seed conditioning and storing. Bulletin 23 (price 5*s*.), edited by R. O. Whyte, is concerned with the methods used in the production of legume seed (lucerne, various clovers, etc.) in different parts of the world, and is a companion volume to Bulletin 19, already published, which deals with the production of grass seed from a similar point of view. Bulletin 24 (price 2*s*.), by F. J. Crider and M. M. Hoover, gives an account of the collection of native grass seed in the Great Plains, United States, and will be of particular interest to those in the more arid grassland countries where erosion is a problem, as it contains illustrations of typical grasses which are being produced in connexion with the soil conservation programme of the Great Plains district.

Arctic and Antarctic Diatom Floras

THE report on the diatoms collected during the Australasian Antarctic Expedition, 1911–14 (Scientific Reports. Series C. Vol. 1, part 1. Pp. 82+6 plates. Washington: U.S. National Museum. 9*s*.) emphasizes the wealth of the diatom flora of the arctic and antarctic areas. Dr. Mann suggests that the high percentage of carbonic acid held in solution owing to the low temperature and the long-continued light during the summer season may be significant in this connexion. In contrasting the two areas, the striking difference is that the arctic species are small and relatively simple in construction, whilst the antarctic forms are large and elegant in form and ornamentation and include many forms common to temperate and subtropical seas. Dr. Mann points out that owing to the distribution of the land masses, wide open seas run down to the antarctic and include various southerly currents, whilst the arctic seas are more enclosed by land masses and even in the Atlantic, the only northward current is that running along Scandinavia towards Spitsbergen. The species recorded are listed and described.

Incompatibility and Sterility in Sweet Cherries

THE results of an exhaustive survey of cherry varieties in respect to the above properties have recently been presented by M. B. Crane and A. G. Brown (*J. Pom. and Hort. Sci.*, 15, 2, 86; 1937). Conclusions drawn from more than 236,000 pollinations are discussed and the results presented in tables which should prove of great value to the cherry grower. Incompatibility in the sweet cherry is due to the failure of the pollen tubes to complete their growth down the tissue of the style, with the result that fertilization cannot take place and the young 'fruit' ceases growth and falls from the tree at an early stage. This is distinguished from sterility, which is expressed by non-viable pollen or imperfectly developed ovules, being more apparent on the female than the male side. Incompatibility is determined by genetic factors which control pollen-tube growth, and it seems that under normal conditions pollen cannot function in the style of a plant carrying the same factors as the pollen. All the varieties examined exhibited self-incompatibility without exception, whilst cross-incompatibility was common and always reciprocally expressed. The yields from compatible crosses showed considerable variation, which though largely due to indirect factors such as age of tree and previous cropping, was undoubtedly due in certain cases to the effect of generational sterility on the proportion of fruits which set and reached maturity. The genetical aspects of the results are discussed and the practical applications indicated. Though many factors such as disease, nutrition, climate, etc., affect the initial setting of the fruit and the ultimate yield, it is clear that effective pollination and fertilization are essential. In view of the general occurrence of self-incompatibility and the frequency of cross-incompatibility, no variety of sweet cherry should be planted in complete isolation either as single trees in private gardens or as large blocks in commercial plantations. Care should be taken to interplant varieties which are known to be compatible and which flower at the same time.

A New Fungus Gall

THE fungus *Cyttaria septentrionalis* causes the appearance of a gall upon *Fagus Moorei* in southern Australia. It is rather infrequent to find that an operculate member of the Pezizales has such an action upon a living tree, and the structure of galls formed by this fungus has been investigated by Miss Janet M. Wilson (*Proc. Linn. Soc. N.S. Wales*, 62, Pts. 1–2; 1937). Wedge-shaped areas of infection appear on the small branches, and although the galls may grow to a considerable size, they do not appear to restrict the growth of that part of the tree upon which they occur. Secondary xylem and phloem, cambium and cortex are all invaded by mycelium of the fungus, and each region is enlarged by the abnormal multiplication of cells. Haustoria of the fungus approach the nucleus of a living cell in the host, and coil around it, but do not cause death. Initial infection appears to be associated with the cambium, and the fungus often lies dormant for a season, before it initiates the formation of a gall.

Ecology of Tomato 'Spotted Wilt' Virus

A VERY extensive study of the incidence of 'spotted wilt' disease in field plots of tomatoes in southern Australia has been made by Dr. J. G. Bald (*Bull. Council for Sci. and Ind. Research*, No. 106, Melbourne, 1937). Records of infection were made for nine years, and yielded a number of interesting results. The degree of infection rose through the growing period in a series of successive maxima which apparently represented the emergence of successive broods of the transmitting insects *Thrips tabaci* and *Frankliniella insularis*. High temperatures usually increased the rate of infection, and within a range of about 15 yards from a source of infection every plant had an equal chance of contracting the disease. It required isolation by distances of 200–300 yards before the spread of infection was seriously reduced. Migration of thrips from overcrowded populations upon plants of *Solanum nigrum* and *Lycium ferrocissum* also accounted for considerable infection in spring, and it was possible in all cases to find a positive correlation between the degree of infection and the relative number of transmitting insects.

Structural Geology of Maryland

VOL. 13 of the reports of the Maryland Geological Survey is of general interest to geologists because it contains a detailed account of the methods used in investigating the structures of crystalline rocks and a fine series of examples of the application of these methods. Hitherto, much of the more recent relevant literature has been in German. The Piedmont Province of Maryland includes complexes of igneous rocks which were intruded as molten masses into

rocks already metamorphosed. Both were then again subjected to forces which further transformed them. Ernst Cloos shows how the various types of rock behave under stress and summarizes the methods by means of which the available evidence can be pieced together to yield a picture of the former conditions and history of the region. H. G. Hershey gives an account of the structure and age of the Port Deposit Granodiorite complex. The ovoidal gneiss-domes near Baltimore are shown by C. H. Broedel to have originated as a result of earth movements which began in Pre-Cambrian time. A volcanic complex in Cecil County has been studied by J. Marshall. The history is one of isoclinal folding, fracture cleavage, intrusion of gabbro, injection of granodiorite followed by dykes and veins, and finally development of cataclastic structures along shear zones. The statement in the preface that "The volcanic activity is the oldest geological incident in the history of this region since the lavas include fragments of all subsequent rocks formed prior to the close of igneous activity after the invasion of the gabbros and granites which now form the rocks of the Susquehanna Gorge" is not very helpful. The Baltimore Gabbro consolidated as a saucer-like body between adjoining domes of Baltimore Gneiss. Made classic by the well-known work of Williams half a century ago, it has now been thoroughly re-studied by C. J. Cohen. Primary flow-lines are distinguished from superposed structures due to subsequent deformations. The volume also contains an account of the Upper Cretaceous stratigraphy of the coastal plain of Cecil County by C. W. Carter.

