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Vol. 145, No. 3683

SATURDAY, JUNE 1, 1940

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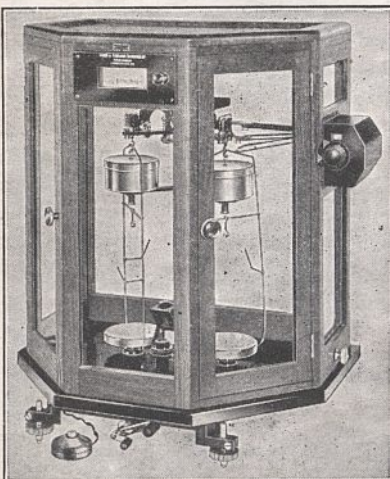
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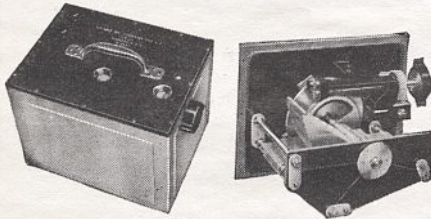
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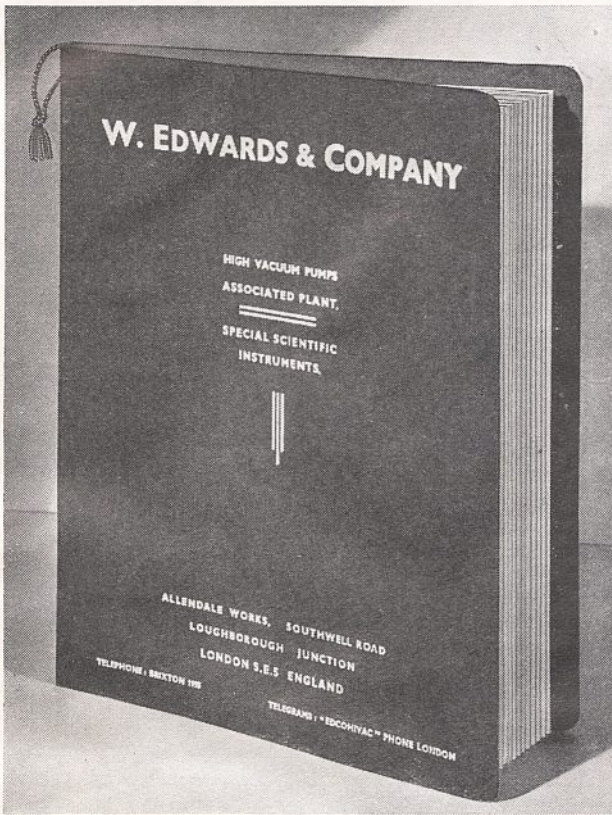
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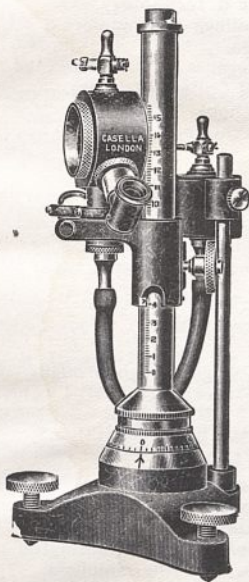


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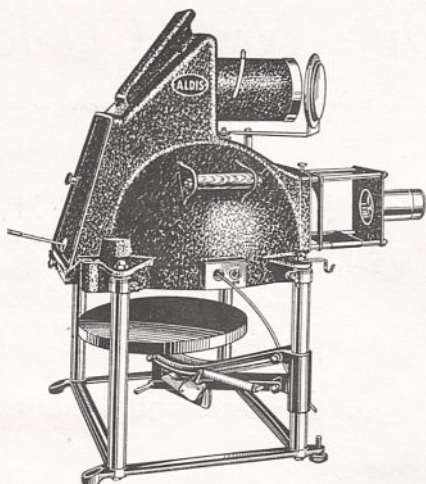
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NATURE

Vol. 145

SATURDAY, JUNE 1, 1940

No. 3683

CONTENTS

	PAGE
"This Freedom"	833
Practical Science in Schools	835
The Stone Age of Mount Carmel. By The Abbé H. Breuil	837
Evolution and Fats. By Dr. E. F. Armstrong, F.R.S.	839
Boiler Water Treatment	840
Recent Work in Experimental Phonetics. By Dr. E. G. Richardson	841
Planned Wheat Production. By Sir John Russell, F.R.S.	843
The Hydrogen Bond. By Dr. C. E. H. Bawn	846
Obituaries :	
Dr. A. C. Haddon, F.R.S. By Prof. C. G. Seligman, F.R.S.	848
W. R. King. By W. J. G.	850
Royal Society: New Foreign Members	851
News and Views	852
Letters to the Editors :	
The Universities and Research.—Dr. J. I. O. Masson, M.B.E., F.R.S. (Vice-Chancellor of the University of Sheffield)	855
Vitamin B ₁ and Acetylcholine Formation in Isolated Brain.—Dr. P. J. G. Mann and Dr. J. H. Quastel, F.R.S.	856
Amino-Acids of Casein Phosphopeptide.—Dr. M. Damodaran and B. V. Ramachandran	857
Cancer Cell and Growth-Regulating System of the Body.—Prof. L. Doljanski and Dr. R. S. Hoffman	857
Serological Properties of Extracts of Hæmolytic Streptococci prepared by Ultrasonic Vibrations.—Dr. H. Loewenthal and Prof. F. L. Hopwood	858
Upper Canine Teeth in the Indian Antelope (<i>Antilope cervicapra</i>).—Prof. James Ritchie	859
Reflection of X-rays with a Change of Frequency.—Sir C. V. Raman, F.R.S., and P. Nilakantan	860
Fission of Uranium and Thorium under Deuteron Bombardment.—Dr. R. S. Krishnan and Dr. T. E. Banks	860
Change of Ultra-Violet Transparency of Glass with Temperature.—Dr. William J. Arrol	861
Surface Potential Changes of Thin Films in the Transformation Liquid to Solid.—Dr. C. Ockrent and W. H. Banks	861
A Magnetic Study of the Effect of Bond Angle Distortion.—D. P. Mellor and W. H. Lockwood	862
History of the Vacuum Flask.—George H. Gabb	862
Economy in Education.—A. G. Lowndes	863
Research Items	864
Mucolytic Effect of Natural and Artificial Spreading Factors. By Prof. G. Favilli ; D. McClean and C. W. Hale	866
Applications of Electricity in Iron and Steel Works	868
Seventy Years Ago	869

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Vol. 145

SATURDAY, JUNE 1, 1940

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“THIS FREEDOM”

THE menace to freedom of thought and learning not merely in Europe but throughout the world has grown unmistakably graver with the latest advances of ruthless aggression. In Belgium and Holland pitiless destruction is spreading in countries which possess traditions representing even more richly than German history the most colourful, creative and imaginative phases of European life. To the lengthy list of centres of learning where creative thought and independent inquiry and research have already been proscribed there are now to be added such names as Brussels, Leyden, Louvain.

No one who has the least appreciation of the debt which science alone owes to research at Vienna, Prague, Warsaw, Cracow, Copenhagen or Oslo can contemplate without dismay the further extension of the list of those centres of learning whose work has in this way been closed down or stultified. “Achievement in science,” as Raymond B. Fosdick, president of the Rockefeller Foundation, remarks in his review for 1939*, “more often than not is the result of the sustained thinking of many minds in many countries driving towards a common goal. The creative spirit of man cannot successfully be localized or nationalized. Ideas are starved when they are fenced in behind frontiers. The fundamental unity of modern civilization is the unity of its intellectual life, and that life cannot without disaster be broken up into separate parts.”

It is well indeed that the president of the Rockefeller Foundation should refer so plainly to the disastrous consequences even to the intellectual life of America which would follow from the interruption, or suspension for half a decade, of the fundamental activities of the universities

* The Rockefeller Foundation. A Review for 1939. By Raymond B. Fosdick. Pp. 72. (New York: The Rockefeller Foundation, 1940.)

and laboratories of Europe as a result of exhaustion or chaos through the War. The onslaught on Holland and Belgium has a further significance. Beyond the achievements in politics and culture of the Low Countries, these peoples, now under German rule, have in the past given noble service to the cause of liberty. Twice at least in history the effort of the Dutch was decisive in the struggle against the domination of Europe, while in recent years both Holland and Belgium have brought to modern politics the best qualities of that city life which stirred the imagination of the Middle Ages and the Renaissance. They have built up communities in which democratic self-government is respected as an ideal and practised as a mode of life.

The passion for liberty and the belief in toleration live no less ardently in the hearts of these peoples to-day, as their heroic resistance has borne witness. What is new in the situation is the comparative inefficacy of that intellectual or moral resistance to-day in the face of the immense material power which can be exerted by a nation barbarous enough to turn its whole national economy to preparation for war, and ruthless enough to disregard all the generous principles and traditions upon which Western civilization is based. As Edouard Herriot reminds us in the “Wellsprings of Liberty”, to-day it is imperative to recognize that “Thought and action are two sisters who must never be separated”.

For scientific workers, the stirring lines of J. R. Lowell's Harvard Commemoration Ode are as pregnant with meaning in the present struggle as when they were first recited seventy-five years ago. Once again the service and quest for truth are no longer sufficient within the walls of a laboratory or university. They must be rendered

over wide fields of national need under stress and strain and peril of life itself. Lowell's eloquent third stanza may well remind us that the struggle in which we are engaged is one which enlists the sympathy and goodwill of all those who are concerned with the quest for truth, the patient, unprejudiced unravelling of the secrets of Nature, the maintenance of learning, of freedom of investigation, and of creative thought, whatever their nationality.

That the reality of the challenge to the finest values in our intellectual heritage is recognized as frankly in the United States as in Europe is shown beyond question in Dr. Fosdick's review. In an admirable passage he traces the intimate relation of European and American science and the interdependence of intellectual leadership. But he goes far beyond this. Pointing out that we are living in a world which threatens to brush aside everything that intelligence stands for, he brings us face to face with the real challenge of force.

Force, he insists, in the end always defeats itself. It appears to cut through the complexity and confusion without the necessity of the severe intellectual effort and discipline involved in the creation of an effective alternative. In the long run it solves nothing and answers nothing, and the surrender to force in practice, while rejecting it as an ideal, is one of the real tragedies of our times. The great society which science and culture have placed within our reach will not be achieved by the application of force, but by the persistent application of intelligence against the things that now dwarf our hopes. In the interdependent society we have created, the issues are no longer simple, individual and local; they are complex, social and world-wide, and beyond the experience of most of us. Money and credit, international relations, trade and finance, national income and its distribution, wages, profits, prices, purchasing power, savings and investment, employment, social security, collective bargaining, housing, propaganda, public administration, relations between Government and business, individual and social adjustment, social welfare, education, population—these are only a few of the urgent issues demanding creative and sustained intelligence for their solution.

With no less compromise than Lord Halifax in his address, the "Challenge to Liberty"* , Dr.

Fosdick brings us face to face with the real issues involved in the present struggle. Lord Halifax sees the conflict between youth and youth through the acceptance of sharply differing standards of conduct in different countries. He sees that there is an active force of evil which unless fought and overcome will rapidly reduce our civilization to a desert of evil, and he insists that if we are to keep our bearings we must base ourselves firmly on social, moral and religious standards. If we are to recapture the secret of order for international society we must as individuals strive to erect or maintain standards that will bring true freedom through the way of discipline.

If the doctrine of force could be effectively put to shame the way would be open to concentrate the effort now mobilized for war upon the improvement of the common lot of man. What matters first is that we should desire not an easier but a better world, and equip ourselves in body, mind and spirit to create it. We must recognize that we have first to overcome the doctrine which denies the corporate claim to liberty of men and women organized in national societies and refuses the even more fundamental claim of men and women to the free expression of human personality, which rests upon the eternal value of every human soul. The future of humanity cannot be left in the hands of those who would imprison and enslave it.

It is well that the fundamental issues should be laid so clearly and unmistakably before us, not merely by British leaders but also by those in the other great Anglo-Saxon nation. If war jeopardizes our heritage and interrupts our normal intellectual activities, we must remember that it also affords fresh opportunities for creative work and reconstruction. As Miss Dorothy Sayers puts it, we can 'begin here' in the task of creating the new society if we are prepared to make the effort.

It is indeed on this note of opportunity that Dr. Fosdick concludes his review. In place of letting conflict degenerate into a mere fight for power, we can maintain the creative struggle for facts and ideas by vigorously supporting competent intellectual efforts to define and analyse the issues facing society. When by objective and competent study the issues are more precisely defined and the facts more exactly known, the conflicting views which still remain can, with reasonable good will, more readily be resolved. A firmer substructure for public and private policy will thus be provided, and the clear statement of the highly involved issues from the technical side is a first

* The Challenge to Liberty: an Address given at Oxford. By Viscount Halifax. Pp. 24. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 3d. net.

step to the clarification of the moral and ethical questions of to-day.

For such reasons, Dr. Fosdick considers that studies in the social sciences present an intellectual challenge of central importance; and his appeal for adequate support, for the development of the highly specialized and complex methods necessary by highly skilled men and women working under the most favourable conditions, no less than his searching analysis of the handicaps under which the social scientist at present works, merits the close attention of the scientific worker even at the present time of crisis and strain. Unless we surrender the idea or resolve of victory, we must face now the issues involved in the ordering of a new society in which creative intelligence and human personality find full expression. We must free our social scientists to think with all possible penetration wherever their thinking may lead, and assist the minority of pioneers whose work in the social studies is reaching up to new levels of scientific achievement.

Intense as may be our immediate concern with our war effort, we must still spare thought for the future if that effort is to reap its full reward. We may still attempt the removal of those handicaps

on social investigations to which Dr. Fosdick refers—the establishment of a sound balance between the extension and the transmission of knowledge in this field, the extent and manner of endowment of social research, the training of the social scientist on broader lines, and the establishment of effective relations between the social scientist and the world of action which is his laboratory. The solution of the problems confronting society is the task of all its intellectual and moral agencies. Society may, however, fairly expect of the social scientist that as part of his contribution to our war effort he should be objective and technically competent, and deepen and make more definite our understanding of fact and relationship in the social world.

Nor are these words for the social scientist alone. It is well to be reminded in this fateful hour of the supreme values for which we contend, the importance of creative thought and of the free expression of human personality. We may well be grateful that there are those of our race across the Atlantic who see so clearly as Dr. Fosdick the real issues before us, and can define the task with a lucidity and precision which at least hint at comradeship in its discharge.

PRACTICAL SCIENCE IN SCHOOLS

THE publication of a communication from Mr. A. G. Lowndes, formerly biology master at Marlborough College, on page 863 of this issue raises a problem which has for long exercised heads of schools and administrators: the problem is whether the money spent on science laboratories and their equipment is justified by the results achieved, especially in the teaching of biological science. Essentially this problem resolves itself into two parts: first, what is the aim of science teaching, and secondly, how may this aim be best achieved?

The aims of science teaching have been well stated in the Spens Report; to give pupils some knowledge of natural laws and of their application; "to reveal the influence of scientific thought and achievement in the evolution of our present day civilization"—an appeal to social interest and social utility; and to give an introduction to scientific methods of thought and investigation. There can be little disagreement among science teachers on these aims; they are, indeed, those

which have been held to be valid for so long as science has been a subject in school curricula. There is, however, some disagreement on how they may be achieved; for it has in the past been widely held that practical laboratory work is essential. Impetus to this view was given by Prof. H. E. Armstrong, whose influence on the teaching of science at the end of the last century was profound, and who insisted that pupils must be placed in the attitude of discoverers, and must, therefore, be given opportunities for discovering, in the form of a laboratory and apparatus. Sir Percy Nunn has expressed this view thus: "to make our pupils feel, so far as they may, what it is to be, so to speak, inside the skin of the man of science, looking out through his eyes as well as using his tools, experiencing not only something of his labours, but also something of his sense of joyous intellectual activity". In its official publications, the Board of Education has frequently stressed the importance of practical work in science, but has invariably qualified this by

pointing out that other methods of presentation are complementary.

There is considerable difference between the practical work possible in physical science and that in biological science. The metrical aspect of physical science (as taught in schools) makes laboratory work comparatively easy to arrange and organize with large classes, and there is a wealth of experiments which can be completed in the space of a double school period. In biological science much more time has usually been spent on observation and laboratory technique (notably dissection and section cutting), and much of the experimental work occupies days and even weeks before conclusions can be reached. There are, however, physiological experiments which can be carried out without taking up excessive time, for example, on plant and animal tropisms and on bacterial cultures.

The attempt to get pupils "inside the skin of the man of science" by means of practical laboratory work cannot be said to have been wholly successful. Dr. Michael West (*Educational India*, 6, No. 4; 1939) has stated that "it is perfectly possible for these expensively educated children to pass right through a school science course and remain at least fifty years out of date in scientific knowledge, to be ignorant indeed of all that really matters in the science of to-day". Much the same view is expressed by Prof. J. D. Bernal, in "The Social Function of Science", in a reference to the report of the Science Masters' Association on the teaching of general science: "Only in the last year year does the outlook become modern, but even then nothing later than 1890 is introduced"; and, "The chemistry is worse; the whole course contains nothing not known in 1810." Bernal also stresses that nearly all practical work in schools is "either preparation, measurement, or description, all operations essential to science but by themselves entirely insufficient".