Sanriku Earthquake Seawaves of 1936

In 1896 and 1933, and to a less extent in 1897, the north-east coast of Japan suffered from the seawaves resulting from great earthquakes. On November 3, 1936, an earthquake, strong enough, like the others, to cause slight damage on the adjoining coast, occurred in the same region of the Pacific. Mr. N. Miyabe (*Bull. Earthq. Res. Inst.*, **15**, 837–844; 1937) has described the small seawaves, about one foot in range, that were recorded at seven stations on the Japanese coast. The interval between the time of occurrence at the origin of the earthquake and the first disturbance on the mareogram, ranging from 28 min. to little more than an hour, enabled him to estimate the distances of the origin from six of the stations, and thus to obtain the position of the epicentre in lat. 38·0° N., long. 143·0° E. It is interesting to notice that all four epicentres lie on a curve roughly parallel to the coast, about 90 miles in length and the same distance from the coast and coinciding nearly with the isobath of 3000 metres, the epicentre of the latest earthquake occupying the most southerly position.

Crystalline Vitamin A

Although the existence of vitamin A was proved so early as 1913, its isolation is only very recent, and a provisional standard based on the extinction coefficient of a concentrate has been in use. H. N. Holmes and R. E. Corbet (*J. Amer. Chem. Soc.*, **59**, 2042; 1937) now describe the preparation of a substance crystallizing in pale yellow needles, melting at 7·5–8·0°, and having the very high extinction coefficient of 2100, as compared with the highest previous value of 1700 and the provisional standard of 1600. The substance is regarded as pure vitamin A. It was obtained from the liver oils of three different species of fish by a process of fractional freezing and cold filtration, and the addition of water to a solution in methyl alcohol. The biological assays give about 3 million international units per gram. The molecular weight by freezing point lowering was found to be 294, whilst Karrer's formula, $C_{20}H_{30}O$, for vitamin A requires 286. It was found that extinction measurements with the spectrophotometer should be made instantly after dilution with ethyl alcohol, since the extinction coefficient changes rapidly on standing and indications of a new absorption band appear, perhaps as a result of chemical change. The combustion analyses of the substance gave C = 83·28, H = 10·44, whilst Karrer's formula requires C = 83·84 and H = 10·56 per cent.

Liquid Parahydrogen

The molecular volumes at saturation of liquid normal hydrogen and parahydrogen have been determined by R. B. Scott and F. G. Brickwedde (*J. Research Nat. Bur. of Standards*, **19**, 237; 1937), who find that parahydrogen has a higher molecular volume, the expansivity being only slightly greater than that of normal hydrogen. The change in molecular volume in passing from orthohydrogen (molecules rotating) to parahydrogen (molecules not rotating) is opposite in direction to the change observed with other substances in passing from rotating to non-rotating states. An explanation is given based on the small moment of inertia of the hydrogen molecule so that the orientation of the axes of the molecules of parahydrogen can have a random distribution in the liquid and solid phases, and hence the state of non-rotating parahydrogen is like that at high temperatures in other substances whose molecules are rotating. The discussion involves a detailed consideration of the intermolecular forces for the two kinds of hydrogen molecule, the repulsive forces arising from regions of high electron density in neighbouring molecules being different. It may be mentioned that E. A. Long and O. L. I. Brown (*J. Amer. Chem. Soc.*, **59**, 1922; 1937) find no essential difference in the p, v, t relations of normal and parahydrogen gases at low pressures from the boiling point to 55° K.

Conductance of Mixtures of Strong Electrolytes

Although the simple theory of Kohlrausch indicates that the electrical conductance of a mixture of strong electrolytes is additively composed of the separate ionic mobilities, calculations by Onsager and Fuoss based on the modern theory of electrolytes indicate that the decrease in velocity of an ion due to the field effect is a function of the properties of all the ions in solution, and a deviation from the additive law is to be expected. Experimental results found by Bray and Hunt in 1911 showed good agreement between observed and calculated values at low concentrations, but at higher concentrations the observed mixture effect appeared to be about half that calculated. In these experiments, mixtures of hydrochloric acid and sodium chloride were used. K. A. Krieger and M. Kilpatrick (*J. Amer. Chem. Soc.*, **59**, 1878; 1937) have now investigated mixtures of lithium and potassium chlorides. The same result is found, namely, that the observed change is about half that calculated by Onsager and Fuoss at higher concentrations and tends to agree with it at lower concentrations. No explanation of the discrepancy is offered.

History of Science and Technology

FOURTH INTERNATIONAL CONGRESS

THE fourth International Congress of the History of Science and Technology was held in Prague on September 22–27 under the presidency of Prof. Quido Vetter. A few days prior to the Congress, Czechoslovakia had been struck a cruel blow by the death of the President-Liberator of the Czechoslovakian Republic, Dr. T. G. Masaryk. The delegates to the Congress assembled on the day of the funeral, and as was to be expected at such a time of national mourning, the Congress opened under a cloud of sadness. The social functions previously announced did not take place, but otherwise the whole programme of work was completed.

The conference, which was most successful, was attended by about two hundred and fifty members, including a distinguished group of Czechoslovakian scholars and scientific workers, as well as by delegates from twenty-four other countries. Official delegates had been sent by the Governments of the Argentine, Austria, Bulgaria, Great Britain, Italy, Latvia, Mexico, Rumania, Spain, Sweden, Switzerland and the United States, while the leading foreign academies of science, scientific societies and universities were also represented. The absence of representatives from Germany, however, was noticeable.

The meeting coincided with the one hundred and fiftieth anniversary of the birth of J. E. Purkyně, the famous Czechoslovak biologist, and delegates were invited to take part in the international celebration and conference which had been arranged by the Purkyně Society to commemorate the occasion. A visit was also made to the tomb of Purkyně at Vyšehrad. It had previously been recommended to the International Academy that the Congress should deal with the development of sciences in the eighteenth century and in the first half of the nineteenth century, while as a second subject the "History of Science in Instruction" was proposed.

The opening session of the Congress was held in the well-appointed Purkyně Hall of the Institute of Medicine, at the University of Charles IV, under the presidency of Prof. Q. Vetter, president of the Congress. The delegates were welcomed on behalf of the Czechoslovakian Government by Dr. E. Franke, Minister of Public Instruction. Prof. Charles Singer, who led the British delegation, communicated friendly greetings and good wishes from Great Britain for the success of the conference, and similar messages of good will were expressed by several other foreign delegates. The inaugural address was then given by Prof. Boh. Němec on the subject "From Newton to Darwin".

On the following day an address on "The Spirit of Science in History" was given by Prof. Singer before one of the plenary sessions of the Congress. He pointed out that the ultimate aim of the scientific mood—as of the other great moods, the religious and the artistic—is to integrate the outer with the inner world. He emphasized that the scientific mood must demand independence of all the other judgments that influence mankind, such as those based on fashion, tradition, taste, nationality or class, and showed that science is of all studies the most truly man-wide, humane and international.

Prof. G. Loria of Genoa gave an interesting account of a study of the geometric representation of values in the different epochs in the history of mathematics, and indicated the conclusions he had deduced from these researches. Dr. Joseph Mayer of Washington directed attention to the reasons why the social sciences lag behind the physical and biological sciences, which have moved forward with unprecedented rapidity during the last hundred to hundred and fifty years. He showed that, at any rate in the light of the history of science, we can at least understand why there is so much uncertainty, hesitation and apparent misunderstanding in contemporary efforts to solve social problems. Other addresses given before the plenary sessions included "The Biological Cosmologies of the Nineteenth Century" by Prof. Otto Grosser, "The Development of Agriculture in Czechoslovakia" by Dr. F. Lom, "The Beginning of Scientific Life among the Rumanians" by Prof. Valeriu Bologa, "Purkyně and the Cellular Theory" by Prof. F. K. Studnička.

The work of the Congress itself was divided into six main sections, namely, (*a*) general science, (*b*) mathematics, (*c*) natural science, (*d*) medicine, (*e*) agriculture, (*f*) technical science. Approximately one hundred and fifty papers, which covered an extremely wide range of subjects, were scheduled for presentation and discussion at these meetings. A memorial meeting was held on the occasion of the one hundred and fiftieth anniversary of the birth of J. E. Purkyně, under the ægis of the Purkyně Society, in the Pantheon of the National Museum on Saturday, September 25, when representatives of universities and scientific societies commemorated the genius of that eminent man of science. The Minister of Education, Dr. Emil Franke, addressed the meeting on behalf of the Czechoslovak Government, and Prof. B. Němec gave an appreciation of Purkyně's work.

The success of the Congress was assured by the cordial hospitality extended to the delegates by the people of Czechoslovakia, and by the well-organized arrangements made by the committee. The delegates were able to visit the many historical buildings and monuments with which Prague is so richly endowed, and were privileged also to inspect the library of the monastery of Prémonstrats at Strahov. Excursions were also made to Karlstein, Křivoklát, Blatná and Strakonice.

A special exhibition of documents relating to the "History of Science in Czechoslovakia" was arranged in the Clementinum, and in the National Museum by the organizing committee with the co-operation of the National Museum, the National Library and the University, while a catalogue of the exhibits was specially prepared for distribution to the members of the Congress. An exhibition of documents and personal relics relating to J. E. Purkyně was also arranged by the Purkyně Society. Another exhibition, of modern scientific and technical literature in Czechoslovakia, was specially arranged, and attracted much attention.

At the opening ceremony of the exhibition in the Clementinum, the delegates enjoyed a performance to ancient Bohemian polyphonous music sung by the Bohemian madrigalists conducted by Prof. B. Špidra. This improvised concert deeply impressed the visitors, as also did the compositions of Rejcha and Mozart played in the large hall of the Wallenstein Palace by the Prague brass quintette. The performance of Weber's "Oberon" in the Prague German Theatre, and that of Smetana's "Libuše" in the National Theatre, as well as the concert of the Czech Philharmonic Orchestra at the Smetana Hall conducted by Mr. Rafael Kubelik, offered further opportunities for the delegates to become acquainted with the cultural life of Czechoslovakia.

Among the resolutions submitted and approved at the final meeting of the Congress was a proposal that history of science should be included in the teaching of secondary and high schools, and also a request for the publication of Isaac Newton's correspondence.

An invitation from the Swiss Government to hold the next congress at Lausanne in 1940 was accepted, and Prof. Arnold Raymond, formerly rector of the University of Lausanne, was elected president. An invitation from the Brazilian Government to an extraordinary congress in 1938 was also accepted.

Overvoltage in Light and Heavy Water

BY means of the polarographic method with a dropping mercury cathode, Prof. J. Heyrovský, in collaboration with Dr. J. Novák, has been able to advance knowledge of hydrogen overvoltage (*Coll. Czechoslovak Chem. Com.*, 9, 207, 273 and 344; 1937). By this delicate method they were able to register significant differences in current voltage curves in light and heavy water, with special reference to hydrogen overvoltage. They find that in 0·001 *N* hydrochloric acid in ordinary water at 20° C. the overvoltage differs from that in 99·6 per cent deuterium oxide by + 87 millivolts; in 94·6 per cent D_2O by 63 millivolts; in 76·5 per cent D_2O by 31 mv. and in 49·8 per cent D_2O by 15 mv. At 60° C. the differences with the purest heavy water is + 71 millivolts. The factor b in Tafel's term, $b \log i$, is 113 millivolts at 20° C. in heavy water and 102 in light water.

The electro-reduction of hydrogen peroxide is similarly inhibited in heavy water. On the other hand, the electro-reduction of oxygen, and of maleic acid in acetic acid solution, and the electro-deposition of thallous ions in heavy water proceed at an unchanged potential or at a distinctly more positive one than in light water. The theoretical significance of these experimental results is discussed by Prof. Heyrovský, who gives a general theory of hydrogen overvoltage which appears to account well for the observed facts. He regards the electro-deposition of the isotopic hydrions as indifferent, but the evolution of hydrogen, including its molalization, as 5·4 times less in heavy water; 5·4 is the ratio of the ionic products of H_2O and D_2O, and signifies that the rate of dissociation of water is 5·4 times that of deuterium oxide. The molalization takes place through the interaction of the deposited hydrogen atoms with the hydrions of the solution:

$$H + H^+ = H_2^+$$

The formula finally deduced for the overvoltage is

$$\pi = + \frac{RT}{F} \log \frac{([H^+] + [D^+])^2}{i + \bar{\omega} i^2} (C_{H_2O} K_1 + C_{HOD} (K_1' + K_2') + C_{D_2O} K_2),$$

where $\bar{\omega}$ is the mean adsorption coefficient of the freshly formed hydrogen molecules, C_{H_2O}, C_{HOD} and C_{D_2O} denote the molar fractions of the solvent, and K_1 ($K_1' + K_2'$) and K_2 are the dissociation constants of H_2O, HOD and D_2O respectively.