There is evidence from American research that factual knowledge and knowledge of scientific method can be imparted as successfully by demonstration as by practical work, and demonstration certainly has the advantage of being less expensive, in time and money, and of setting a standard of work which is not achieved when pupils themselves carry out experimental work. Nor need demonstration be didactic, for every learner is encouraged by the skilful teacher to play a part, by suggestions and observations, in the demonstration as it proceeds. In this connexion the

Spens Report mentions that "by a greater use of good demonstration we believe that science teachers will more commonly stimulate wonder and imagination".

That the place of practical work in the biology syllabus is being subjected to increasing criticism is borne out by the fact that recently a strong representation from the teaching profession has suggested to certain examining bodies that the amount of practical work in the syllabus should be considerably diminished, and that failure in practical work at the examination should no longer involve failure in the biology examination as a whole.

It is not suggested that all practical work should be jettisoned, but rather that the warning issued in 1933 by the Board of Education in "Science in Senior Schools" should be headed: "Many schools are in danger of falling into superstition and treating practical work as a ritual." A new stimulus to real scientific investigation, involving purposeful practical work, has come from the development of rural activities in an increasing number of schools, particularly public elementary schools. Wherever a garden is maintained, and wherever live-stock is kept (poultry and pigs are popular), real problems capable of scientific solution by pupils at once crop up. How to obtain the maximum yield from a soil as yet unanalysed; how to feed a pig in order to obtain the maximum weight at a certain age; how to house hens so that they are healthy; these and kindred problems involve observation, measurement, recording and, most important, *planning* and the proper use of controls. (At least one influential university teacher has stated that his scholarship pupils seem often unable to *plan* their experimental work.) The problems arising out of rural activities are susceptible to laboratory treatment, though the laboratory may sometimes be out of doors; they are real first-hand problems, with educational, social and utilitarian values, which cannot equally be said to be true of the routine experiments so frequently carried out in school laboratories.

A final point to bear in mind, especially during present circumstances, is the difficulty in obtaining material (especially biological) for laboratory examination and experimentation. This difficulty has always been present and never satisfactorily solved. Now is the time, therefore, to tackle this problem, not as a temporary measure, but with the view of eliminating the necessity of at any rate certain kinds of material altogether.

THE STONE AGE OF MOUNT CARMEL

The Stone Age of Mount Carmel

The Fossil Human Remains from the Levallois-Mousterian. Vol. 2. By Theodore D. McCown and Sir Arthur Keith. Pp. xxiv + 390 + 28 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 63s. net.

THE human remains described in this very important and voluminous work come from two neighbouring caves—the biggest, et-Tabūn (Levels B and C), and the other a mere rock shelter, Mugharet es-Skhūl (Level B). The first, a big cave, is at the mouth of the Wady Mughara, looking down on the coastal plain. The second is a little above the foot of the valley, slightly upstream and on the same bank as the first.

The excavations, carried out jointly by the British School of Archaeology in Jerusalem and the American School of Prehistoric Research, were directed during six years work (1929–35) by Miss D. Garrod, with various fellow-workers, Mr. Theodore McCown taking her place during one year when her health obliged her to rest. It was during this year that the greater part of the site of es-Skhūl was examined (continuing the work previously begun) and that, in a breccia as hard as building stone, most of the graves were discovered.

Et-Tabūn was excavated by Miss Garrod on her return, while Mr. McCown, with the help of Sir Arthur Keith and of the staff of the Royal College of Surgeons of England, devoted himself to the very laborious task of freeing, preparing, restoring and studying the very important remains from es-Skhūl. This work began in 1933 and finished with the publication of the present big volume; not too large, since the remains of Quaternary man studied were adults as well as children of both sexes: three almost complete skeletons with their skulls in a good state of preservation; five less complete with their skulls crushed, a single leg and sixteen other fragments from Skhūl. Tabūn produced only one complete skeleton, a mandible and other isolated fragments. The approximate ages of these individuals are given as four, five and ten years, five people between thirty and forty, and one of about fifty.

Although, except for some slight remains in a final Acheulean level at Tabūn, all the rest of the human remains are associated with a Levallois-Mousterian industry, they are not exactly contemporaneous. Those at Skhūl came with a fauna in which bovine animals predominated, and those

of Tabūn with one in which the gazelle was most common. But these differences are not far apart in time, so that these funerary remains can be considered as almost contemporary.

Very different characteristics distinguish the human types, Tabūn I possessing many Neanderthalian traits, and the men of Skhūl exhibiting all the transitional features leading from the Neanderthal to the Neanthropic Cro-Magnon type.

The authors think that the human type of Mount Carmel was subject to variations greater than those of any living human group; so much so, that, if it were not for the intermediate types seen even in the same level, these variations might be considered as two distinct races, one akin to the Neanderthal and the other to the Cro-Magnon. Having examined the question as to whether it was interbreeding of the two which produced these intermediate types, the authors reject that idea and prefer to consider it as an example of a human group in a crisis of mutation.

These leanings towards a Neanderthalian type produce a strain more resembling that associated with the Central European interglacial Krapina, Ehringsdorf and Steinheim type, rather than the Rhenish or French Neanderthalian. As for the skulls, many are like the Neanthropic group of Předmost, but they have far more Cro-Magnon traits. If, by the forehead, ribs, vertebrae and teeth (though the ribs are flattened as in Neanthropic man) the people of Mount Carmel may be classed, like the Galilee skull which is of the same race, as Neanderthalian, by the height of the man of Skhūl (1 m. 70 cm. and 1 m. 78 cm.), and the characteristics of most of the limbs (not of all, for some are more Neanderthalian), these Palestinians have chiefly Cro-Magnon traits.

This all goes to support the theory of Hrdlička (1927), who held that the Cro-Magnons of Europe descended from the Neanderthalian of the same continent. But, though this may be possible, according to the authors' ideas, it is too simple an explanation, and in any event severe glacial conditions cannot be evoked as the discriminating factor, since in Palestine there were pluvial and not glacial periods. Still, it is true that a transitional human type is found there, leading from one race to another. They are not proto-Cro-Magnons, but proto-Caucasians, their cousins.

The authors then pursue their detailed analytical comparative study in Chapters iii–xxii, treating successively the foot, leg, thigh, pelvis, vertebral column, thorax, shoulder girdle, hand, fore-arm,

arm, dentition, mandible, facial and cranial characteristics of Skhül V, of Tabün I, of Skhül IV, then IX, II, VI, VII, and the brain of Skhül I as reflected in the endocranial cast.

In a review such as this, one cannot follow the authors in their innumerable comparative tables and measures, and we pass to Chapter xxii, "An Analysis of the Structural Character of the Mount Carmel People", producing twenty-five points of comparison between the Neanderthal, Palestinian,

the many intermediate characteristics, the authors think that the Palestinian of Mount Carmel should be classed as genus Palæanthropic, but forming the link with the genus Neanthropic.

It is still an open question whether the woman found in Tabün I, who is the most Neanderthalian of all those found, represents a different race, and what is her place in time compared to the people of Skhül. The few remains found either in the Acheulean or neighbouring overlying levels have

AN ANALYSIS OF THE STRUCTURAL CHARACTERS OF NEANDERTHAL, MOUNT CARMEL AND CRO-MAGNON MAN

Neanderthal Man	Mount Carmel Man	Cro-Magnon Man
Stature, short but stocky.	Men tall, women short, or of medium stature.	Men tall, women of medium stature or small.
Head massive with the facial parts large relatively to the brain-containing part.	Head massive, but face not excessively developed.	Head massive but not excessively developed.
Skull dolichocephalic or mesaticephalic.	Most are strongly dolichocephalic; but one Tabün woman has an index of 77.	Most are strongly dolichocephalic.
The vault is very low (platycephalic).	Vault of medium, or even above, medium height.	Vault high.
Eyebrow ridges assume form of continuous torus.	Torus, but with a tendency to separate into median and lateral parts.	Separation into median and lateral parts is complete.
Forehead very receding.	Forehead moderately full.	Moderately or fully developed.
Occiput <i>en bourrelet</i> compressed vertically, does not project behind attachment of neck.	Not compressed vertically. Projects slightly beyond attachment of neck.	Compressed laterally. Projects well behind attachment of neck.
Face—particularly the upper face—very long.	Face of moderate, or above moderate, length.	Face of moderate length.
Face prognathous.	Face usually orthognathous.	Face orthognathous.
Malar bone has the flat form seen in anthropoid apes.	Malar is flat and anthropoid-like, but with a decided tendency in some individuals towards a Neanthropic form.	Malar is Neanthropic.
Superior maxillæ are devoid of canine fossæ and are snout-like in form.	Superior maxillæ, although devoid of fossæ, are flattened in front but not snouted.	Neanthropic.
Orbits are large and rounded in form.	Orbits wide but not high.	Orbits wide but not high.
Nose very large, projecting and wide, its lateral margins not demarcated from face.	Nose variable in projection and width; laterally it is partially demarcated.	Nose variable in projection, usually narrow; laterally sharply demarcated.
Subnasal part of face is deep and wide.	Subnasal area wide, but not deep.	Subnasal area moderate in width and depth.
Mandible robust.	Variable, some robust, others if large yet not robust, some small but stoutly built.	Moderate in development both in size and strength.
Chin absent or rudimentary.	Chin absent, or of moderate development.	Chin moderate or well developed.
Ascending mandibular ramus very wide.	Width varies, in some very wide, others of moderate width.	Width varies, some very wide.
Mandible, in the region of the angle truncated or flattened.	Angle moderately developed.	Angle moderately or well developed.
Teeth are big.	Teeth are moderate in size or large.	Teeth moderate in size.
Molars retain certain primitive characters.	Molars retain certain primitive characters.	Molars are Neanthropic in characterization.
Spinal column and its vertebrae present pitechoid characters.	Spine and vertebrae possess certain Neanderthaloid features; others are Neanthropic.	Spine and vertebrae are Neanthropic.
Adaptation to the upright posture and to bipedal progression less perfect than in Neanthropic man.	Adaptation to bipedal progression apparently as perfect as in modern man; cervical curvature probably less developed than in Neanthropic man.	As in Neanthropic man.
Lower limbs short.	Lower limbs long.	Lower limbs long.
Mean cranial capacity about 1,400 c.c.	Capacity in 3 adult males ranges from 1,518 c.c. to 1,587 c.c.; one woman (Tabün) 1,271 c.c.; one woman (Skhül) about 1,300 or 1,350 c.c.	Capacity large.
In form the brain shows primitive or simian features, particularly in the small size of frontal lobes and in convoluntary pattern.	Neither in size nor in form of lobes is there a decided difference from brain of Neanthropic man. Convoluntary pattern, so far as our evidence goes, was simple.	Lobes large and well convoluted.

Mount Carmel and Cro-Magnon peoples. This shows that the Palestinian of Mount Carmel has only three points in common with Neanderthal man (frontal torus, shape of the malar, pattern of the teeth): eight points in common with the Cro-Magnon and twelve which are intermediate. Comparing 86 other details of unequal importance, the authors arrive at a total of 111 characteristics examined: 16 are Neanderthalian, 32 Neanthropic, 46 intermediate, 13 indeterminate and 4 special. But if most weight is attached to details concerning the teeth, eyebrow ridges, shape of the cheek-bone, the sphenoid and certain metacarpal bones, and

certain characteristics which make it difficult for the authors not to class them as older than the people of Skhül. They consider the Tabün type older, though this has been contradicted, for on p. 265, where the character of the Tabün woman's skull is compared with those from Skhül, we read: "Cranial characters support the view, already founded on a comparison of their skeletons, that they represent different types or breeds of humanity, and yet breeds of the same stock. In the Skhül cranium there are many Palæanthropic features, but these are overshadowed by those of a Neanthropic character. In the

Tabūn cranium it is the opposite, the Palæo-anthropic features vastly preponderate over the Neanthropic." The author of this part of the text remarks on the close relationship between the female skull of Tabūn I and the Neanderthalian skull of Gibraltar, although it differs by certain Neanthropic features such as the angle of the skull's development, a rise in the vault and flattening of the sides of the skull. The conclusion is that "the Tabūn woman represents a separate race of the Neanderthal type, the difference between the Tabūn and Gibraltar skulls being of approximately the same amount as that which distinguished the skull of a European from that of a negro".

We quote the summing up: "We find it very difficult to believe that these are mere individual anomalies; they have all the appearance of intrinsic structures of morphological value. Only future discoveries can resolve the problem of her position—whether an individual sport, or a representative of a distinct race."

As I heard Prof. Boule say, speaking of the Palestinian man: "The complexity of evolution

amongst human types, as new discoveries are made, and this one in particular, far from simplifying the problem, appears little by little to present us with new ones, still insoluble".

I would add that, in spite of the enormous progress and the sensational discoveries which have been made in modern times, such as those in Palestine, Chou-Kou-Tien and Java, Palæo-anthropic anthropology is still necessarily 'in the making'. It cannot be otherwise, for we must remember that, though we are fairly well informed about the human types contemporary with the last interglaciation, and later times, we know extraordinarily little of what took place during the two preceding interglacial epochs and the intervening glaciations, though these represent more than sixty per cent of the time that man has existed.

In spite of everything, a certain law of gradual development becomes more apparent each time, and however much we hesitate over such problems, they grow clearer each day, showing us human types less and less removed from anthropoids.

H. BREUIL.

EVOLUTION AND FATS

The Chemical Constitution of Natural Fats

By Prof. T. P. Hilditch. Pp. xi+438. (London: Chapman and Hall, Ltd., 1940.) 35s. net.

THE fats constitute a large group of natural substances. They are present in plants and animals on land and water, both salt and fresh; they represent an important ingredient of our food. To the chemist they are compounds of glycerol with fatty acids, long straight-chain carbon compounds in an ascending series of numbers from C_{14} to C_{24} , increasing by two carbons at a time. Nature has curious devices, eccentric habits; one of them is to ring the changes with relatively few substances, combined together in different ways, so as to produce a vast number of different fats, that is glycerides, characteristic of individual plants and animals. The process is akin to the infinite number of melodies which the pianist can produce on a few notes.

The devices of Nature have to be discovered in the laboratory; they cannot be reasoned out in a dark room until sufficient data have been accumulated to justify the setting up of a theory, which is only then of value when it leads to new experiments. The nature of animal fats was first established by Chevreul in classic researches

published in 1823; it is noted that he was a determined enemy of charlatanism in every form. Since then, research on the fats has gone on in laboratories throughout the world, and the accumulated knowledge provides material for many volumes. Nowhere has the search been more diligent or more successful than in the laboratories at Liverpool under the leadership of Prof. T. P. Hilditch. He has devised new experimental technique of much higher accuracy, and accumulated data as to the nature of some six hundred natural fats.

Valuable as is such work in itself, it acquires new interest when chemical structure can be related to biological source. The monograph before us is written with this intent. Science proceeds on the assumption that the world is intelligible, and we may claim that it is an achievement to establish a relationship, a sequence, between the nature of the fatty acids present in fats and the biological development of their parent organisms.

The connexion was developed in outline in NATURE in 1936 (137, 479) in an article by Hilditch and Lovern, but it is of sufficient importance to give it a paragraph. The most widespread of natural fats is oleic acid; the major saturated

acid is palmitic acid with sixteen carbon atoms. In freshwater life, C_{16} and C_{18} acids predominate, but in salt water there is both greater unsaturation and a high proportion of acids up to C_{24} —nearly 30 per cent in marine fish.

Coming on land, there is a simplification in the number of fatty acids, there being a definite gradation through the amphibians, reptiles and birds to the domestic animals, which is largely in parallel with the course of evolution traced by the biologist. It is to be expected that a change in external character indicates a change in chemical architecture, but it could not so easily be predicted that the change in the fats would parallel evolution,

It is a triumph for the learned doctors of chemistry,

“Profoundly skilled in analytic,
Who can distinguish and divide
A hair 'twixt south and south-west side.”

Plant fats, as has long been known, sometimes contain as major constituents a specific unusual fatty acid confined to one or at the most only a few of the natural plant families: plants seem to have the urge to be enterprising and try chemical syntheses on their own. Another fact relating to plant fats is the relation between saturation of the acid and climatic temperature: in cooler climes linseed oil is as a rule more unsaturated.

The monograph is arranged so as to bring into prominence the component acids of fats. It contains chapters on the component glycerides, on the chemistry of the acids and on experimental technique. It is a storehouse of knowledge, a guide to future experimentation and a stimulus to the reader. A philosopher condemns science because it enthrones the measuring, weighing, calculating faculty of the human creature. The achievement described here may be set against such criticism. E. F. ARMSTRONG.

BOILER WATER TREATMENT

Boiler Feed Water Treatment

By F. J. Matthews. Second edition, revised and enlarged. Pp. 319+16 plates. (London: Hutchinson's Scientific and Technical Publications, 1939). 12s. 6d. net.