The validity of the equation has been tested by substituting calculated quantities of light and heavy water, and the observed results are in good agreement with theoretical requirements. The electrolytic separation coefficient for the hydrogen isotopes at cathodes with large overvoltage is dependent on the composition of the mixture and on the current density. The mean value of 5·4 should increase to 50 in concentrated heavy water and decrease to 2·7 in ordinary water.

Employment of University Graduates

YEAR by year some 15,000 students enter the universities of Great Britain. Their intentions, hopes and aspirations and those of their parents and other counsellors are almost as various as their pedigrees, but they are admitted on the assumption that their undergraduate years are to be dedicated more or less to preparation for their life's work, and the shaping of university policies is to a large extent determined by that ideal. In their careers after the completion of their undergraduate courses, the value of that preparation is tested, and the employment of graduates is, obviously, a matter of concern not only to them but also to university administrators and to the community as a whole.

The University Grants Committee in its quinquennial report published last year dealt at considerable length with problems of student numbers and employment. This year the National Union of Students held a Congress at Southampton on April 1–8, at which these formed the main subject of

discussion, the actual title given to the Congress being "Training for What ?" The subject was chosen after a serious and sustained effort on the part of the National Union (in association with local unions) to elucidate some of these problems—an effort frustrated to some extent by want of statistics.

For the university statistician, a student ceases to exist from the moment when he ceases to be an active member of the university, and in the absence of authentic statistical data, only conjectural, vague or partial answers can be obtained to such questions as : How many graduates, with what qualifications, were seeking employment twelve months after leaving the university ? How many specially prepared for certain vocations have accepted employment in other fields ?

This matter of the lack of official statistics of employment of graduates was repeatedly mentioned in the University Grants Committee's report, but without any indication that the Committee thought anybody ought to do anything about it. The Congress report stresses the importance of a comprehensive knowledge of the actual facts about graduate employment, and takes the view that it is 'up to' the universities to acquaint themselves with the practical results of their methods of undergraduate education. Foremost among the topics dealt with by one of the three sections of the Congress, the Commerce and Industry section, was "the work and functions of a university appointments board", the pressing importance of which had been emphasized last year by the University Grants Committee. The results of the discussion of this topic were formulated as a series of definite recommendations, now published in an appendix to the report, including one to the effect that every university appointments board should be charged with the duty of obtaining information about the employment (including unemployment and misemployment) of graduates, and tabulating it in standardized forms.

It is worth noting that in the case of the University of Wales, the matter is somewhat simplified by the fact that every graduate is, by virtue of graduation, a member of the Guild of Graduates of the University. A valuable report by the secretary of the Guild on "Graduate Unemployment in Wales", published as Appendix D to the Congress report, shows that the Guild's standing committee is a resourceful and influential body. The report is based mainly on replies to 2,250 *questionnaires* distributed last November. The fact that only 60 per cent were answered suggests that something more compelling than membership of a guild is needed.

So much for statistics. The Congress discussions ranged over many other important matters, among them being the prospects of increased employment of graduates in primary schools and in the local government services.

As pointed out in an article in *The Times* Educational Supplement of September 4 on "Openings for Graduates", the primary schools present a field of service second to none in national importance. The rapid expansion of staff requirements for secondary schools since 1902 has had a most unfortunate result as regards the staffing of the elementary schools. The idea of attracting recruits for these schools from among university graduates was allowed to lapse and a cleavage of type between the teachers in the elementary and those in the secondary and 'public' schools became firmly established. The graduates who now find their way into elementary schools do so, in general, with reluctance, having failed to obtain employment in secondary schools (for which their training was designed to fit them) and are liable to be regarded with disfavour by their co-workers on that account. Some approach towards unification of conditions of service in the elementary and secondary schools suggests itself as a promising first step towards remedying this unfortunate state of affairs, and one of the Congress resolutions proposed that the Onslow Committee in its investigations into salary scales should be urged to remedy the more glaring inequalities.

The situation is aggravated by the fact that many of the students in the teacher-training departments not merely dislike the idea of teaching in elementary schools but do not really wish to teach at all. "Many of them," says the report, "had obtained a Board of Education grant because it was the only way by which they could obtain the benefits of a university education, while others had drifted into teaching through the absence of any apparent alternative". While lamenting this result of the Board's system of grants, affecting both elementary and secondary schools, it is well to remember that dissatisfaction with one's work is a complaint by no means peculiar to the teaching profession—or to the present age (Horace satirized it). The Education section of the Congress suggested as a remedy "the institution of a greatly increased number of scholarships or grants which, while they would still cater for the needs of the poor student, would not bind the holder in advance to the pursuit of any particular career".

As regards the recruitment of graduates for the local government services, it is perfectly clear that local authorities are proof against persuasion in the form of impressively worded recommendations supported by apparently flawless arguments such as are to be found in the final report of the Royal Commission on Local Government, the report of the Hadow Departmental Committee on Qualifications, Recruitment, Training and Promotion of Local Government Officers, and the reports of the University Grants Committee. Mr. Chuter Ede, chairman of the Surrey County Council, addressed the Professions and Public Services section of the Congress on this subject. He suggested one-year post-graduate courses in the principles and practices of local government, and that the universities should agitate for the institution of competitive examination for appointments to local government service. Discussion of these and other suggestions led to the adoption of resolutions that the N.U.S. should consider co-operation with professional associations such as the National Association of Local Government Officers and that university authorities should be approached in the matter of courses of training for the public services including courses open to persons already in local government service. It had transpired in the course of discussion that in London and Liverpool time is allowed to local government employees for attendance on university courses, and it was thought that in the general adoption of such an arrangement was to be found a hopeful line of approach to the desired liaison between universities and local authorities in relation to appointments. Sir Richard Livingstone's plea, in his address on September 6 to Section L of the British Association, for adult education of a new type, should help to speed such a movement.