WHEN this book was originally published in 1936, it was pointed out by the author that while the great developments which had recently been made in the methods and apparatus for boiler feed water treatment had been very advantageous for those in charge of the larger steam plants, they had created a problem for the small operator who has not at his back all the facilities which exist at the big power stations, but is forced to worry out his problems for himself. In relation to feed water treatment, the problem is to know what is the right thing to do in a given case, for, without clearly stated principles and well-substantiated practical guidance, it is difficult for the average technician to exercise a fair judgment as to the appropriate system, and to ascertain if all goes well when his choice of plant has been installed.

Generally speaking, three courses are open to the boiler operator: the use of one of the proprietary softening agents, the installation of a lime-soda plant, or the adoption of the zeolite or base-exchange system. The purpose of this book, therefore, was to provide such practical information as would place him in a position to be able to choose and operate a water-softening plant with

intelligence and efficiency. The author deals with the subject in a logical sequence which will greatly appeal to the practical man as well as to the student and chemist. He describes the various types of natural waters, and explains in what respects they prove unsuitable for use as boiler feed. Proceeding then to operating troubles, he gives first the older corrective measures and then, by setting out their failings and insufficiency, brings into their proper perspective the later improvements which have been effected. Four main aspects of water treatment and its bearing on boiler operation are dealt with, these being scale formation, corrosion, foaming and priming, and finally analysis and routine testing. From this method of presentation there emerges for the reader a clear picture of the purposes served by each process or combination of processes.

In this enlarged edition a considerable amount of revision is apparent, bringing the information up to date and in line with the results of recent research. Caustic embrittlement, one of the most serious problems of the boiler-house engineer in recent years, is treated in considerable detail, and the numerous contributory causes, preventable and unavoidable, are set forth. Among other new features are the subjects of colloidal conditioning, the Budenheim process, electrical scale prevention and the avoidance of turbine deposits. For students, the selected references at the end should also prove a valuable addition.

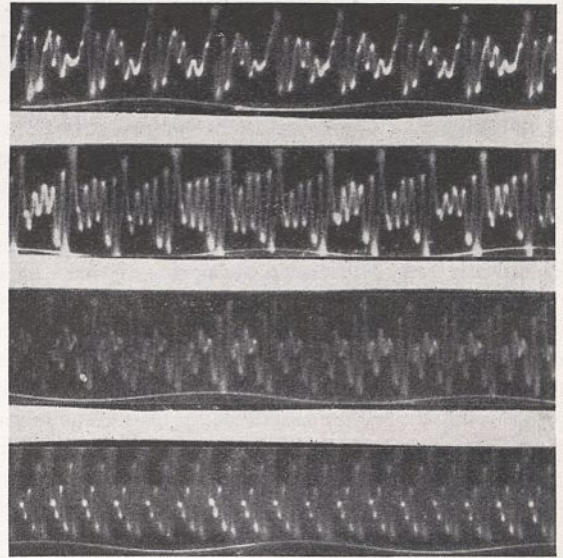
RECENT WORK IN EXPERIMENTAL PHONETICS

BY DR. E. G. RICHARDSON,
KING'S COLLEGE, NEWCASTLE-ON-TYNE

IT is now ninety years since Scott with his phonautograph—the precursor of the gramophone—first made traces of the wave forms of speech sounds. The mechanical wave-tracers progressed and reached their peak of development in the phonodeik of Miller, but they have been largely superseded by electrical recorders. The talking film and the cathode ray oscillograph have found their way into the phonetics laboratory, and the physicist has been called in to assist the philologist in the scientific study of speech forms. Such a team of workers operating an experimental phonetics laboratory (such as that of King's College, Newcastle-on-Tyne¹) can carry out useful work in the classification not merely of standard English speech forms, but also of local variants, which may be preserved in the form of gramophone or film records to remain, perhaps as museum pieces, when all speech has been reduced by education and broadcasting to a dull uniform 'standard English'. To this end a number of linguists are exploring the country districts of Great Britain, where special forms die hard, with portable recording equipment, to persuade the older people to "say something into the microphone".

Any points which require detailed examination may be pursued further in the laboratory, where by means of electrical pick-ups or photo-electric cells the wave-form characteristic of a vowel or consonant may be selected and projected on to the screen of the cathode ray oscillograph. By such means, for example, it is possible to distinguish the Northumbrian 'burr' or guttural *r* from the frontal *r* which the French adopt, even when it occurs in rapid speech so that the distinction might fail to be detected by a sensitive ear.

Such deductions cannot be made without certain safeguards, and it is here that the co-operation between scientist and linguist is most helpful. On one hand, the philologist is apt to be mazed by the elaborate convolutions in the wave-form of a simple vowel—and even to the physicist, it seems a big step from the wave-form of a tuning-fork to that of a vowel; on the other hand, the scientist, in his desire to attach a label to every sound, is liable to read into the record sounds which are not there. For example, a record has been published of the wave-form of the word



WAVE-FORMS OF THE VOWEL α AT FREQUENCIES OF 104, 129, 150 AND 208 C./SEC. RESPECTIVELY. (PHOTO BY W. RIDDELL.)

farmers with a section ascribed to the central *r*, which is never pronounced in normal English speech.

Amid a vast accumulation of such records, it is pertinent to inquire how much can be learned from speech wave-forms. How far can the sound α be recognized as such, when uttered by different persons or by the same person in different circumstances? The difficulty is enhanced when one reflects that vowel sounds are not quantized, but range over an infinite number of fine gradations; so that how many distinct vowels should be recognized and where their boundaries lie are matters hotly contested by the philologists themselves. The problem is being tackled in the King's College laboratory by making collections of oscillograph records of the same vowel enunciated at a series of pitch values.

A set of such records of the vowel α by a male voice is reproduced herewith. The characteristic pattern of this vowel—a series of peaks diminishing in height within the period—can be recognized in each trace, although analysis of each trace into its acoustic spectrum scarcely helps the identification. It reveals not only a change in the fundamental pitch but also, accompanying each fresh setting of the vocal cords, the intrusion of sufficient harmonics

of the fundamental to disguise in the spectrum the fact that the same vowel is being enunciated throughout the set.

Changes in the spectrum also occur when the intensity is altered, the pitch remaining constant. The general effect of singing the vowel more loudly is to throw more of the energy into the higher partials. This is what might be expected of any form of musical instrument. It is shown, for example, in the timbre of the clarinet played at a fixed note with rising blowing pressure.

Of course, one must not overlook the psychological aspect of these tests. Someone, either the speaker or a listener, has to judge whether the task set—to enunciate the same vowel at different values of the fundamental pitch or of intensity—has been faithfully carried out. Actually, it is difficult to keep these two changes—of pitch and loudness—separate, the general tendency of a choir being to raise the pitch of a note which it is asked to sing more loudly, particularly if it is unaccompanied by an organ or orchestra. There is, however, more behind this than a mere psychological exhilaration on the part of the singer or speaker. Our vocal apparatus is such that it is physically impossible to sing a given vowel over a wide range of intensity. Certain vowels also having important partial tones low in the musical scale cannot be truly elicited at a high pitch. Female singers especially have to make a compromise with such vowels sung at a high pitch, though the context provided by the neighbouring consonants usually suffices to convey the meaning of the words so altered.

Other variations in the wave-form of a vowel may be introduced by the consonant which precedes or follows it. With the exception of the so-called voiced consonants, these sounds may be likened to those which occur during the attack on, and relinquishing of, a steady note by a musical instrument; such sounds as the biting of the bow upon the violin string and the tonguing of the flute by the player. It has recently been shown by J. W. Black that these transient speech sounds have little influence on the vowel sound which follows or precedes them, during the period that the vowel holds the field. (The same applies to mechanical instruments of music.)

Minor deviations from what one may regard as the standard form of the vowel occur during the sustained singing of it or even within the few seconds which it occupies in conversational speech. The 'tone' of the muscles which put tension upon the vocal cords, the 'blowing pressure' within the lung-bellows, the setting of the mouth resonator; these are not rigidly set in the human instrument as they are, for example, on the organ while a key is held down. It is not surprising, therefore, to

find slight fluctuations in the wave-form from one period to the next during the enunciation of one and the same vowel. The strips of film reproduced in the figure would not exactly overlay other strips from the same films ten feet farther on, but such deviations would appear of little significance compared to the variations between the four films shown. Some philologists make much of these variants within the record of a vowel. E. W. Scripture indeed goes so far as to consider that they invalidate any application of Fourier analysis to the wave-forms of vowels.

Nevertheless, there is hope for the view that to each vowel a definite wave-pattern may be attached. Moreover, the majority of recent research favours the 'formant' theory of vowel sound production. This regards every musical instrument as being composed of a resonator or system of resonators coupled to an exciting or maintaining agency. In the human voice the exciting element is located in the vocal cords, while the cavities of the mouth, nose and sinuses form the sound-boards. The setting of the exciting agency at a definite fundamental frequency will give rise to a sound, the acoustic spectrum of which will be rich in those resonances which happen to march with the fundamental exciting frequency or its attendant harmonics. This formant of resonances—or 'wolf notes' as the violinist calls them when they are undesirably prominent on his instrument—is an individual characteristic. On most mechanical instruments and, for that matter, in the voices of animals like the cow and the dog, the formant is fixed, but man has learned to change these sound-board resonances by subtle gradations whereby the different vowel sounds may be recognized by an interlocutor.

The existence of a formant proper to each vowel is the cause of such variation of the wave-pattern with pitch as is shown in our figure. Of course, there are certain portions of the vocal resonators which remain unchanged in size and therefore in frequency as the speaker readjusts his cavities for another vowel, and these have been recognized in the acoustic spectrum of most of the sounds uttered by an individual in normal health. They are as characteristic of the adult individual as his finger-prints. The formant theory is supported by the possibility of synthesizing vowel sounds out of models constructed of a generator coupled to variable resonators, as in the well-known work of Sir Richard Paget with mechanical models on one hand, and that of Dr. W. H. Eccles and Prof. G. W. Stewart with electrical models on the other.

Another feature which characterizes speech is intonation—the variation in intensity and pitch which a person puts into a speech. Compare, for example, the level monotone of an Italian

announcer in the broadcasting service with the excessive modulation of his Swedish confrère; or the stolid utterance of the Somerset man with the lilt of the East Anglian or Northumbrian. This is a characteristic which may readily be measured on inexpensive electrical apparatus of the noise meter and beat-frequency types. Both these instruments incorporate some form of valve-voltmeter in their final stages, the deviations of which from a mean setting (of intensity and frequency, respectively) can be recorded as a flickering of the needle, or, better still, as the root mean square value of the deviations. The latter figures can be obtained if some form of wattmeter in the output stage is used, and may be taken as a measure of intonation, in the same way that the root mean square value of the deviation from a standard stream velocity is taken in hydrodynamics as a measure of the intensity of turbulence in the stream.

Nor must the physiologist be left out of this

work. Though experiments on the vocal apparatus of dead mammals played a part in the early development of phonetics as an experimental science, results so obtained are rather discounted as criteria for the science of the human voice to-day. Much, however, is to be learnt from X-ray photographs of the larynx taken when set in position for the production of a sound, which is oscillographed at the same instant. Such studies are being made by—among others—Prof. O. Russell in America and Dr. R. Curry in England.

Other work which should prove of great import to linguistic studies involves the taking of high-speed cinematograph pictures of the motion of the vocal cords as seen through the laryngoscope. Such photographs, in various modes of action of the cords, normal, falsetto, etc., are now being obtained in the laboratories of the Bell Telephone Company at New York.

¹ NATURE, 133, 655 (1934).

PLANNED WHEAT PRODUCTION

By SIR JOHN RUSSELL, F.R.S.,

ROTHAMSTED EXPERIMENTAL STATION

WE have in Great Britain nothing quite like the Food Research Institute of Stanford University, California, which periodically publishes important monographs on foods, and in consequence it would have been difficult to produce here the comprehensive study "Competition among Grains" recently issued by Dr. Jasny. Mr. Paul de Hevesy's achievement in completing his great work "World Wheat Planning*" is therefore all the more remarkable, and he is to be congratulated on having brought together in one volume an enormous mass of data relating to the production of wheat in the different countries of the world, its distribution and its consumption. The labour involved has been prodigious, but it is known that he has been engaged on this work for a long time, and his extensive knowledge of the subject is well recognized.

Wheat, like sugar, affords an example of the triumph of politics over Nature. Both crops grow admirably in the regions naturally suited to them, and these regions are adequate to produce all, and more than all, that the world is likely to require. If they were in fact called on to produce all the supplies, the necessary corollary would be un-

hampered trade between the producing and the consuming countries. But there is an alternative method. Science has opened up the possibility of growing both crops in conditions not naturally suited to them, and so enabled many countries to produce their own supplies. It is true that the supplies cost more, are less certain and less abundant than by the other method, but in those countries where political considerations have dictated a policy of autarky or self-sufficiency, agricultural science is called upon to make the best of the task of growing a crop in conditions not really suited to it. Two general methods are adopted: the environmental conditions are changed by various devices of soil management, and the plant is changed by cross-breeding and other methods. Sooner or later pathological problems arise, sometimes of great importance: these also have to be dealt with.

Wheat is really a plant of the semi-arid regions: it has been found wild in Asia Minor, northern India, Abyssinia, etc. Throughout long years of cultivation many varieties have been selected or bred, but the crop still retains its semi-arid nature.

The optimum climatic conditions for wheat production are a moderately low rainfall of about 20–25 inches per annum, with dry warm weather

* World Wheat Planning and Economic Planning in General. By Paul de Hevesy. Pp. xv + 912. (London: Oxford University Press, 1940.) 38s. net.

for maturation and harvesting. These conditions prevail over great belts of continental areas, especially in North America, Australia, and Eastern and Central Europe, including the U.S.S.R.; in these regions wheat can be grown cheaply and in abundance. England, with its many soils and climates, also has a considerable proportion of wheat-growing regions. The area east of a line from Durham to the Isle of Wight is largely suitable, and another area extends westwards from the southern part of this line; the boundary is roughly the escarpment formed by the Inferior Oolite outcrop. The determining factor is chiefly the rainfall but with soil as a strong subsidiary, for wheat is less easy to grow than grass on a heavy clay soil or than barley on a light one, so that it tends to keep to the loams. It is better suited to heavy than to light soils, and in the old days was much grown on the clays in the eastern counties, the Midlands and the south; for this purpose the land was laid up in high ridges separated by deep furrows, many of which still remain, giving a curious wave-like appearance to the pastures. Their original purpose was to provide drainage, and although modern mole-draining would be much better, the cost of levelling the ground would be more than the land was worth.

The area under wheat in Great Britain was at a maximum in the early 1870's, when there were $3\frac{1}{2}$ million acres. The total production was probably about $2\frac{1}{2}$ million tons, sufficient for the needs of 19 million people at present rates of consumption (300 lb. wheat per head per annum). The population of Great Britain in 1871 was 26 millions, so that the home production amounted to 73 per cent of the total consumption.

Even in those days there were importations of wheat from America, Australia and Europe, but only by way of completing the home supplies. Then, with almost dramatic suddenness, wheat growing in England became unprofitable. The American and Canadian farmers had been rapidly breaking up the prairies, the railway was pushed across the continent and the trans-Atlantic steamship services were organized. When the chain was completed, wheat was brought over from North America in great quantities and sold on our markets at prices far below the cost of production here and, in some years during the financial crises in the West, below the cost of production there. The politicians of the day decided to leave economic forces alone and so did nothing; English farmers gave up wheat-growing, and a short time before the War we were producing not much more than 10 per cent of our total consumption. Then the Government stepped in, and virtually made a contract with farmers to produce about 15 per cent of home requirements at an agreed price.

The actual arrangements were complicated by the fact that the Government did not wish to interfere with the usual marketing arrangements, and so left the ordinary machinery at work, but paid to the farmers the difference between the market price which they had actually received and the contract price which they were due to receive. These are called 'deficiency payments'; they work well enough so far as the farmer is concerned. Unfortunately a section of the Press calls it a "subsidy", which, of course, it is not. Most business enterprises nowadays are worked on contracts, and it would be a very good thing if the system were more widely extended to agriculture.

As a result of the Wheat Quota Act, the nation can count on 15 per cent of its requirements being met at home, and in peace-time this proportion is fairly satisfactory, though a case could be made for a larger one; however, the figure is a good compromise. For there is a very considerable difference between ordinary English and imported wheat: the English wheat does not give the large, well-piled loaf obtainable with the so-called 'strong' imported wheat, and the English housewife, therefore, does not like it and will not buy it. Most of the mills are situated at the ports, and they use in normal times only a small fraction of English wheat: the inland mills use more, especially when they can get the one 'strong' wheat commonly grown in England—Yeoman, produced by Sir Rowland Biffen at Cambridge. English wheat is much used for biscuit-making and for poultry feeding; for both purposes it is admirable. What English wheat lacks in 'strength', however, it more than makes up in power of growth, and the English 'weak' wheats include some of the heaviest yielders known. 'Strength' refers only to the character of the dough, and has nothing to do with vigour of growth of the plant or nutritive value of the grain.

In war conditions, a production of only 15 per cent at home is insufficient, and efforts are therefore made to increase the output here. The chief difficulty is that wheat is one of the less productive crops: it usually gives less than 1 ton per acre of dry matter for human food, while potatoes yield two to three tons of dry matter and mangolds may give double this quantity—this, however, is food for animals. The war-time increase comes from the ploughing up of the less productive grass land, our great national reserve of fertility.

An important reason for relying on importation in peace-time is that wheat is one of the easiest of all crops for the farmers on great continental plains to grow. Their first methods led to severe soil erosion, but where this has not gone too far the modern methods are free from this objection. Wheat is also one of the easiest of all agricultural

products to store, to transport, and to sell. In a world permanently at peace, densely populated countries like Great Britain could confine themselves to crops giving larger quantities of dry matter per acre, or to products like vegetables, milk, eggs, high-quality meat and fruit where freshness is an asset.

A cynic looking for examples of human folly could find none better than the human treatment of the bountiful supplies of wheat of the last fifteen years. The nations pray that their daily bread may be given to them, and it has been, with a margin to spare. Mr. Hevesy gives a completely dispassionate and objective statement of the results. During the period 1926-34, the world produced more wheat than it consumed: the margin was only small, and never exceeded 2.5 per cent except in one year, but the continued small over-production made the markets so sensitive that prices fell to ruinous levels. Since most of the world's population is engaged in agriculture this loss of purchasing power by farmers and farm workers led to serious industrial and financial depression. The over-production did not arise from heavy yields, but from an extension of acreage partly in Europe as a consequence of the self-sufficiency policy.

Countries that lived in part on their wheat exports—Canada, Australia, the Argentine—had to subsidize their farmers to save them from bankruptcy, while countries that aimed at self-sufficiency found themselves obliged to export temporary surpluses at shipwreck prices, paying the normal price, however, to their producers. Mr. de Hevesy instances a country where 25 million quintals (92 million bushels) excess were produced at an average cost of 19 gold francs (that is, the Swiss franc before its devaluation in September 1936) per quintal which had to be exported at 6-7 francs, the difference being made up by the taxpayer. Yet the small percentage excess that was causing all the trouble was not really superfluous: millions of people in Europe and other countries were under-nourished, but the attempts made at Geneva and elsewhere to persuade nations to buy more bread-and-butter failed.

The trouble was intensified by fiscal arrangements. An inquiry showed that during 1929-30 consumers paid 66,000 million gold francs for their bread, but the growers received only 36 per cent of this total; most of the remaining 64 per cent went in taxes.

There were considerable indications of a further wheat crisis ahead had not the War brought on a still greater crisis. The "Big Four"—the United States, Canada, Argentine and Australia—were last August discussing the possibility of arranging for quotas, and after agreement they

intended to hold a wheat conference in London to be attended by the U.S.S.R. and the Danubian countries. The War stopped this, but Mr. Hevesy thinks more wheat crises, with all their attendant evils, are inevitable until world wheat production is planned and organized.

Much of the book is occupied with a full description of wheat production in all countries from which any information can be obtained. In a particularly interesting section on Germany it is pointed out that, prior to the War, Germany was one of the foremost wheat-importing countries, but during the period 1931-35 she became nearly self-sufficient and can now, if the harvest is good, produce all her requirements of wheat, rye and other grains. Nevertheless Germany bought some 15½ million bushels of wheat from wheat-exporting countries during the autumn of 1938, and her reserves must now be considerable. The yield of wheat in Germany between 1890 and 1930 increased by about 11 bushels per acre and is now about 32-33 bushels per acre, about as much as our own yield. Gigantic distributing machinery has been set up called *Reichsnährstand*, a kind of cartel including all farmers and their associations, all merchants of agricultural produce, the exchanges and all processing industries. It is organized like the National Socialist Party itself, having in the village its "confidential agents", above these the district leaders, and at the top the chief for the whole Reich; practically all the officials are members of the Party. It exercises very complete control over farmers, salesmen, millers and all others who handle food production. The farming is based on the Hereditary Farm Law of 1933, setting up about 700,000 hereditary farms which may be inherited by one child only, usually the eldest, who has no power to subdivide, sell, or mortgage the land without a State permit, and if this is granted at all it is only for sale to another farmer.

While the fixing of prices is effectively carried out, there is no such planning of production as in the U.S.S.R.; it is left to the individual to decide what he shall sow, and this seems to be all that is at his discretion. The Government, of course, influences his decision by the prices they fix. In the end food prices are considerably higher than in England and the standard of living of the people is lower.

In the section on the U.S.S.R., Mr. Hevesy finds no evidence of increased yields since the pre-Revolution days, notwithstanding enthusiastic claims as to what Russian science has done for agriculture; also he states that the cost of production, so far as can be ascertained, is very high, in spite of the much-praised mechanization and social-economic system. The total production of

wheat seems not to have kept pace with the growth of population. However, Russian wheat statistics are complicated by the change which took place in 1933; prior to that date they were based on the grain actually collected; after that date they are based on the "biological" or unharvested crop, a deduction being made for

"technically inevitable losses in harvesting". In 1933 the deduction was given as 10 per cent, that is, about 1 bushel per acre, but much doubt has been expressed as to whether the losses could be kept as low; the figures for production are taken by Dr. Schiller as maximum figures which certainly have not been exceeded.

THE HYDROGEN BOND

BY DR. C. E. H. BAWN,

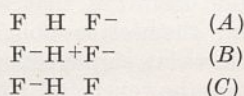
UNIVERSITY OF BRISTOL

IT has been recognized for many years that under certain conditions a hydrogen atom can form a connecting link between two other atoms. It may be considered as forming a bond between them, known as the hydrogen bond. Although the hydrogen bond is not strong, recent investigations have shown it to be of very wide occurrence. The concept has been extremely useful in explaining the association of polar liquids like water, the association of carboxylic acids, alcohols, amides, etc., the closure of rings within the molecule, and in interpreting many measurements of structure by X-ray and electron diffraction methods and of the frequency shifts of the infra-red absorption bands of certain known groupings. It was investigations of this type that not only established the existence of this form of bond but also provided information regarding the conditions in which its formation is to be expected, and, in many cases, of the actual energy of the bond. In spite of the enormous amount of experimental data now available, there is still much information which is lacking; the exact mechanism of the bonding power of the hydrogen is not clear, and there are many difficulties with questions of terminology.

With the object of clarifying the situation, a general discussion on "The Hydrogen Bond" was held by the Faraday Society on May 17 at the Imperial College of Science and Technology, London. A number of subjects was discussed in the six papers presented to the meeting, but briefly, the discussion can be considered under two headings: (1) the methods of studying hydrogen bonds by infra-red absorption, X-ray diffraction, and magnetic susceptibility measurements, and a survey of the results obtained; and (2) the occurrence of hydrogen bonds in molecules of biological importance, such as the proteins and carbohydrates.

It follows from the quantum-mechanical theories of valency that hydrogen cannot form more than

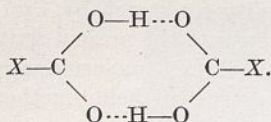
one covalent bond and that the attraction of two atoms as found in hydrogen bond formation must be due to ionic forces. The positive hydrogen ion with no electronic shell around it attracts one anion to its normal internuclear separation, and this could then attract a second anion, namely, $X^{-}H^{+}Y^{-}$. As might be expected, the strength of the bond formed should increase with increase in the effective negative charge of the bonded atoms. Thus fluorine, oxygen, nitrogen, and chlorine should form hydrogen bonds of strength decreasing in this order. Perhaps the best example of this type of ionic bonding is the HF_2^{-} ion; Pauling considers that this ion resonates among three structures:



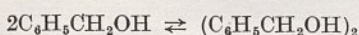
When we come to consider more complex structures involving intermolecular hydrogen bonds, steric requirements must also be satisfied, that is, the interacting groups must be capable of sufficiently close approach to enable the attractive forces to come into play. When we review the conditions of formation of the hydrogen bond, it is not at all surprising that one meets examples of bonds covering a wide range of interaction, from strong bonds to weak bonds, finally emerging into groups of interaction which we know as due to van der Waals forces. It seems at present that the only means of characterizing the hydrogen bond in the molecule is the energy required to break it.

The most important and useful method for the discovery of hydrogen bonding is infra-red spectroscopy. The main results obtained up to the present time were discussed by Dr. G. B. B. M. Sutherland. Every molecule containing an XH group gives rise to well-marked absorption bands in the near infra-red, which are characteristic of the stretching and contraction of the XH bond.

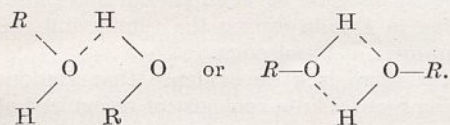
If the hydrogen atom of the XH group becomes subject to the influence of a force other than that which binds it to the X atom, then the frequency of vibration will be altered and the characteristic band will be shifted. The presence of hydrogen bonds in the molecule can therefore be inferred from the perturbation it produces in the normal XH bond. In this way both intermolecular and intramolecular bonds have been determined. As an illustration of the method we may select one of the best-known examples of the hydrogen bond, namely, the dimeric form of the carboxylic acids,



The effect of association is shown by the shift of the OH fundamental frequency at 2.83μ to 3.25μ in the acid, and the change in intensity of the band with temperature can be used as a measure of the degree of dissociation of the dimeric molecule, and hence of the heat of dissociation. The method is equally applicable for the study of hydrogen bonds in solids, solutions and liquids. Thus, the association of the alcohols in carbon tetrachloride is characterized by a band at 2.84μ – 2.88μ , in contrast to the sharp monomeric band at 2.75μ . Dr. J. J. Fox and Dr. A. E. Martin find that the monomeric O–H bond of benzyl alcohol in carbon tetrachloride has two components, 2.750μ and 2.765μ , which seems to indicate two molecular species of the alcohol. At low concentrations this alcohol dimerizes (2.865μ) and an equilibrium

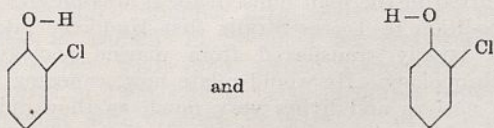


is set up, but it is not possible to decide whether the dimer has the structure,



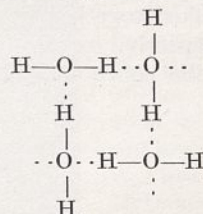
At higher concentrations polymeric association becomes predominant, and this they conclude is in accordance with an equilibrium between dimer and quadruple molecule.

Numerous infra-red investigations have shown the presence of intramolecular hydrogen bonds. The classic example of this group is the two forms of *o*-chlor-phenol,

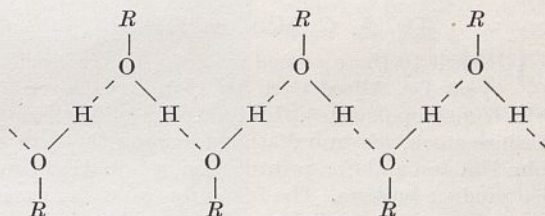


the possibility of *cis-trans* isomerism giving rise to two absorption peaks, one at about $7,050 \text{ cm.}^{-1}$ (*trans*-form) and the other at about $6,890 \text{ cm.}^{-1}$ (*cis*-form). Many other examples were given in Fox and Martin's paper.

The results obtained by the other powerful method of studying hydrogen bonds was reviewed in a paper by Dr. J. M. Robertson. By this method the distance between the bridged atom or groups forming the hydrogen bond can be directly measured. In this way the presence of hydrogen bonds has been demonstrated in many inorganic and organic structures. Perhaps the most interesting example is that of ice, in which each oxygen is surrounded tetrahedrally by four other oxygen atoms at a distance of 2.76 \AA . The structure is pictured to be of the type



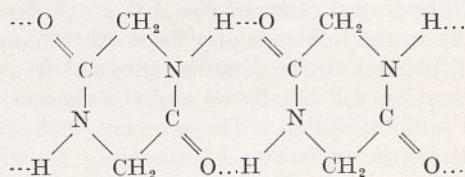
In the crystalline alcohols a similar sort of structure exists, the molecules combining through hydrogen bonds to form indefinitely large structures,



Bernal has suggested that on the basis of results obtained by X-ray analysis, two types of bonds should be distinguished, for which he proposes the names hydrogen and hydroxyl bonds. In the former, hydrogen is attached by equal firmness to two oxygens, $\text{O} \cdots \text{H} \cdots \text{O}$, the energy being about $8,000 \text{ cal.}$ and the distance between the oxygens being 2.5 – 2.65 \AA . In the latter, the hydrogen remains unsymmetrically attached to one of the oxygens, $\text{O} \cdots \text{H}-\text{O}$, giving a bond energy of $5,000 \text{ cal.}$ and an oxygen–oxygen distance of 2.7 – 2.9 \AA . Since the experimental evidence seems to indicate an almost continuous transition between these two extremes, the necessity for this distinction is not accepted by all.

In a short paper Dr. W. Rogie Angus and W. K. Hill described some preliminary results on a general investigation of diamagnetism and hydrogen bonding. There seems to be every indication that hydrogen bonding should be detectable by susceptibility measurements.

The hydrogen bond may be of great importance biologically, and two papers of the discussion were concerned with the role of hydrogen in determining the structure of the proteins and starch. Our knowledge of the detailed structure of these molecules is still far from complete, and consequently it was not possible to do more than to survey the possible part which hydrogen bonds might take in determining the structure of these substances. In this short summary, one can only restate the conclusion reached by Dr. W. T. Astbury after a critical discussion of the way in which hydrogen bonds may intervene in protein structures, "that whichever way we turn it is impossible to reach a verdict that is really satisfying". However, X-ray analysis of crystalline diketo-piperazine, a substance related to the proteins, shows that the molecules are linked together by hydrogen bonds between their respective oxygen atoms and =NH groups, to form flat continuous chains throughout the structure.



It may be expected that the formation of hydrogen bonds may be important in determining the behaviour of complex molecules containing multiple active hydrogen bond-forming groups, for example, polysaccharides. A critical consideration of this possibility for starch by Prof. E. L. Hirst, Dr. G. T. Young and the present writer shows that the properties of this molecule are inconsistent with those of a structure held together by hydrogen bonds. Analysis of physico-chemical data indicates that the repeating units in starch are held together by normal glucosidic linkages. It is pointed out, however, that the macro-molecules may be associated by hydrogen bonds in native starch.

OBITUARIES

Dr. A. C. Haddon, F.R.S.

ON April 10 there passed away in his eighty-fifth year Dr. Alfred Cort Haddon, the doyen of British anthropologists*. Haddon came of Northamptonshire stock, his grandfather founding the firm of John Haddon and Co., printers and typefounders and also produce brokers. The family business connexion brought people from all parts of the world to Haddon's home, and this may well have influenced his choice of a career. From his mother, who wrote children's books, came an interest in natural history, and young Haddon spent much of his time at the Zoo studying and drawing animals. This led friends to advise his father to send him to Cambridge to study zoology, but the boy was destined for his father's business, which he entered on leaving Mill Hill School.

According to Haddon's own account, it took his father scarcely two years to discover that it might be less costly to send his son to Cambridge than to retain him in the firm. So to Cambridge he went, entering Christ's College at the age of twenty, where he worked at zoology under F. M. Balfour and also came under the influence of Michael Foster. It was the former who inspired his first big book, the "Introduction to Embryology" (1887). He took his B.A. in 1879, and was appointed demonstrator in comparative anatomy almost immediately, holding this post until 1880, when he migrated to Dublin as professor of zoology in the Royal College of Science. The M.A. followed in 1882 and the Sc.D. in 1897; he

* I wish to thank Miss E. S. Fegan for invaluable assistance in the preparation of this notice.

was a fellow of Christ's from 1901 onwards. In 1881 he married Fanny Elizabeth Rose, the sister of his college friend J. Holland Rose (later Harmsworth professor of naval history), by whom he had three children.

In Dublin, Haddon was active in marine biology, being secretary of the Dredging Committee, which did much work off the south-west coast of Ireland, and this led to a series of papers, mostly on the Actinozoa, in the *Proceedings of the Royal Dublin Society* and the *Royal Irish Academy*. For some years he divided his time between Dublin and Cambridge, lecturing in Dublin during the winter and spending the summers at Cambridge.

So far there is little evidence that Haddon was anything more than a zoologist of recognized ability, and it was in this capacity that he was sent to Torres Straits in 1888, where he spent nearly a year, though an early interest in decorative art (he was then twenty-five) is shown by a letter to NATURE (23, 9-10; 1880) on the Greek fret. The zoological material brought back from this expedition was published in the *Proceedings of the Royal Society* and in the *Transactions of the Royal Dublin Society*. However significant these results may have been, their importance is entirely eclipsed by the alteration that occurred in the man himself, for it was on this first expedition to Torres Straits that Haddon's interest was largely transferred from marine zoology to anthropology. He would relate how, canoeing with the natives and living very much as they did, he became conscious of the change in their old mode of

life, that with this came the conviction that it was his duty to save for science what could be saved, whether of their beliefs, language, or arts and crafts. Haddon was, in fact, in time to save most important evidence both of language and of art—witness the splendid collection of turtleshell masks in the British Museum, and the papers written in conjunction with S. H. Ray on the Torres Straits languages.