The ever-growing complexity of the modern world is continually throwing up new opportunities for the

employment of trained intelligence. The report takes the view that university students are too prone to ignore all avenues to worthwhile occupations other than the beaten paths of teaching, medicine, engineering, law, civil service, the church and set courses in industry and commerce. "Arts graduates, especially, rarely think of any possible occupation other than teaching". Such considerations point to the need for more recourse to vocational guidance. A first-year course on careers, available for all students, was advocated in an address by Prof. J. H. Jones of the University of Leeds. It should aim at "the development of some conception of citizenship and social responsibility" and should be given, *not* by an appointments officer but by a number of persons experienced in their profession and in the life and purpose of a university. It should be voluntary, but time should be allowed from existing first-year courses to enable students in all faculties to attend. The Congress recorded its approval of the introduction of such orientation courses coupled with a recommendation of vocational guidance by 'careers masters' in schools and appointments boards in universities, mutually co-operating.

The question of limitation of entry into universities has an obvious bearing on graduate employment. This prickly subject is touched on in the report somewhat gingerly. Fairly general agreement was reached in discussions in the Commerce and Industry section that universities ought to select from among candidates for admission only those capable of a distinctively university type of education, "an education in which the student is not so much taught as provided with the tools for the acquisition of knowledge and technique", others being referred to suitable institutions providing higher education of a technical character. Presumably such a selection would be made after a brief probationary period of membership in the university. The report recognizes that any recommendation from a student body that there should be any limitation of educational opportunities might be open to misconstruction and abuse, and suggests, therefore, that the whole matter should be inquired into further by a thoroughly competent commission. The matter is certainly one of enormous importance, but it is difficult to imagine the desired reform being effected without infringing the autonomy of the universities.

Engineering Progress in the Navy

IN taking office, for a second term, as president of the North-East Coast Institution of Engineers and Shipbuilders, Prof. C. J. Hawkes delivered an address in which he reviewed some recent history of the engineering branch of the Royal Navy, established by Orders in Council just a hundred years ago. He referred in particular to the period of his own service, dating from 1900, when great difficulties were being encountered with large water-tube boilers of the Belleville type. Small-tube Thornycroft boilers had given good results in H.M.S. *Speedy* in 1893. The decision in 1894 to install Belleville boilers in the 25,000 h.p. cruisers *Powerful* and *Terrible* was a momentous one and raised a storm of protest. The trials were satisfactory and demonstrated the weight-saving advantages, but later performance was disappointing, breakdowns were frequent and leakage was excessive, thus giving point and momentum to the attacks in Parliament and Press. The committee set up to investigate, however, confirmed the advantages and greater suitability of the water-tube as compared with the cylindrical boiler for use in the Navy. Improved methods of construction and the installation of special machinery in the dockyard enabled the Belleville boilers to give good service, but owing to inherent defects, including the long water and steam course of about 170 ft., some irregularity in water circulation and the deformation of tubes by local heating, it ultimately gave place to more modern designs.

In 1904, oil fuel as a supplement to coal was sanctioned, and seven years later it was decided that all new cruisers and battleships should be designed to burn oil only. Although this was a change of great national importance, it aroused none of the violent passions associated with the introduction of the large-tube water-tube boiler. From the engineering point of view and that of the ship as a fighting unit, oil firing has several important advantages over hand-fired coal for steam raising. As native sources of supply are as yet quite inadequate to meet the needs of the Navy even in time of peace, the position is a difficult one, but so necessary is it that the Admiralty has decided to continue its use for steam raising in the Fleet. The production of oil fuel from coal is therefore being encouraged.

Up to 1900 all warships were propelled by reciprocating steam engines; the T.B.D. *Viper* was the first to have turbines. There were early difficulties in operating turbines at cruising speed and full speed, but these were so far overcome that in 1905 it was decided that all future warships be fitted with turbine machinery and, in that year, the *Dreadnought*, the first turbine-driven battleship, was laid down. At first turbines were direct-coupled to propeller shafts, but from 1911 gearing was used resulting in increased propulsive efficiency and reduced fuel consumption per shaft horse-power. The lubrication of multiple-thrust blocks was a constant difficulty and the author quotes a case in which at a certain speed, the flow was reversed and oil from the thrust-block wells overflowed from the oil box situated 10–12 feet above the shaft. A system of forced lubrication was thereupon devised and worked without trouble, but the real solution came with the invention of the Michell thrust-block which alone has made present-day shaft loads practicable.

Prof. Hawkes gave figures to show the saving in weight and space which has resulted from these and other improvements, the more marked as they are accompanied by greater reliability and durability. Further advances may be looked for, but it must be borne in mind that in naval design there are limitations which do not apply to land practice.

Electrification of the Paris-Orléans and Midi Railways

THE paper read on November 18 by Mr. A. Bachellery at a joint meeting of the Institution of Electrical Engineers with the British Section of the French Society of Civil Engineers, shows that considerable progress has been made with the electrification of some of the French railways since Mr. Bachellery read a previous paper in 1923. At that date, only about 15 miles of the Paris-Orléans railway was operated electrically, and on the Midi railway there were three sections operating on different systems and at different pressures.

In 1934 the two railway systems were formed into a single group, the electrification work being under common direction. The new permanent way equipments are now of the 1,500 volt direct current type. The system covers nearly the whole of the mountain lines in the Pyrenees, including the two trans-Pyrenean routes, where there are gradients of more than 1 in 25. Next year, when the line between Tours and Bordeaux has been completed, electric locomotives will be able to run without interruption from Paris to Irun on the Spanish frontier, a distance of about 500 miles. At present electrification covers 22 per cent of the length of the whole system and handles 50 per cent of the traffic.

In 1936 the consumption of electrical energy for the railways was 470 million kilowatt hours, and this effected a considerable economy in the use of coal. The energy is mainly produced by hydro-electric plants belonging to the railways, but part is drawn from steam plants connected with the railways' high-voltage lines.

In some parts of the line it was necessary to adopt electrification, as with coal the attainable speed and maximum loads were far too low. It is noteworthy that although the companies have made very successful attempts to improve the power and fuel economy of its express steam locomotives, the electrification still makes steady progress in advance.