There was, however, no immediate change of allegiance. When, after his return, Sir William Flower suggested that he should seriously devote himself to anthropology, Haddon, in his own words, "was not very ready to do [so]". There is in existence a most interesting letter written (Nov. 6, 1889) by T. H. Huxley in reply to a request for his advice. "I know of no department of Natural Science more likely to reward a man who goes into it thoroughly than Anthropology. There is an immense deal to be done in the science pure and simple and it is one of those branches of inquiry which brings one into contact with the great problems of humanity in every direction. I once dabbled in it a good deal and I should have liked nothing better than to give myself to it". He goes on to outline the training necessary, and continues: "The only part of your project in which I am afraid to give you any encouragement is the expectation that when the labourer is thus carefully prepared his hire will be forthcoming. I admire Mrs. Haddon's and your pluck immensely, but after all, you know, there is an irreducible minimum of bread and butter, the need of which is patent to a physiologist, if not a morphologist, and I declare with sorrow that—I do not see any way by which a devotee of anthropology is to come at the bread—let alone the butter. And you must recollect (*experto crede*) that the necessity of having to make an income independently of one's proper work—is a frightful burden upon anyone who desires to do that work as it ought to be done. Don't burn your ship in a hurry."

Nevertheless, the leaven worked, and Haddon burnt his ship. Finding little scope for his new interests in Dublin, he resigned his professorship within a few years and settled permanently in Cambridge in 1900, having been appointed lecturer in physical anthropology at a salary of £50 per

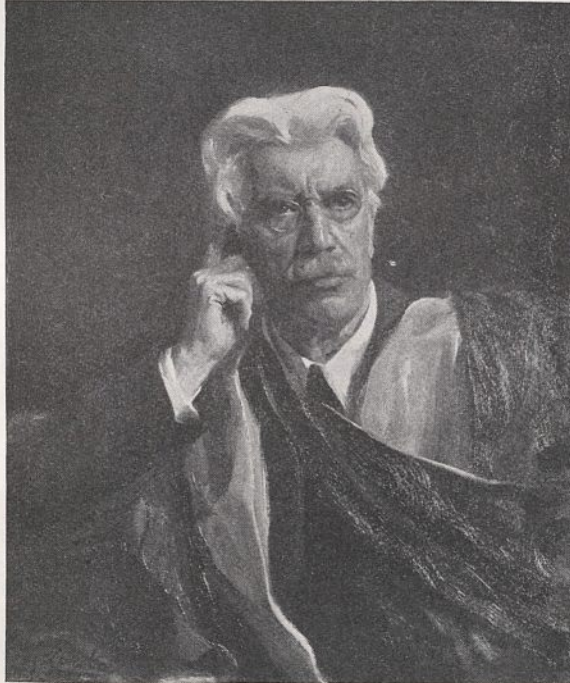
annum the year before. This entailed a considerable financial sacrifice, and he used to allude to this period as one of acute struggle, always emphasizing the encouragement he received from his wife and her constant self-sacrificing assistance.

The idea of revisiting Torres Straits soon crystallized into a definite project, and clearly became an increasing purpose during the next few years. Funds were raised, and on April 22, 1898, the Cambridge Expedition to Torres Straits reached Murray Island, with Haddon as leader. The expedition had from the beginning been planned as something far bigger than a rescue party to a decaying culture, though naturally

all possible information bearing on the islanders past and present was collected. It was Haddon who in Great Britain first appreciated the need to study the psychology of 'primitive' peoples, and the importance of that science in relation to what we now call social anthropology. Thus it was that Rivers, McDougall and C. S. Myers became members of the expedition. Here the leader—like so many outstanding men—was ahead of his time; apart from the study of the senses, the psychologists were not yet ready for the anthropologists, nor had more than a limited attention been paid to the unconscious, while the technique of its investigation had scarcely been explored. Nevertheless, this inclusion of psychologists was to lead

almost immediately to a most important anthropological development, for it was in the Torres Straits that Rivers elaborated the genealogical method, the most valuable single instrument of investigation that has yet been put into the hands of the social anthropologist. Its importance did not escape Haddon, and in after years he would speak of the conversion of Rivers from psychologist to anthropologist as one of the really important results of the expedition. Haddon did not spend the whole of his time in Torres Straits, but with Ray and Seligman visited New Guinea, where in a few weeks he accumulated an amazing amount of material in every branch of anthropology. On leaving the Straits, he and some other members of the Expedition visited Sarawak, at the invitation of Charles Hose, then Resident of the Baram District.

Election to the fellowship of the Royal Society coincided with Haddon's return in 1899, and from



ALFRED CORT HADDON

Reproduction of a portrait by De Laszlo now in the Museum of Archaeology and Ethnology, Cambridge.

then on his life was so bound up with anthropology as almost to be an epitome of the progress of the science in Great Britain. He was appointed University lecturer in ethnology, becoming reader in 1909 and retaining this post until his retirement in 1926. He was also lecturer in ethnology (Martin White Benefaction) in the University of London during 1904-9. He was president of the Royal Anthropological Institute during 1901-1902, its Huxley Memorial Medallist in 1920, and its first Rivers Medallist in 1924. He was a constant attendant at the meetings of the British Association, presiding over Section H in 1902 (Belfast) and 1905 (South Africa); he was also president of the Folk-lore Society, and of the Cambridge Antiquarian Society. In company with his daughter, now Mrs. Rishbeth, he re-visited Australia and New Guinea in 1914, collecting some fresh material for the "Reports" and greatly increasing his knowledge of Papuanian canoes, knowledge which later led to the publication, with James Hornell, of "Canoes of Oceania".

On his retirement from the Cambridge readership in 1926, he retained his post of honorary curator of the New Guinea collections, which he arranged and catalogued, intending later to do the same for the Borneo material. Leisure from teaching, and intensified contact with museum material, led to the planning of a new work largely concerned with decorative art. This required much museum research—especially in Holland, where he was enthusiastically received—and the MS. of "Smoking and Tobacco Pipes in New Guinea" was completed only a week before his death.

Haddon reviewed for several papers; he was a contributor to NATURE for sixty years, and was the author of countless memoirs and papers, as well as an unusual number of important volumes. This is no place to discuss the Torres Straits "Reports", which he edited and so largely wrote; they speak for themselves. Of his other works, "Iban or Sea Dyak Fabrics and their Patterns" (1936), written in conjunction with L. E. Start, again indicates his persistent interest in decorative art. "Races of Man" (1909, 1924 editions), and "The Wanderings of Peoples" (1911), both illustrate the influence of his zoological training, while the latter book is an exhibition of the extremely condensed style he could at need employ. "We Europeans", written in collaboration with Julian Huxley, is an example of the best form of *œuvre de vulgarization*, produced in the hope of countering some of the insane theories of race now prevailing.

It is surpassingly difficult to give any idea of Haddon the man in a short notice such as this. His strength of build, prominent features, and later his shock of snow-white hair, made him a conspicuous figure in any assembly. Intensely energetic, he had a great capacity for work (in Torres Straits he worked a longer day than any of us), and accuracy of detail seemed to come naturally to him. While the outstanding feature of his character was a broad humanity and kindness, there was a somewhat unexpected streak of Puritanism, which, however,

mellowed greatly as time went on, his wife persuading him to smoke and even to take a drink now and then. He had a keen sense of humour, could be frivolous, and thoroughly enjoyed a holiday as a rest, but in the main his thought and conversation were directed and constructive, and apart from his work he had no hobbies. He was working for an hour or two a day until within a couple of weeks of his death. Far more disinterested than most, there was no one whom he would not go out of his way to help, provided that the claimant was himself doing his best. He hated pretence, and 'side' withered in his presence.

Haddon's work shows a capacity for wide generalizations with, as it seems, a preference for the intensive study of smaller areas in which the intrinsic characters of a people can be compared and contrasted with foreign traits. His method and capacity in this direction are particularly well shown in much of volume I (the last written) of the "Reports". It was no doubt his kindness, tolerance, and honesty of purpose that enabled him to make friends with natives and to gain their confidence in the way he did. "He close up alongside God, he savvy too much" ("too much", that is, a great deal), was the phrase used of him by a Murray Islander, and indeed probably expresses the opinion of all his friends. To have known, appreciated, and been the pupil of A. C. Haddon has been one of my greatest privileges.

C. G. SELIGMAN.

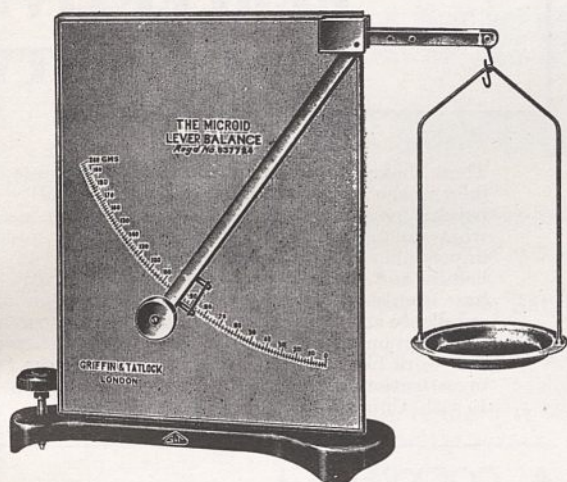
W. R. King

MR. W. R. KING, who died on April 8, aged seventy-two, was Wimshurst's assistant in the development of the Wimshurst electrical 'influence' machine, which of course displaced the frictional machine for the generation of static electricity in the laboratory. This type of apparatus seems to have required quite special skill in the selection and application of apparently simple materials, such as suitable glass and varnishes, necessary for reliability for experiments in static electricity; and Mr. King's experience in this respect was exceptional. The old Nairn machine of Sir Humphry Davy, now standing in the hall of the Royal Institution, owes its restoration to his skill, and he has also carried out similar work for the Science Museum.

In the early days of electrical knowledge numerous and ingenious working models were used to illustrate the behaviour of charged bodies. Many of these were quaint but very striking; Mr. King's collection was unique, and at one of the Friday Evening Exhibitions at the Royal Institution especially, when he showed many of them in action, he easily kept the members interested and delighted to a late hour. He also distinguished himself at the Faraday Exhibition at the Albert Hall in 1931 by a very striking continuous display of lightning from a battery of Leyden jars charged by his largest power machine.

Mr. King's strength had been ebbing for two or three years, continually weakened by bronchial attacks; but he died quietly in his workshop chair. W. J. G.

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Contents

Preface	The Diploblastic Phyla The Germ-layer Theory The Law of Recapitulation Cellular Differentiation Bibliography
CHAPTER I Protoplasm, the Cell, and the Organism	CHAPTER VI Metazoa of the Cellular Grade of Construction — Phylum Porifera, the Sponges
Protoplasm The Cell The Organism Bibliography	The Characters of the Phylum Classification of the Phylum General Morphology and Physiology Class Calcarea or Calcispongiae Class Hexactinellida or Hyalospongiae Class Demospongiae General and Phylogenetic Considerations Bibliography
CHAPTER II Classification	CHAPTER VII Metazoa of the Tissue Grade of Construction — The Radiate Phyla—Phylum Cnidaria
General Remarks on Classification The Principal Divisions of the Animal Kingdom Bibliography	Characters of the Phylum Classification of the Phylum General Morphology and Physiology Class Hydrozoa Class Scyphozoa Class Anthozoa: Subclass Alcyonaria Class Anthozoa: Subclass Zoantharia General and Phylogenetic Considerations Bibliography
CHAPTER III The Acellular Animals—Phylum Protozoa	CHAPTER VIII The Radiate Phyla—Phylum Ctenophora
Characters of the Phylum Classification of the Phylum General Morphology and Physiology Class Flagellata or Mastigophora Class Rhizopoda or Sarcodina Class Sporozoa Class Ciliata Class Suctoria General and Phylogenetic Considerations Bibliography	Characters of the Phylum Classification of the Phylum General Morphology and Physiology Bibliography
CHAPTER IV Phylum Mesozoa	Index
Bibliography	
CHAPTER V Introduction to the Lower Metazoa	
Origin of the Metazoa General Characters of the Metazoa Development through the Gastrula Stage	

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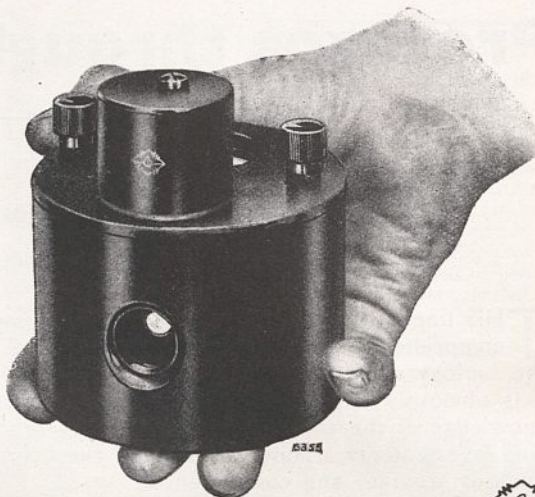
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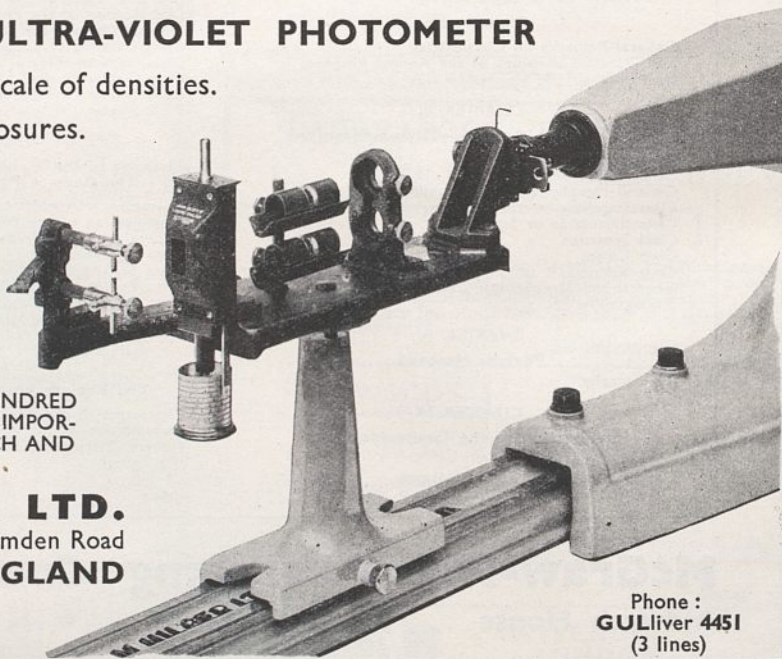
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NEW FOREIGN MEMBERS**M. Le Duc de Broglie**

MAURICE, DUC DE BROGLIE, was born in 1875, and has made important contributions to the study of X-rays and the establishment of the now well-known scheme of X-ray electron shells. In 1913, soon after the discovery of the diffraction of X-rays by crystals, he devised a photographic method of investigating X-ray spectra, similar to that developed independently by Moseley in Manchester. During 1920-1922 he used the method of semicircular focusing in a magnetic field to investigate the secondary electrons obtained from these films by the absorption of X-rays. In this way he obtained a direct and beautiful confirmation of the existence of electron energy-levels and of the X-ray quanta. About this time he wrote "Les Rayons X", which was for some years the best account of these phenomena. More recently, the Duc de Broglie has worked on the Brownian movement, on the total reflection of X-rays and on neutron emission. He has served on many committees of the Paris Academy of Sciences, and in 1937 became a member of the Conseil National des Recherches Scientifiques et Industrielles.

Prof. R. G. Harrison

PROF. ROSS GRANVILLE HARRISON, of Yale University, is one of the most distinguished experimental zoologists of to-day. He is probably best known as the originator of tissue culture, his first experiments in this direction being published in 1907. He showed that pieces of the medullary cord of frog embryos could be kept alive in clotted lymph, and he observed the outgrowth of nerve fibres from the explants. Thus he not only originated the method of tissue culture, but also used it, as it should be used, to solve a general problem, namely, that of the mode of origin of nerve fibres. In his later work, he has not by any means confined himself to the tissue culture technique, or even to the problems of the development of the nervous system, important though his contributions to both these fields have been. But, employing grafting methods, he opened up the very important question of the influence of the body of an embryo on the orientation and symmetry of organs grafted into it; and he initiated what is probably the most fundamental approach yet made to the problem of relative growth.

In all these fields, Prof. Harrison's work has been characterized by extreme clarity and precision. His papers are exemplary models, both in contents and presentation, for all young experimental morphologists; and they can be recommended as an antidote to those who think that there can be no exact biology except in those fields within reach of physical and chemical methods; while his Croonian Lecture on the origin and development of the nervous system, given in 1935, is a beautiful example of a broad and penetrating analysis of a biological problem.

Prof. G. N. Lewis

PROF. GILBERT NEWTON LEWIS, of the University of California, is well known for his important experimental researches in electrochemistry. In this field he and his pupils have made some very accurate measurements in difficult fields, including determinations of the electrode potentials of the alkali metals. This work links up with Prof. Lewis's outstanding contributions to thermodynamics, in which he introduced the very original and serviceable conception of the activity. This has been of fundamental importance in the development of the study of strong electrolytes, to which Prof. Lewis and his pupils have made many valuable contributions, and also proved to be very closely connected with the theoretical developments of the subject made by Debye and Hückel.

Another theoretical contribution made by Prof. Lewis was the explanation of covalency as due to electron sharing, and this conception is now firmly established in the modern theory of valency. There are few fields of modern physical chemistry which do not owe something to the highly original and constructive work of Prof. Lewis, and the systematization of thermodynamic data by him and his pupils has also been very important in the application of physical chemistry to industry.