The weight of the fast passenger trains on the French railways is going steadily up. They now often weigh about 750 tons. This is due to the continued increase in the construction of metal coaches and the growing demand for comfort. The road transport competition has forced them to raise their speed, and this implies a large increase in tractive power. Whilst the continuous rating of the most modern passenger steam locomotives does not in practice exceed 2,500 h.p. at the drawbar, and it is only with great difficulty that the average fireman can withstand the strain that this represents, the performance of the high-speed electric locomotive is at least 50 per cent greater. This easily gives the required acceleration for heavy passenger trains.

The average economy of coal on the companies' electrified lines is roughly 670 metric tons per mile of route, and this warrants the cost of electrically equipping the permanent way. Recent economic and social changes have tended to increase operating expenses ; but this increase is far less in the case of electric traction than with steam traction. This is due to the fact that whilst the price of coal is steadily rising, that of the energy generated in the companies' water-power plants is practically constant. The capital spent on electrification by the Paris-Orléans and Midi companies has proved a good investment.

Drilling Mud

MUD-FLUID is now an important factor in oil-field development, but although it has actually been in use for more than sixty years, comparatively little technical literature is available on the subject. P. Evans and A. Reid, being sensible of this position, and particularly of the essential part now played by mud-fluid in rotary drilling, have compiled a paper (*Trans. Min. and Geol. Inst. India*, 32, December 1936) which has for its theme the investigation of the properties of mud-fluid, its manufacture and testing.

In this paper, which forms a complete volume, are incorporated certain results of experimental work carried out in the Burmah Oil Company's laboratories and also a review of literature consulted by that Company's technical staff during the course of research work.

Mud-fluid is best prepared by the combined methods of jetting and churning, and should be manufactured at a central plant to facilitate distribution where there are many rotary wells. Reconditioning of used mud by means of de-gassing and de-sanding is essential, especially where the cost of new mud is high ; this can sometimes be done by chemical methods, though mechanical means are more usually employed. Above all, mud-fluid should be adequately and regularly tested. Specific gravity can be controlled by varying the proportions of solid and liquid. Viscosity should be determined, and in so doing both 'yield value' and 'mobility' taken into consideration, as the flow of drilling mud is not similar to that of a simple liquid such as water. Specially designed viscometers are suggested for determination of this function. As the mud has to flow at high speed in a very restricted space, the pressure needed to pump it through the circulating system of the well is proportionately high, and lines are indicated on which it might be possible to relate physical properties of the mud to pressures required for pumping them.

Thixotropy has also to be taken into account in assessing the value and efficiency of mud-fluid. This is a property which causes certain muds to set to a jelly-like mass, but to return to a mobile liquid when agitated. The change from liquid to jelly and vice versa may be repeated almost indefinitely. Viscosity measurement of thixotropic substances is complicated, as viscosity increases or decreases according to whether the mud is agitated or disturbed.

Various other properties of mud-fluid are discussed and the whole work liberally illustrated by graphical and other results. The book serves admirably to show the present state of knowledge of this somewhat obscure subject, and to indicate the lines on which future research could most profitably be undertaken.

Science News a Century Ago

The Royal Geographical Society

THE meeting of the Royal Geographical Society held on December 11, 1837, was devoted to communications relative to Australia. Captain Maconochie had sent a paper "On the Soil and on the Natives, at Port Philip"; the Chief Justice, Sir John Jeffcott, in a letter to Sir John Barrow, had described the site chosen for the City of Adelaide, and Captain Vetch spoke "On the Political Geography and Geographical Nomenclature of Australia". Regarding nomenclature, he said, "This is a branch of geography usually left to chance or caprice; and it will not be easy to find any department so left, which has been more abused. Good taste, and even common sense, is concerned in rescuing Australia from a barbarous and nonsensical catalogue of names which nothing but a positive necessity should tolerate. Whenever native names exist, and when these names may have existed for ages, it appears something like sacrilege to disturb or change them; such names, too, are generally significant, and often contain in themselves useful information as to the migration of the human race, and the former connexion which existed between tribes, now far separate."

Outburst of η Argus Observed by Herschel

"TOWARDS the close of his residence at Feldhausen [Sir John] Herschel was fortunate enough to witness one of those singular changes in the aspect of the firmament which occasionally challenge the attention even of the incurious, and excite the deepest wonder of the philosophical observer. Immersed apparently in the Argo nebula is a large star denominated η Argûs. When Halley visited St. Helena in 1677, it seemed of the fourth magnitude; but Lacaille in the middle of the following century, and others after him, classed it as of the second. . . . Herschel, on his arrival at Feldhausen, registered the star as a bright second, and had no suspicion of its unusual character until December 16, 1837, when he suddenly perceived it with its light almost tripled. It then far outshone Regel in Orion, and on the 2nd of January following it very nearly matched α Centauri. From that date it declined; but a second and even brighter maximum occurred in April 1843, when Maclear, then director of the Cape Observatory, saw it blaze out with a splendour approaching that of Sirius. In 1863 it had sunk below the fifth magnitude, and in 1869 was barely visible to the naked eye. . . . There is some reason to believe that its variations are included in a cycle of about seventy years . . ."—(A. M. Clerke's "Popular History of Astronomy.")

The Collège de France

IN its column of Weekly Gossip, the *Athenæum* of December 16 had the following note: "'The French Government', says a distinguished foreigner, by way of comment, on our correspondent's letter last week, 'has resolved to create three new professorships at the Collège de France, one to be added to Natural History, for it has been found that since the death of Cuvier the present establishment is insufficient to fully record the progress of the science; and another for the Coptic and Hieroglyphics, the professorship formerly held by Champollion being devoted to general antiquities. The Constitution of the Collège de France (he observes) does not at all resemble ou universities: its object is not to teach the element of knowledge, but to keep progress with its advance and to inform the well-informed. It is a nobl institution, which we owe to Francis I. There is n similar institution in the world, that I am aware of it is open to the public, in the most enlarged sense the words; there is no payment required, no sub scription, no obedience to authority, no registration— the doors are always open, and all persons, male an female, may there enter and obtain knowledg Cuvier's lectures were always attended by man ladies of distinguished rank; and even the lecture of Abel Rémusat, on Chinese literature, were fo years attended to by a lady, who made her Chines book serve as a veil, for the strangeness of the thin excited some surprise and curiosity'."

University Events

CAMBRIDGE.—Prof. E. Cartan, of the University Paris, has been appointed Rouse Ball lecturer for th year 1937–38.

The Treasurer has received through the Profess of Zoology a gift of £500 for the Experimental Zoolog Fund from a benefactor who wishes to rema anonymous. His gifts to the Fund now amount £1,800, and he has intimated that he hopes to co tinue his support of the fund.

Prof. M. Siegbahn, of Stockholm, has been appoint Scott lecturer for the year 1938–39.

It is proposed that Dr. W. H. Thorpe and D A. D. Imms, of Christ's College, be appointed delegat to the International Congress for Entomology to held in Berlin on August 15–20, 1938.

H. C. Gilson, of Trinity College, Dr. F. S. J. Hollic of St. John's College, J. W. S. Pringle, of King College, and Dr. S. Smith, of St. Catharine's Colleg have been appointed University demonstrators zoology.

The Royal Astronomical Society has appoint Prof. S. Chapman, of Trinity College, chief profess of mathematics in the Imperial College of Scien and Technology, London, to be a member of t Committee for Geodesy and Geophysics.

It is recommended that the stipend of the Cavendi professor be £1,400, and that he be paid £200 a ye non-pensionable, for administration as head of t Department of Physics.

LONDON.—The title of emeritus professor anatomy in the University has been conferred Prof. Thomas Yeates on his retirement from t S. A. Courtauld chair of anatomy at the Middles Hospital Medical School.

OXFORD.—Dr. J. V. Harrison has been elec University lecturer and demonstrator in geology

An inquiry by the University as to the number students in receipt of financial assistance fr sources other than relations and friends in the y 1936–37 was recently completed. Out of a total 4,920 students, 2,646,—that is nearly 54 per cen were in receipt of assistance. School exhibiti (915), local education authorities' grants (862), o scholarships (602), open exhibitions (405), and gra from colleges (320) were the principal forms of emoluments.

Societies and Academies

Edinburgh

Royal Society of Edinburgh, November 8.

F. A. E. CREW: The sex ratio in the domestic fowl and its bearing upon the sex-linked lethal theory of differential mortality. Among 2,216,051 live-born chicks the percentage of males was $51{\cdot}38 \pm 0{\cdot}03$. Among 8,565 dead in shell the percentage of males was $51{\cdot}03 \pm 0{\cdot}54$. These figures do not support the sex-linked lethal theory. There are significant differences in the secondary sex ratio of different 'breeds' and this fact probably explains the differences in the sex ratio reported by different investigators.

N. GALPIN: Factors affecting hatching weight of chickens. Analysis of data show that chicken hatching weight, egg weight, percentage hatching weight of egg weight, and hatchability, tend to decrease as egg production increases. When reproductive activity falls off the above factors increase. From glandular weight, thyroid activity appeared to be highest during months of high egg production. The high thyroid activity has been related to the decrease in hatchability, egg weight, hatching weight, and percentage hatching weight of egg weight.

F. A. E. CREW and S. S. MUNRO: Gynandromorphism and lateral asymmetry in birds. Three new cases of gynandromorphism and five of simple lateral asymmetry are recorded. Critical examination of all reports indicates that autosomal elimination is responsible for simple asymmetry, and autosomal non-disjunction for gynandromorphism and pronounced lateral size asymmetry in the *XY* or female type, and for pronounced lateral size asymmetry only in the *XX* or male type.

Paris

Academy of Sciences, October 26 (*C.R.*, 205, 697-760).

JULES DRACH: The reduction of the general equation of Riccati.

PAUL DUBREIL and MME. LOUISE DUBREIL-JACOTIN: The algebraic properties of the relations of equivalence.

ALEXANDRE WEINSTEIN: The spectrum of the equation of the vibrations of framed plates.

MENAHEM SCHIFFER: A calculus of variation for a family of univalent functions.

FERNAND AIMOND: Some properties of surfaces deduced from their mechanical significations.

ALEXANDRE FAVRE: Study of the Toussaint-Carafoli hydrodynamic tunnel with the view of obtaining bidimensional movements. Flow without circulation.

ROBERT SILBER: The definition of unitary coefficients and of the polars of the complete aeroplane.

JEAN DUFAY: Remarks on the diffusion of light in the Milky Way.

HENRI MINEUR: The determination of the distance of the centre of the Milky Way and the constants of the galactic rotation by means of the open clusters.

EMILE SEVIN: The theory of stellar radiation.

JEAN LOUIS DESTOUCHES: The equivalence group of a deductive theory.

JOSEPH BETHENOD: Study of the discharge of a condenser through a gas tube.

MARCEL LEMARCHANDS and WALTER JUDA: Concerning the phenomena of electrolytic overvoltage.

PIERRE GENET: Sodium hydrogen arsenate, NaH_2AsO_4, and its hydrates.

GEORGES ARRAGON: The structure of two pentacetylsorbosides.

MME. YVONNE KHOUVINE and YOSHINORI TOMODA: Tagatose and methyltagatoside.

ANDRÉ WAHL and VICTOR LIVOVSCHI: The dimethyloxindoles.

CHARLES DUFRAISSE and JEAN HOUPILLART: Researches on the dissociable organic oxides. The hydrogenation of the photoxides. The results of the hydrogenation of naphthacene, tetraphenylnaphthacene (rubrene), anthracene and mesodiphenylanthracene, with Raney nickel as catalyst, are given, and their meaning discussed.

PAUL RIOU, GÉRARD DELORME and HORMISDAS GAMELIN: The distribution of manganese and iron in the conifers of Quebec province. Analyses are given of various organs of six species of conifers. In all species, the leaves have the highest proportion of manganese, and an increase in the amount of manganese is accompanied by a reduction in the amount of iron.

AURELIO QUINTANILHA: Contribution to the genetic study of Buller's phenomenon.

JULES ALQUIER and MLLE. ANDRÉE MICHAUX: The calcium/phosphorus ratio in the cutaneous tissue and in the blood of the rabbit in the course of growth.

VICTOR PLOUVIER: Researches on the stabilization of some plants giving hydrocyanic acid.

CHARLES JOYEUX and JEAN GEORGES BAER: Researches on the evolution of the cestodes of Gallinaceae.

STÉFAN NICOLAU: The genesis of the inclusions produced by ultra-virus in general and by the herpetic virus in particular.

ANDRE LWOFF and HISTAKE DUSI: Thiazol, a growth factor for the flagellates *Polytoma caudatum* and *Chilomonas paramœcium*.