Dr. Francis Peyton Rous

DR. ROUS is a graduate of Johns Hopkins University and has worked at the Rockefeller Institute for Medical Research, New York, since 1909. He is best known for his researches on the problem of transmission of cancer. More than thirty years ago he found a spontaneous sarcoma in a barred Plymouth Rock hen which could be transplanted into other individuals of stock closely related to the fowl in which the growth originally occurred. The fragments of tissue which produced new tumours on injection into other chickens did not contain any visible organisms, and extracts of the ground tumour material produced fresh sarcomata on injection into other fowls even after filtration through apparatus which would retain very small micro-organisms. The tumour, known as the Chicken Tumour I, or the 'Rous sarcoma', retained its distinctive properties whether it was transmitted by a graft of living tissue, by a cell-free filtrate or by dried tumour material, and it is still propagated at the present day. Rous later found many other fowl tumours.

During the last few years Dr. Rous has investigated the Shope rabbit papilloma virus. He has also worked on many physiological problems concerning the liver and blood vessels, the reaction of tissues to injury and vital stains and the preservation of blood. The papers describing the transmissible fowl tumours are classical for accuracy of observations recorded, and for deductions placed on the results.

NEWS AND VIEWS

Imperialism and Service

THE concepts of Empire Day and imperialism were given a new and fuller meaning by H.M. the King in his broadcast address on May 24. He referred in bitter tones to "the spirit of domination and the lust of conquest" to which our enemies give the term imperialism, and he re-defined the term as it now applies to the British Empire. Imperialism, he said, stands for "peace in which our institutions may be developed, the condition of our peoples improved, and the problems of government solved in a spirit of good will". The far-reaching implications of this statement will be readily apparent, and will meet with general approval, for it stamps the British Empire as held together by the strongest but least irksome of bonds, those of friendship and toleration. Of equal significance were His Majesty's words on the consequences of the struggle now in progress. "Defeat will not mean some brief eclipse from which we shall emerge with strength renewed—it will mean destruction of our world as we have known it, and the descent of darkness upon its ruins." All our resources and all our scientific energy are not too much to spend in averting this disaster.

Duddell Medallist of the Physical Society

THE Council of the Physical Society has awarded the seventeenth Duddell Medal to Prof. E. O. Lawrence, of the University of California, Berkeley, for his invention and subsequent development of the cyclotron. Prof. Lawrence, who was born in 1901, went to Berkeley in 1928 and was appointed professor of physics there in 1930. In that year, with M. S. Livingston, he constructed the first cyclotron, which had a comparatively small electromagnet and a pole-gap chamber only six inches in diameter. An 85-ton electromagnet was incorporated in the next cyclotron, designed in collaboration with D. Cooksey; it has an 8-inch pole-gap and a cylindrical chamber 37 inches in diameter. Lawrence was fortunate in obtaining supplies of deuterium oxide from Prof. G. N. Lewis, of the Chemical Department of the University, who had prepared it in quantity. By the summer of 1935, the 37-inch cyclotron had been used to accelerate deuterons to energies equivalent to about $5\frac{1}{2}$ million electron-volts, and $4\frac{1}{2}$ Mev. deuterons had been employed as projectiles for nuclear transformations. Later, 8-Mev. deuterons and 16-Mev. α -particles were produced and used as projectiles to obtain large yields of neutrons from beryllium and also to obtain artificial radioactive elements, for example, 100 milligrams of radio-sodium.

An impressive mass of results has been obtained by Lawrence and his school at Berkeley. Most of them relate to the large number of radioactive isotopes produced by the bombardment of most of the 92 chemical elements with protons, deuterons and α -particles of different energies. Biological effects

of neutrons and other products of artificial radioactivity have been studied by Lawrence in collaboration with his brother, Dr. John Lawrence of Yale University Medical School, and wide use has been made of radioactive indicators in the study of metabolism. The new 60-inch cyclotron, with a 220-ton magnet, in the Crocker Radiation Laboratory at Berkeley, has been constructed primarily for biological and clinical purposes, and with it deuterons having energies of about 18 Mev. have been obtained. The Rockefeller Foundation has now undertaken to finance the construction of a 4,900-ton (184-inch) cyclotron, with which it is hoped to accelerate deuterons to energies in the neighbourhood of 100 Mev. With such energies mesotrons may be artificially produced from nuclei.

Prof. F. A. Lindemann, F.R.S.

THE appointment of Prof. F. A. Lindemann as one of the Prime Minister's personal assistants, with particular reference to statistics and research, will be welcomed by scientific workers. Prof. Lindemann, who holds the chair of experimental philosophy in the University of Oxford, has a distinguished record as a man of science and of affairs, going back over the past thirty years. During the War of 1914-18, he was attached to the Royal Air Force and carried out important investigations on spin. Before that time, however, he had done work on the specific heat of solids at low temperatures, and on his appointment to the Oxford chair of experimental philosophy in 1919, he took up investigations on the nature of magnetic storms and on conditions in the upper atmosphere. He has also devised an electrometer now known by his name. Readers of NATURE will recall many contributions in the correspondence columns and elsewhere from Prof. Lindemann and workers in his laboratory. In recent years, Prof. Lindemann has also given much attention to the social consequences of scientific advances. His appointment to a post in close contact with the Prime Minister ensures that the Government will have at hand an adviser who will approach the problems on which he is consulted with full knowledge and appreciation of the scientific method.

Awards of the Institution of Civil Engineers

THE James Alfred Ewing Medal of the Institution, founded in 1936 in memory of the late Sir Alfred Ewing and awarded for specially meritorious contributions to the science of engineering in the field of research, has been awarded for 1939 to Prof. G. I. Taylor, Yarrow research professor of the Royal Society. Prof. Taylor is distinguished for his development of various aspects of mathematical physics, many of which have found applications of great importance in the engineering field. His work on the problem of the turbulent fluid, with special relation to air movements and tides, has furthered know-

ledge of meteorology, and has been applied to aeronautics, being of material assistance to the fruitful use of the wind-tunnel. He is also a pioneer in the field of research into the conditions in solid bodies during strain, plastic deformation, fatigue, and creep. The practical character of his researches is exemplified by his work on the torsional stiffness of airscrew blades, and he has forged new links between science and engineering to their mutual advantage.

The Sir Charles Parsons Memorial of the Institution, founded in 1936, comprises the erection of a memorial in Westminster Abbey, a Parsons Memorial Library, and an annual lecture on any of the subjects in which Sir Charles Parsons was interested, for which a commemorative bronze medal is awarded. The lecturer for 1939 was Dr. H. L. Guy, who dealt with "Some Researches on Steam Turbine Nozzle Efficiency". Dr. Guy has been the chief engineer of the Mechanical Department, Metropolitan-Vickers Electrical Co., Ltd., since 1919.

Colonial Policy and Scientific Research

NOTWITHSTANDING the preoccupation of Parliament with the grave crisis in the position of the Allies, the second reading of the Colonial Development and Welfare Bill was moved in the Commons on May 21 by Mr. Malcolm MacDonald, Secretary of State for the Colonies in the previous administration. The measure, in spite of an expression from Colonel Wedgwood of his disbelief in the post-War possibility of the financial provision which the Bill proposes, met with the general approval as to its principles from all parts of the House and was read a second time. Mr. MacDonald, in supporting his motion, asked that Parliament, by passing the Bill, should let the world mark our faith in ultimate victory, and our confidence that after the War Great Britain would still exercise vast responsibilities for the Government of colonial peoples. In the subsequent debate Sir George Schuster pointed out that there are no people in the world to whom the success of Germany would be more disastrous than those, for example, in the parts of Africa which we now administer.

That this is no exaggeration may readily be inferred from the Nazi doctrine of the treatment to be meted out to the so-called inferior races. Over against this, Britain may point with justifiable pride to what is unquestionably the most liberal and far-sighted act of policy ever initiated in the history of colonial administration. Not only will the territories under the Colonial Office be relieved of a heavy burden by the remission of £11,000,000 out of their Governments' debt of £15,000,000 to the United Kingdom Exchequer, but also the provision of funds for development and research should ensure that the way to their future prosperity is laid open to them. The provision for research should make it possible to mobilize every resource of science in their service, especially under the leadership of Lord Moyne and Lord Hailey, who, as Mr. MacDonald announced, will act as chairman of the Advisory Committees on Development and Research respectively when these are appointed.

Food and the Housewife

IN a lecture on May 28 at the Royal Institution in the series "The Nation's Larder", Prof. V. H. Mottram pointed out that the housewife who takes an intelligent interest in feeding her family well and according to modern dietetic principles needs some simplified scheme of the facts of dietetics upon which to work. Energy foods are not usually useful for body-building and body-protecting purposes; body-building foods are often poor as energy and protective foods. Protective foods often have little energy or body-building power. Therefore the foods of one class must not be replaced by those from another class. For example, there is a danger that because we have less meat to eat we may replace it with bread. We must replace it with milk, cheese or fish. Those foods (for example, milk, cheese, fat fish) which combine the functions of two or more classes of foods, are much the most precious foods in diet. The safest rule is first to make sure of the protective foods (dairy foods, greengroceries and the fat fish), add some meat and bacon, and then to satisfy appetite with bread and groceries. Increased consumption of milk, cheese, green vegetables, salad vegetables, fruits and fish such as herrings, sprats, mackerel and salmon (fresh or tinned) is desirable. If this is achieved, it is probable that the energy and even the body-building values of foods will look after themselves. The climate and soil of Great Britain are particularly well adapted to producing protective foods.

Malaria as an Occupational Disease

IN his inaugural thesis (*Thèse de Paris*, No. 707; 1939) Dr. J. C. Lévy states that malaria is regarded as an occupational disease, for which appropriate compensation should be made, in certain countries, particularly North America (especially the States of Wisconsin and Illinois), Brazil, Spain and Italy, where its frequency as an occupational disease has given rise to special legislation. In France, on the other hand, there are no legislative measures recognizing malaria as an occupational disease, and compensation for contracting it is allowed only in the case of soldiers, sailors and airmen. Dr. Lévy therefore demands that malaria should be added to the list of occupational diseases in France for the following reasons: first, to repair the material damage to which a variety of workers are liable, namely, colonials and labourers in the veldt or canals, and secondly, for the adoption of additional prophylactic measures in conditions and localities where the work involves the risk of contracting malaria.

The Nature of Virus

DR. THOMAS M. RIVERS discussed the possibilities that viruses represent a transition between living and non-living matter, at a meeting of the New York Academy of Medicine on March 29. A report of the meeting issued by Science Service mentions that the discovery of bacteria was formerly held by some men of science to indicate the origin of life in the world. Many workers now believe this to be the case

for viruses. Dr. Rivers discussed the retrograde and the evolutionary vital theories, and also the non-vital autocatalytic ideas of several students of the problem. He pointed out that the weakness of these conceptions is that viruses may not all be similar, and such a plastic group may well embrace all the forms mentioned.

Venereal Disease in the United States

THE United States Public Health Service reports that treatment and laboratory facilities and services in the control of venereal disease increased between 30 and 85 per cent during the last fiscal year ending June 30, 1939. Every State Department now has a separate division or sub-division for the control of venereal disease. Approximately 103,000 persons were discharged from clinics as cured or the disease arrested in 1939, as compared with 78,000 in the previous year. Persons treated for the first time numbered 305,000 and the number of treatments administered was 8,000,000. Training centres for physicians and nurses in venereal disease control have been established in nine universities.

Earthquakes in Peru

AN earthquake on the night of May 24 did considerable damage to the towns of Lima and Callao in Peru. A dry dock and pier at Callao were damaged, part of a building belonging to the College of St. Thomas Aquinas collapsed, and hundreds of other buildings were destroyed. Two aftershocks of some severity followed on May 25. As a result of the shocks it is estimated that there were 300 dead and 1,500 injured in the two towns, though detailed information is lacking owing to the temporary severing of communications with the area as a result of the earthquakes. Although the whole of Peru is subject to minor earthquakes and earth tremors, the present epicentre appears to be farther north than the most seismic district in Peru, namely, the regions around Arequipa. On January 8, 1725, an earthquake with its epicentre near Arequipa caused widespread destruction and damage was caused in Lima. In the present instance no news has yet been heard of Arequipa. Slight tremors, possibly sympathetic with the above, have also been felt at Guayaquil in Ecuador.

Agricultural Work for University Students

A SCHEME has been prepared by the Ministry of Agriculture and Fisheries to encourage students at universities and colleges to undertake agricultural work during the summer vacation. Recruiting bureaux have been set up at the principal universities, where full particulars of the scheme and application forms may be obtained. Volunteers will receive at least the appropriate minimum wage-rates fixed by the local agricultural wages committee. This particular scheme is intended for men only, but the Minister also appeals to women students who are willing to spend four weeks or more on the land to

join the Women's Land Army Auxiliary Force, particulars of which may be obtained from the local county secretary of the Women's Land Army, or from the headquarters at Balcombe Place, Balcombe, Sussex.

The Parliamentary and Scientific Committee

AT a meeting of the Parliamentary and Scientific Committee at the House of Commons on May 22 it was decided in view of the grave situation to hold regular weekly meetings in future to examine all ways by which a greater application of scientific knowledge could be applied to the conduct of the War in its various aspects and to bring these matters to the immediate notice of the appropriate Ministers. The first of these meetings was held at the House of Commons on May 29.

Announcements

AT the anniversary meeting of the Linnean Society of London held on May 24 the following were elected officers for the year 1940-41: *President*, Dr. E. S. Russell; *Treasurer*, Mr. Francis Druce; *Secretaries*, Mr. I. Henry Burkill (botany), and Dr. Malcolm Smith (zoology). The new members of the Council are Mr. J. S. L. Gilmour, Mr. J. R. Norman, Dr. C. F. A. Pantin, Dr. E. S. Russell and Major F. C. Stern.

SPECIMENS of a rare nickel-iron sulphide mineral, bravoite from Mill Close Mine, Derbyshire, have been presented to the Department of Mineralogy of the British Museum (Natural History) by Prof. W. G. Fearnside. This is the first known occurrence of the mineral in the British Isles.

THE attainment of the Government's ploughing-up objective in Great Britain and Northern Ireland was announced on May 23 in the House of Commons by the Minister of Agriculture and Fisheries. The total additional grassland ploughed amounts in England and Wales to 1,542,236 acres—an excess of 42,000 acres over the target programme of 1½ million acres. When the figures for Scotland (about 222,000 acres) and Northern Ireland (about 270,000 acres) are added, a grand total of 2,034,236 acres is obtained.

THE Association for Education in Citizenship is organizing a Summer School at Lady Margaret Hall, Oxford, during August 7-14, the subject for discussion being "Education for Effective Democracy". Further information can be obtained from the Association for Education in Citizenship, 10 Victoria Street, London, S.W.1.

THE Brighton Summer School in Animal Biology will be held during August 3-15 at the Municipal Technical College, Brighton, under the direction of Prof. L. E. S. Eastham. Further information can be obtained from Mr. F. H. Toyne, Education Officer, 54 Old Steine, Brighton.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 863. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Universities and Research

THE leading article in NATURE of April 27 opened with a paragraph which purported to give the reasons for university authorities encouraging their staffs and students to do research work: ". . . the *principal* reason, especially applicable to the students, probably being that research is excellent educational training and therefore falls within the sphere of the primary activity of universities. A *secondary* reason, especially applicable to the staffs, is that research may produce results of great *public* benefit and is, to that extent, not inconsistent with the reason for existence of universities" (italics mine).

It may be that the writer (whose main concern in this article was with patentable discoveries) had to express himself in this introduction with a hard-and-fast conciseness which has misled me, and which he might have wished to elucidate if he had had more space. But I will own that his words quoted above, especially those which I have italicized, stirred in me a feeling of dissent, akin to that roused in many of us who live and have our being in universities by certain publicists (and even by writers in NATURE) who of late years have attempted to gauge and guide our work by standards which we feel are faulty. The passage seems to ascribe to "university authorities" grudging and illiberal ideas about academic research which, to my knowledge, many of them do not hold. Others of them would, I believe, consider that the statement begs large questions, and they would not be ready to endorse it without changing at least the balance of its emphasis. Some—but, I think, very few—might give it a casual and more or less cynical assent. On the other hand, many people whose working life does not make them "university authorities", and whose view of our universities is limited or external (with, usually, some background of former studentship in one of them), would subscribe to the statement. If the following different statement puts little that has not been said before (and criticized) about academic research and university authority, perhaps I may preface my own excursus on these two matters by borrowing, in a modest way, the classic retort of some advocate of honesty as the best policy—"I have tried both".

In normal times, and where thought and speech are free to all who can think and speak, spontaneous inquiry must be free to all who can inquire. The primary activity of a British university is the cultivation of informed inquiry and the development of its techniques. The training stages of this—by which stages I mean all undergraduate curricula and the postgraduate studies—must go on inseparably within

the same walls as a maturer use of the diverse and changing techniques if either sort is to be kept alive. Without that continued and equal coupling, universities cannot do their teaching duty to the ordinary undergraduate, or their duty (inherent in no other system of institutions) as the nurseries both of new knowledge and of the men to make it.