Cape Town

Royal Society of South Africa, October 20.

W. E. ISAAC: Evolution of a growth inhibiting emanation from ripening peaches and plums. Air passed over certain varieties of ripening peaches and plums was found to exercise a marked effect on seedlings of the broad bean (*Vicia Faba*), sunflower (*Helianthus annuus*), and the Canadian wonder bean (*Phaseolus vulgaris*) and also on sprouting potatoes. The Canadian wonder bean was used for most of the experiments. The effects were: retardation of growth in length, increased growth in thickness due primarily to an increase in the size of the cortical cells, decrease of total amount of growth and changed reaction to gravity. Quantitative evidence was obtained of decrease in total amount of growth. Evidence is presented for regarding ethylene, evolved in very small amounts, as the effective growth inhibitor.

J. L. B. SMITH: A new gobioid fish from South Africa.

I. DONEN: A note on the distribution of chemical compounds in the inner and outer portions of the flesh of the Kelsey plum.

W. PUGH : Complex fluorides of gallium and some heavy metals.

F. G. CAWSTON : (1) The development of teeth in the radula of fresh water Mollusca. There is a rapid increase in the number of teeth of fresh water Mollusca as soon as the radula is put to use after the animal hatches out. Tricuspid teeth in each row are added to from the marginals whose cusps coalesce as the animal grows. Fresh water species possess broad rows of teeth but not so many as some lagoon and land species. The stoutest teeth are those which are exposed to most use. Some increase in size of individual teeth may be expected during the first few months of the animal's existence. The best illustrations of typical teeth of the various fresh-water molluscs are obtained by preparing camera lucida models. (2) South African larval trematodes with forked tails the life-cycle of which is at present unknown. It is considered important to discover the life-cycle of furcocercous cercariæ if the various forms are to be recognized. Difficulty is experienced in the differential staining of cercariæ. Notes are given on some South African cercariæ.

JOHN HEWITT : Descriptions of new forms of the genus *Acontias* Linn. Five new subspecies are described, preceded by an introductory account dealing with the forms occurring in Africa and their distribution.

W. J. COPENHAGEN : Sulphur as a factor in the corrosion of iron and steel structures in the sea. (2) Sulphides in bottom muds of certain harbours of the world. In a previous paper, reference was made to the occurrence of ferrous sulphide in the corrosion product on the surface of iron and steel vessels and structures when immersed for a period in sea-water. In all cases of bottom muds, except open roadsteads, ferrous sulphide was present in the bottom muds in comparatively higher concentration than that of marine muds on the floor of the ocean. The origin of the ferrous sulphide in bottom muds has been investigated and is of bacterial origin, that is, (*a*) from decomposition products of waste in harbours, and (*b*) by the reduction of sulphates in sea-water. Ferrous sulphide under certain conditions is oxidized to ferric oxide and elementary sulphur. The latter rapidly combines with exposed iron (in iron and steel structures) and rapid corrosion of the structures ensues.

Moscow

Academy of Sciences (*C.R.*, 16, No. 3, 1937).

I. M. VINOGRADOW : Some new problems of the theory of primes.

B. SALTYKOV : (1) The solution of the integral equation of N. Moisseiev in the theory of the non-regularized geoid figure. (2) The quasi-Stokes form of the integral equation of N. Moisseiev for the non-regularized geoid.

M. KELDYŠ and M. LAVRENTIEV : The uniqueness of solution of the Neumann problem.

B. FUCHS : The group of analytical movements of invariant geometry with pseudoconformal images.

L. V. KANTOROVIČ : The moment problem for a finite interval. (A correction to the note published in *C.R.*, 14, No. 9, p. 531 ; 1937.)

L. MAGNARADZE : Fundamental problems of the theory of elasticity in two dimensions, for contours with angular points.

I. N. VÉCOUA : A complex representation of the general solution of equations of the stationary flat problem of the elasticity theory.

V. A. GAVRILENKO : Additional considerations regarding the distribution of velocities in turbulent uniform flow.

V. KUPRADZE : The theory of electromagnetic fluctuations in an even non-homogeneous field.

N. K. MIHAL : The determination of plummet deflections from the anomalies in the horizontal gradient of gravity.

A. I. KURENCOV : Fundamental regularities in the distribution of the dendrophilous lepidopterous fauna (Macrolepidoptera) in the Ussuri province.

B. A. ZENKOVIČ : Weighing whales.

E. ANDREJEVA : Ossification of the skeleton of the extremities in embryos of the Kirghizian fat-tail sheep.

A. A. TERENTJEVA : Development of the hairy covering in the Kirghizian fat-tail sheep.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*

Monday, December 13

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—F. S. Chapman "Lhasa in 1937".

Wednesday, December 15

GEOLOGICAL SOCIETY OF LONDON.—Prof. R. M. Field "Geophysical Exploration of Ocean Basins".

Thursday, December 16

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Si Charles Sherrington, F.R.S. : "Jean Fernel an Astrology" (Thomas Vicary Lecture (2)).

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Genera Discussion on "Electrical Engineering Education" Introductory papers by Prof. C. L. Fortescue, Co H. C. Fraser and F. H. Clough.

Friday, December 17

INSTITUTION OF CHEMICAL ENGINEERS (at the Institutio of Civil Engineers), at 6.30.—Dr. R. E. Slade : "Th Development of Grass Drying" (Annual Public Lec ture).*

Appointments Vacant

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

UNIVERSITY DEMONSTRATOR IN MINERALOGY AND PETROLOGY the University of Cambridge—Dr. F. C. Phillips, Department Mineralogy and Petrology, Downing Street, Cambridge (December 14

SCIENTIFIC OFFICER in the Air Ministry Scientific Research Pool The Chief Superintendent, Royal Aircraft Establishment, Sou Farnborough, Hants. (December 17).

LECTURER IN ELECTRICAL ENGINEERING AND MATHEMATICS in t Aston Technical College, Whitehead Road, Birmingham, 6—T Principal (December 18).

LECTURER IN MECHANICAL ENGINEERING in the Oxford School Technology, Art and Commerce—The Chief Education Officer, C Education Office, Oxford (December 20).

JUNIOR ECONOMISTS to the Ministry of Agriculture and Fisheri 10 Whitehall Place, S.W.1—The Secretary (January 7).

LECTURER IN CHEMISTRY in the Rotherham College of Technolo and Art—The Director of Education, Education Offices, Rotherha