As to the public benefit of such new knowledge: a university may sometimes find it easier to get from non-academic sources money for researches which have an immediate and obvious public use, than to get it from them for other inquiries. This is, however, not usually the case; for as a rule the former kinds of research are the more expensive, and there are also alternative homes for them. But, as need scarcely be said, immediate public utility is not the standard by which university authorities measure the value of university researches; nor by that scale do they mete out such encouragement as they are privileged to give to true investigators, whether these are scientific, or technological, or work in the domains of letters and scholarship.

In time of peace to insist, as various people have tried to do of late years, that the active curiosities of original minds shall be turned aside to topics selected by non-practitioners or lay arbiters as bearing on current public problems; to constrain into 'practical' themes men of highly specific abilities, whose reason for living hard and (by newspaper standards) inconspicuous lives is that they crave to know certain sorts of unknown things and can endure the long process of finding out: all this is a kind of regimentation which would frustrate its own ends. For the mind of the genuine researcher (as distinct from imitations, here negligible) simply will not work productively upon things in which it is not technically interested, or on 'problems of the day' which he knows are too crowded with shifting and arbitrary variables to be resolved by means of his specific aptitudes. Each researcher is a key that opens only the range of locks which it fits. His own results are normally what the public calls 'useless', because they are beyond the horizon of even the educated contemporary layman, and because the integrated effects of them and their like will not reach the surface of public apprehension for a long time to come. That future time would be intellectually sterile, its educated laymen atavisms instead of our heirs, but for present-day 'academic' work, wherein the investigator follows the inspirations of his own instructed nose, and not the noses of those who plunge about after more noticeable scents.

If these views are called reactionary, I do not much care, so long as I am not thought by implication

to decry the doing of applied research by all who can do it well. (Invention is another matter.) But I myself think those people reactionary who have lately been preaching that academic scientists are unsocial irresponsibles, wreaking they know not what in a world which they ignore, and that their talents should be turned upon public affairs. That is an old and seductive song; its dwindling had been an improvement, its renewal in time of peace was a backward and a timorous move. In war, of course, the deflection of research ability to short-focus utilitarian questions is necessary; and it is valuable to the nation in measure as the specific aptitude and the common sense of each worker are properly noted in allotting him his war task. Afterwards, he will return again, if he can, to his work as an active philosopher; and no doubt he will yet again be grudged the exercise of that function—but not by university authorities.

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Vitamin B₁ and Acetylcholine Formation in Isolated Brain

WE have shown in earlier papers¹ that in the presence of glucose or of pyruvate and under aerobic conditions brain tissue, whether sliced or minced, synthesizes acetylcholine. In the absence of such substrates, little or no synthesis takes place. Since it is well known from the work of Peters and his colleagues that the presence of vitamin B₁ (as cocarboxylase) is necessary for the oxidation of pyruvic acid in brain *in vitro*, it becomes of interest to discover whether the presence of vitamin B₁ has any influence on the rate of acetylcholine synthesis in isolated brain tissue. MacIntosh² investigated the acetylcholine contents of brains of polyneuritic pigeons and found these to be of the same order as those in the brains of normal pigeons. We have examined the abilities of intact brain slices, from normal and polyneuritic pigeons, to synthesize acetylcholine under suitable aerobic conditions in bicarbonate - Locke - pyruvate media containing eserine. (The eserine is added to prevent the decomposition of the acetylcholine by the choline esterase in the tissue.) We have found no appreciable difference between the rates of acetylcholine formation in normal or polyneuritic brain tissue examined under these conditions; nor have we found as a general rule that the addition of vitamin B₁ has any significant effect upon these rates. (On one occasion we found that the addition of vitamin B₁ definitely increased the rate of acetylcholine formation by polyneuritic pigeon brain in a phosphate-pyruvate medium.)

Quite a different result, however, is obtained if the brain slices are examined aerobically in a bicarbonate - Locke - pyruvate - eserine medium containing a relatively high concentration (0.03 M.) of potassium ions. Under these conditions polyneuritic pigeon brain synthesizes acetylcholine at a smaller rate than in the case of normal brain. The addition of vitamin B₁ to the polyneuritic brain restores the rate of acetylcholine formation to the normal. The addition of vitamin B₁ to the normal pigeon brain, on the other hand, has no significant effect on the

PIGEON BRAIN SLICES IN BICARBONATE (0.025 M.)—LOCKE-ESERINE (1/6,000)—PYRUVATE (0.01 M.) MEDIA. INCUBATED FOR 1½ HOURS AT 37° IN AN ATMOSPHERE OF 95 PER CENT OXYGEN + 5 PER CENT CARBON DIOXIDE

	Condition of pigeon	K ⁺ concentration added to that in basal medium	Amount of vitamin B ₁ added	Total acetylcholine Cl formed, μ gm. wet weight of brain tissue
Expt. 1	Normal	Nil	Nil	9.8
	"	Nil	4 γ	9.6
	"	0.03 M.	Nil	27.0
Expt. 2	Normal	Nil	4 γ	24.8
	"	0.03 M.	Nil	13.5
	"	0.03 M.	4 γ	26.7
Expt. 3	Polyneuritic	Nil	4 γ	24.1
	"	Nil	Nil	7.5
	"	0.03 M.	4 γ	7.4
Expt. 4	Polyneuritic	0.03 M.	Nil	14.0
	"	0.03 M.	4 γ	24.6
	"	0.03 M.	4 γ	18.8
Expt. 5	Polyneuritic	0.03 M.	Nil	29.8
	"	0.03 M.	4 γ	17.2
	"	0.03 M.	4 γ	26.2
Expt. 6	Polyneuritic	0.03 M.	Nil	15.2
	"	0.03 M.	4 γ	23.4
	"	0.03 M.	4 γ	

rate of acetylcholine formation. Typical results are shown in the accompanying table, where total acetylcholine was estimated by the technique described in our papers.

To explain this phenomenon (see ref. 1), it is important to point out that the total acetylcholine, measurements of which are given in the accompanying table, is made up of the sum of bound and free acetylcholine. The quantity of bound acetylcholine which is formed cannot exceed a certain value, this being determined by the amount in the cell of a (? protein) component which enters into the constitution of the bound acetylcholine. Free acetylcholine arises by breakdown of the bound ester, and the amount of free acetylcholine is determined by the rate at which the bound form breaks down to produce the free ester. An equilibrium exists in the cell between the concentrations of bound and free esters. Normally the rate of formation of bound acetylcholine is much faster than the rate of liberation of free acetylcholine, but, as stated before, not more than a limited quantity of the bound ester can be synthesized. It is therefore understandable that a diminution in the rate of synthesis of the bound ester may take place without affecting the final quantity, or the limiting concentration, of bound acetylcholine in the cell. Hence the rate of formation of total acetylcholine may be independent of small changes of the rate of synthesis of the bound ester. In the presence of relatively high concentrations of potassium ions, however, the rate of formation of free acetylcholine is greatly increased, presumably by an increased rate of diffusion through the cell wall¹. In this case a relatively small fall in the rate of synthesis of the bound ester may be such as to prevent the attainment of the limiting concentration of the bound acetylcholine, owing to the increased rapidity with which the latter is being broken down. Under such conditions the rate of synthesis of bound acetylcholine determines the rate of formation of total acetylcholine. It is in these circumstances that we may hope to see pronounced effects, on the rate of acetylcholine formation, of changes of pyruvate metabolism in the brain caused by variations of vitamin B₁ content.

The experiments the results of which are recorded in the accompanying table show clearly that the presence of vitamin B₁ affects the synthesis of acetylcholine

by polyneuritic brain in the presence of pyruvate. In the absence of substrate we have observed no accelerating action due to the action of vitamin B₁. Hence the action of vitamin B₁ on acetylcholine synthesis is linked with pyruvate metabolism. It is, however, uncertain whether the effect of the vitamin is to be attributed to its influence on pyruvate oxidation or upon some other phase of pyruvate metabolism in the nervous system.

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¹ Mann, Tennenbaum and Quastel, *Biochem. J.*, **33**, 822, 1506 (1939).
² MacIntosh, *J. Physiol.*, **96**, 6P (1939).

Amino-Acids of Casein Phosphopeptone

THE proof of any hypothesis of protein structure must in the last resort be based upon the isolation of partial cleavage products of definite composition, ranging in complexity from the amino-acid to the intact protein, and the elucidation of their constitution. From this point of view the phosphorus complexes formed from casein by enzymic digestion provide attractive material for investigation, as the phosphorus serves as a helpful label for isolation identification.

Rimington¹ isolated a trypsin-resistant phosphopeptone from casein which he claimed was made up of 3 mol. of hydroxyglutamic acid, 4 mol. of hydroxyaminobutyric acid and 2 mol. of serine. However, on several grounds, the problem appeared to require re-investigation. In particular it may be mentioned that Harington² has been unable to identify hydroxyglutamic acid as a constituent of casein.

By digesting with trypsin the precipitate of 'paranuclein' (obtained by the action of pepsin on casein, and containing about 50 per cent of the total phosphorus of the protein), a phosphopeptone of constant composition resistant to the further action of trypsin is formed. The substance, isolated as the barium salt which is insoluble in 50 per cent alcohol, has an amino-N content of 10 per cent and a N : P ratio of 3.2 to 3.3, indicating a polypeptide made of 10 amino-acids united to three phosphoric acid residues. Analysis of the products of hydrolysis carried out on many separate samples shows the amino-acid composition to be: 3 mol. of glutamic acid, 3 mol. of isoleucine, and 4 mol. of serine.

The glutamic acid was isolated either as the hydrochloride or by precipitation with barium hydroxide and alcohol according to the modified Foreman method³, the yields being 29.7 and 28 per cent respectively of the total nitrogen. The yield of isoleucine (separated by means of butyl alcohol extraction⁴ followed by conversion to copper salts⁵) was 27.9 per cent. For the separation of serine, fractional crystallization was the only serviceable method and the best yields came to only 13.1 per cent of the total nitrogen. However, by oxidation of the hydrolysate with chloramine-*T* and gravimetric determination of the glycollic aldehyde formed as the 2 : 4-dinitrophenylosazone the serine present was also found to account for 28.9 per cent of the total nitrogen of the phosphopeptone. 10.9 per cent of the total nitrogen was present in the hydrolysate as

ammonia. From the time course of ammonia liberation in the presence of dilute acids⁶ it has to be concluded that the ammonia arises not from an amide group but from secondary decomposition, most probably of serine. This is supported by the fact that glyceric acid can be isolated from ether extracts of the hydrolysate in the form of its quinine salt. Small amounts of pyruvic and lactic acids also appear to be formed. The absence of any hydroxyamino-acid other than serine has been established by oxidation of the various fractions by means of chloramine-*T* and the identification of the osazones formed with phenyl, *p*-nitrophenyl, and 2 : 4-dinitrophenyl hydrazine. Only glyoxal osazone was formed.

Certain difficulties in the analytical procedure caused by the presence of serine are worth special mention, as they are of general significance in protein analysis and also throw some light on the alleged isolation of hydroxyglutamic acid. Under the usual conditions of precipitation of the dicarboxylic acids by barium or calcium hydroxide and alcohol, serine is also precipitated to a considerable extent. Glyceric and pyruvic acids formed by the secondary decomposition of serine are similarly precipitated; these acids interfere further in the estimation of dicarboxylic acids by titration also. In distinguishing the hydroxyamino-acids by oxidation with chloramine-*T* it has to be remembered that the melting points of the *p*-nitrophenylosazones are not suited for identification; the phenylosazones are more serviceable.

Full experimental details will be published elsewhere. The question of the order in which the amino-acids are present in the phosphopeptone is being now investigated.

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- ¹ Rimington, C., *Biochem. J.*, **21**, 1179, 1187 (1927).
² Harington, C. R., *Biochem. J.*, **25**, 1916 (1931).
³ Kingston, H. L., and Schryver, S. B., *Biochem. J.*, **18**, 1070 (1924).
⁴ Dakin, H. D., *Biochem. J.*, **12**, 290 (1918).
⁵ Damodaran, M., *Biochem. J.*, **25**, 190 (1931).
⁶ Vickery, H. B., *J. Biol. Chem.*, **53**, 495 (1922).

Cancer Cell and Growth-Regulating System of the Body

A FRAGMENT of tissue removed from the body and explanted *in vitro* does not commence growing immediately. A certain period of time must elapse before proliferation sets in. In a paper some years ago which has been overlooked in the literature on tissue culture, Cohn and Murray¹ reported that the period between the moment that the tissue fragment is explanted *in vitro* and the first appearance of new cells varies with the age of the embryo. As the embryo develops, this latent period becomes progressively longer. The latent period of adult tissue explanted *in vitro* is considerable as compared to that of embryonic tissue. We have demonstrated² that it is approximately three times longer than that of tissue taken from an embryo in a late developmental stage. Furthermore, we have shown that during post-natal growth the latent period increases gradually³. It reaches its maximum when the animal ceases growing and remains constant thereafter, not even changing during senescence^{3,4}.

The fact that after explantation a definite period must expire before proliferation sets in may be explained by assuming that the growth-inhibiting factors which act in the organism remain active for a certain length of time outside the body. The progressive increase of the latent period, corresponding to the successive developmental stages of the growing animal in embryonic and post-natal periods, could then be due to an increase in the forces which oppose cell multiplication in the organism. This explanation of the significance of the latent period and its variations is based on the hypothesis that tissue stability in the body is a result of the balance between the growth-proliferating and -inhibiting mechanism (Murphy⁵).

In the light of the above conception, we thought it important to investigate the latent period of neoplastic tissue explanted *in vitro*. The experiments here reported were carried out with explants from benzpyrene sarcoma of rats and Rous sarcoma of chickens. The tumour fragments were planted in Carrel flasks containing plasma diluted with double its volume of Tyrode solution and one drop of dilute embryonic extract. The flasks were kept in the incubator at 37° C. and examined at regular intervals. The time was noted when the first cells appeared on the margin of the explanted fragment.

A total of 490 explants from 14 tumours (9 rat sarcoma and 5 Rous chicken sarcoma) were used in these experiments. All the explanted fragments commenced to proliferate *in vitro* following a latent period which was very much shorter than that of normal adult tissue. Whereas in normal adult tissue the latent period ranges from 18 to 28 hours, in neoplastic tissue it never exceeded 8 hours. Moreover, it must be emphasized that in about half of the experiments the first cells appeared on the margin of the tumour fragments after 40–50 minutes—that is to say, practically without any latency. This absence of a latent period places tumour tissue in a unique position compared with all other tissues, normal adult as well as embryonic tissue. Even early embryonic tissue, taken from 6–7 day old embryos, always has a latent period of between 1½ and 4 hours.

The fact that explants of tumour tissue begin to grow *in vitro* after a very short, or even without any, latent period affords evidence of the unique position of tumour tissue with regard to the growth-inhibiting mechanism of the organism. We see herein experimental proof for the conception, increasingly gaining favour, that "what distinguishes a malignant cell from a normal cell is its freedom from control by the organism to which the normal cell is subjected" (Cramer⁶).

A detailed report will be published elsewhere.

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Cohn, A. E., and Murray, H. A., *J. Exper. Med.*, **42**, 275 (1925).

² Goldschmidt, J., Hoffman, R. S., and Doljanski, L., *C.R. Soc. Biol.*, **126**, 389 (1937).

³ Doljanski, L., Palevitch, M., and Goldschmidt, J., *C.R. Soc. Biol.*, **133**, 56 (1940).

⁴ Simms, H. S., *Science*, **83**, 418 (1936).

⁵ Murphy, J. B., *Bull. Hopkins Hosp. Baltimore*, **56**, 1 (1935).

⁶ Cramer, W., *Brit. Med. J.*, **2**, 997 (1936).

Serological Properties of Extracts of Hæmolytic Streptococci prepared by Ultrasonic Vibrations

It has been shown¹ that in order to produce protective sera of high potency against hæmolytic streptococci the vaccines employed for immunization have to be prepared from cocci cultivated for a few hours only. While such young cocci are well capsulated, the capsules are lost after the early stage of growth. The assumption seemed therefore justified that an antigen contained in the capsular substance is responsible for the production of protective antibody. Since it is also known¹ that this antigen is highly labile and easily altered by chemicals or excessive heat, in any attempt at its isolation a method must be used which interferes as little as possible with the constitution of the antigen. Disintegration of streptococci by sonic vibrations of audible frequency has previously been described by Chambers and Flosdorf², and Mudd and collaborators^{3,4} have used this method for the extraction of labile antigen. The results of these workers have, however, no direct bearing on the problem of the streptococcal capsule as they employed 'overnight' cultures only in their investigations. It was thought that disintegration of the cocci by means of ultrasonic vibrations would liberate the antigen unaltered.

This expectation was tested in the following manner. A suspension of the streptococci was hermetically sealed in thin-walled glass test-tubes and held in an oil bath containing a powerful quartz piezo-electric oscillator operating at 550 kilocycles per second. The ultrasonic generator has already been described and is the same as that employed by Hopwood and Gordon⁵ and by Hopwood, Salaman and McFarlane⁶ in their experiments on vaccinia virus.

Preliminary experiments were undertaken to find out how long the streptococci had to be exposed to the vibrations under the experimental conditions in order to be deprived of their capsules. This time was found to be about four minutes when 5 c.c. of a suspension of streptococci in saline made up from the sediment of 100 c.c. of a 2 hours culture was used. For the main experiments six minutes was chosen as the time of exposure.

The periods of irradiation were always interrupted to permit the cooling of the suspensions in a bath of ice water, and so prevent any undesirable rise of temperature.

After the exposure the suspension of streptococci was centrifuged and the supernatant portion filtered through Berkefeld V candles. Immune sera precipitated these crude extracts prepared from young as well as from overnight cultures, but an extract prepared from a well-capsulated young culture was still precipitated by the homologous immune serum after absorption with the sediment of an overnight culture. A similar quantity of young cocci completely exhausted the serological activity of the serum. Attempts to isolate and purify the type-specific antigen from extracts prepared from young and overnight cultures respectively also showed that the amount of type-specific antigen present in ultrasonic extracts was larger when these were prepared from young cultures. The type-specific antigen of Group A hæmolytic streptococci having the characteristics of a nucleo-protein is precipitated by weak solutions of acetic acid. In the case of a Type 3 streptococcus in the non-mucoid phase, precipitation

of ultrasonic extracts with acetic acid yielded serologically active material only when the extracts were prepared from young cocci. With streptococci of Types 3 and 13 in the mucoid phase, however, the first precipitation with acetic acid yielded active material from extracts both of young and overnight cultures. Further purification led finally to fractions where serologically active substance was demonstrable only in those derived from young cultures.

The result of these experiments is in favour of the assumption that fully capsulated young cultures of hæmolytic streptococci provide a better antigen than overnight cultures owing to their larger content of unaltered type-specific antigen. However, since the disintegration of streptococci by ultrasonic vibrations liberates serologically active material not only from the fully capsulated cocci, but also from those possessing no demonstrable capsule, these observations, though very suggestive, cannot be taken as conclusive proof that the type-specific antigen of streptococci is situated only in the capsule.

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¹ Loewenthal, H., *Brit. J. Exp. Path.*, **19**, 143 (1938).

² Chambers, L. A., and Flösdorf, E. W., *Proc. Soc. Exp. Biol.*, **34**, 631 (1936).

³ Mudd, S., Czarnetzky, E. J., Pettit, H., and Lackman, D., *Proc. Amer. Phil. Soc.*, **77**, 463 (1937).

⁴ Czarnetzky, E. J., Mudd, S., Pettit, H., and Lackman, D., *J. Immun.*, **34**, 155 (1938).

⁵ *J. Sci. Inst.*, **6**, No. 2, 39 (1929).

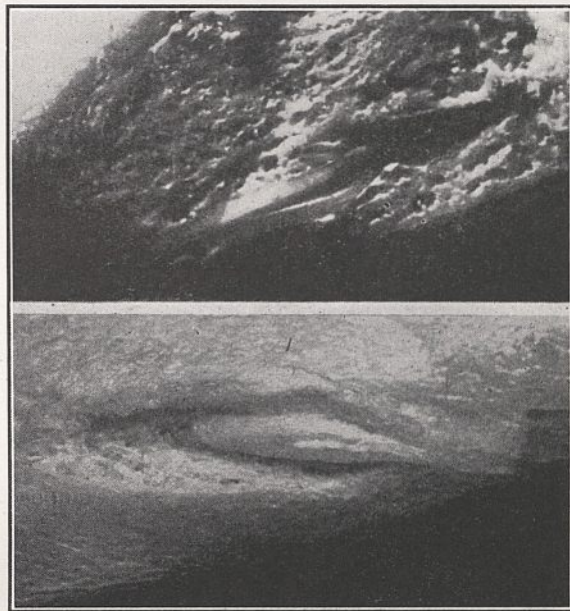
⁶ NATURE, **144**, 377 (1939).

Upper Canine Teeth in the Indian Antelope (*Antilope cervicapra*)

UPPER canine teeth do not persist in either sex throughout the Bovidae, but the occurrence of these teeth even in young animals at any stage of development has seldom been recorded. Regarding the antelopes, Forsyth Major in 1904¹ stated that "deciduous upper canines have not often been recorded. . . . I can find only five writers who mention them". He himself added notes upon their presence in five species, mostly in very young or foetal individuals, and came to the conclusion "that calcified rudimentary milk-canines will be found to be normally present in all foetal and most very young Antelopes, and that it is owing to the scarcity of foetal and very young skulls in our Museums that they have not been observed more frequently" (p. 422).

At various times I have received from the Park of the Zoological Society of Scotland the bodies of three Indian antelopes or black buck (*Antilope cervicapra*) which have died at or within a few days of birth. In one individual (1937. 15. 21), three days old, rudimentary upper canines were present, but were lost during the process of macerating the skull; in a second (1937. 15. 2), which died just after birth, well-formed and definitely edged open alveoli are present, and although no teeth were

seen the alveoli indicate that rudiments must have existed. In the prepared skull of the third specimen (1940. 8), one day old, no alveolus was visible, but dissection revealed the presence in each jaw of a rudimentary canine, 4 mm. long, lying almost parallel to the free edge of the maxilla, and showing in median section a large pulp cavity (see accompanying figure). There is only one record of the presence of rudimentary upper canines in the Indian antelope, by Nehring², who, in parenthesis, remarks that in the upper jaw prepared by him from a young individual which died in a zoological garden, two well-developed canine teeth were present.



DISSECTIONS SHOWING RUDIMENTARY UPPER CANINE TEETH OF THE INDIAN ANTELOPE ($\times 7.5$).
ABOVE, LEFT JAW, TOOTH IN MEDIAN SECTION;
BELOW, RIGHT JAW, SAME SKULL, EXTERNAL ASPECT OF TOOTH.

The result of the examination of three additional skulls of the Indian antelope suggests that in that species rudimentary upper canines may be present in all foetal individuals, although they do not cut the gum and may scarcely reach the level of the surface of the maxilla. This evidence supports Major's belief that rudimentary canines will be found in all foetal or very young antelopes. On the other hand, Lönnberg³ has examined eight very young skulls of different species in the collections of the Natural History Museum at Stockholm without observing "a single indication of upper canines or traces of alveoles after such". It is possible, however, that even in these cases dissection would have shown the presence of rudimentary canines. Lönnberg describes moderately well-developed upper canines in a young skull of *Gazella granti* from East Africa.

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¹ Forsyth Major, C. I., *Proc. Zoo. Soc. Lond.*, **1**, 420 (1904).

² Nehring, A., *S.B. Ges. naturf. Fr. Berlin*, 136 (1884).

³ Lönnberg, Einar, *Ark. Zool. Stockholm*, **29B**, No. 1, 1 (1937).

Reflection of X-rays with a Change of Frequency

A CHANGE of frequency in the scattering of light or of X-rays is a familiar phenomenon. On the other hand, the coherent X-ray reflections given by crystals are a consequence of classical optics and any change of frequency in such reflection might seem inadmissible. A closer consideration shows, however, that even on the classical theory, a change of frequency might accompany a coherent reflection, if the structure-amplitude of the crystal planes responsible for the reflection were to vary periodically with time. This would occur, for example, when the interpenetrating lattices in the crystal oscillate against each other with the characteristic infra-red frequencies and produce pulsations of the electron-density in the crystal. On the principles of the quantum theory, therefore, such lattice oscillations, though initially non-existent, may be excited as the result of the incident radiation and give rise to a *coherent reflection of altered frequency*.



LAUE PATTERN OF SODIUM NITRATE.

Consider the effect on a beam of monochromatic X-radiation passing through a crystal of a set of spacings having a large structure-amplitude. If the angle of incidence on these spacings is different from that given by the Bragg formula, the usual type of X-ray reflection would be forbidden. A periodic variation with time of the structure-amplitude, *if it has the same phase throughout the crystal*, would also fail to give rise to a reflection with modified frequency. In other words, reflections with and without modification of frequency would occur only in accompaniment with each other. On the other hand, if the variation of structure-amplitude has not the same phase everywhere, the two types of reflection may occur independently. While the unmodified reflections could appear only at the correct Bragg angle of incidence on the crystal spacings, the modified reflections would not be restricted to such incidences. The direction in which they appear would correspond with that of geometric reflection, *not from the crystal spacings*, but from the plane waves of constant

phase of the structure-amplitude variations. The inclination of these waves would, in fact, be uniquely determined by the circumstances of each reflection, as these must satisfy the Bragg condition as well. In other words, on the quantum theory, only that particular mode of oscillation would be excited which would give the observed reflection.

A crystal of sodium nitrate gives excellent examples of these modified reflections. The accompanying illustration is a Laue pattern obtained with such a crystal, the direction of the incident X-ray pencil (from a copper target) being normal to one of the three pairs of the rhombohedral cleavage faces and therefore equally inclined to the other two pairs of such faces. Along the two radial lines marked in the figure will be seen following each other in order, the usual Laue reflection from the cleavage spacings and the modified reflections corresponding to the incident copper K_{α} and copper K_{β} monochromatic radiations. Still nearer the centre will be seen the faint radial streaks corresponding to the modified reflections of the incident white radiations.

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Fission of Uranium and Thorium under Deuteron Bombardment

IN continuation of the experiments on uranium fission under deuteron bombardment reported by Gant¹ from this laboratory, we have carried out a chemical separation of the recoil products. The particles projected from the uranium target under deuteron bombardment were collected on an aluminium foil using the experimental arrangement described by Gant. The foil was then dissolved in aqua regia and, after adding the necessary carriers, platinum, barium and lanthanum separations were made in the usual way. The activities observed were 15 min., 1 hr. and 30-40 hr. with the platinum fraction, 11 min. and 80 min. with the barium fraction, and 4 hr. with the lanthanum fraction. Some of the periods are thus found to correspond to those obtained with neutron fission in uranium², in agreement with Gant's conclusion that 9 Mev. deuterons are capable of producing fission in uranium. Control experiments with lead and bismuth targets failed to show any appreciable activities in the carriers.

Using the same experimental arrangement as before, we have bombarded thorium with 9 Mev. deuterons, a thin layer of metallic thorium being used as the target. Seven minutes after a 6 μ . amp. min. bombardment, an aluminium foil *F* (3.3 mgm./cm.²), which had been placed inside the side pocket of the target box and protected from the low-energy products due to mechanical disintegration of the target by 2 mm. S.P. aluminium, gave an activity of about 1,200 counts per min., whereas a second aluminium foil *D* which was placed behind the foil *F* and therefore measured the scattered deuteron effect, gave an activity of 100 counts per min., decaying with the well-known 2.4 min. period of ²⁸Al. The activity produced in a third aluminium foil *N*, placed inside the pocket but separated from the foil *D* by a copper sheet ($\frac{1}{2}$ mm. thick), was of the order of 20 counts

per min. The activity of F was found to decay with a composite period, the decay curve agreeing with that calculated from Frisch's formula³. With a target entirely of lead, F as well as D showed only a small effect. Replacement of the aluminium foil as a collector of fission products by pieces of ciné film did not appreciably affect the activity of F .

The magnitude of the fission effect caused by the background neutron radiation produced at the target was assessed by measuring the neutron-induced fission in a second thorium target enclosed in the side pocket and safely protected from the scattered deuterons. After identical bombardments, the activity on an aluminium collector placed in front of the second thorium target and separated from it by aluminium of 2 mm. S.P. was less than one thirtieth of that observed in the case of direct deuteron bombardment.

The maximum range of the radioactive nuclei projected from the thorium target under 9 Mev. deuteron bombardment was found to be equivalent to about 1.8 cm. of air. Excitation function measurements showed that the threshold for deuteron fission of thorium is at about 7.5 Mev. and that the fission cross-section increases rapidly between 8 and 9 Mev.

Chemical separation of the deuteron-induced fission products of thorium gave the following periods: platinum fraction, 18 min. and 2½ hr.; barium fraction, 15 min.; and lanthanum fraction, 2.5 hr.

Comparison between the fission cross-sections of uranium and thorium for 9 Mev. deuterons showed that for thorium the cross-section was about two thirds of that for uranium.

We wish to express our gratitude to Mr. D. H. T. Gant for lending us his apparatus and also for valuable suggestions.

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¹ Gant, NATURE, 144, 707 (1939).

² Livingood and Seaborg, Rev. Mod. Phys., 12, 30 (1940).

³ Frisch, NATURE, 143, 852 (1939).

Change of Ultra-Violet Transparency of Glass with Temperature

THE transmission of ultra-violet light by glass in the region of 3000 Å. has long been known to be reduced when the glass is exposed to light, and restored by heating to 250–300° C. Slow restoration also takes place when the glass is kept in the dark.

Another effect has been examined, not to be confused with the first, whereby the absorption coefficients of glasses are found to vary very appreciably with temperature in the region of wave-length close to the ultra-violet limits of transparency of the glass. The effect is immediately reversible, and over the range 10°–50° C., the relation absorption coefficient–temperature is strictly linear, and in all cases absorption coefficient increases with increase in temperature. The specimens of glass were kept at known temperature in a vessel with quartz windows top and bottom. Through this vessel water was passed, the temperature of which was controlled by a small electric heater.

3300 Å.

Glass	Absorption coeff. per cm. thickness		Percentage variation per ° C.	
	3300 Å.	3110 Å.	3300 Å.	3110 Å.
'Vita'	0.121	0.578	0.48	0.38
Pilkington's 'White'— Sample 2	0.426	1.67	0.49	0.39
Patent plate—Sample 5	1.59	—	0.47	—
Pilkington's 'White'— Sample 4	0.482	—	0.38	—
Ordinary microscope cover glasses	1.69	6.10	0.34	0.24
Ordinary photographic plate glass	0.925	5.14	0.66	0.46

With the particular spectrophotometer used, only three wave-lengths were available, and assuming for the longest, namely, 4500 Å., a negligible absorption for all the glasses used, the values of absorption coefficient per cm. thickness and percentage increase per degree centigrade (shown in the accompanying table) were obtained for light of 3300 Å. and 3110 Å.

During a control experiment without glasses but with tap water at various temperatures, the spectrophotometer readings were constant.

The percentage change of absorption coefficient with temperature was found in the first three widely different glasses to be constant for a given wave-length, and it was thought that if this should hold for all glasses, then the effect might be due to a single impurity—possibly iron—present in them all in varying amounts. However, the later specimens gave results which were rather different, so it seems that more than one substance in the glass contributes to the effect.

It follows from the above results that, for work involving the absorption of ultra-violet light by glass filters, it is necessary to keep the filters at a known temperature constant to about 1° C. for reasonable accuracy to be obtained.

This effect may be known to some people, but it does not seem to be generally recognized, and little reference to it can be found in published works.

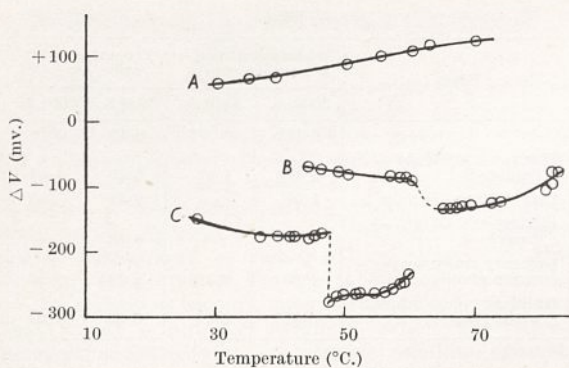
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Surface Potential Changes of Thin Films in the Transformation Liquid to Solid

IN an investigation on the oxidation and polymerization of polymerizable glycerides, it appeared feasible to follow the polymerization accompanying the oxidation by measuring the change of potential at the gas/liquid interface, as the liquid phase passes abruptly to a solid or gel phase. This has been successfully accomplished. From this it was considered that similar changes in surface potential might attend the change from liquid to solid of pure polar materials at the melting point.

Measurements have been carried out on two typical polar materials, stearic acid and cetyl palmitate, and for comparison purposes on a relatively non-polar material, paraffin wax. These were spread in thin films, about 1 mm. thick, on a polished platinum plate kindly supplied by the Mond



A, PARAFFIN WAX, M.P. 60° C. B, STEARIC ACID, M.P. 65° C. C, CETYL PALMITATE, M.P. 48° C.

Nickel Co. The potentials were measured by the usual method employed for following surface potential changes on unimolecular films spread on water, using a valve electrometer and a radioactive (polonium) electrode¹. The accompanying figure shows the potential in millivolts as a function of temperature for the three materials. It is significant that the two polar materials exhibit an abrupt change at the melting point (within the experimental error) while the non-polar paraffin wax exhibits no abrupt change at the melting point. The recorded potentials are, of course, not absolute values since they involve various contact potentials inherent in the apparatus. The potentials recorded are the sum of these various contact potentials and the potentials arising at the boundary metal/film and film/air. Only the two latter sources of potential might be expected to show discontinuities at the melting points in the case of polar materials, since the passage from the liquid to the solid state will involve changes in molecular orientation.

The exact source of these potentials is not clear, but changes in orientation of polar molecules at phase boundaries might be expected to play a part, and the absence of any abrupt change in the case of the non-polar paraffin wax appears to be significant in this respect.

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Adam and Harding, *Trans. Far. Soc.*, **29**, 837 (1933).

A Magnetic Study of the Effect of Bond Angle Distortion

THE prediction¹ that diamagnetic nickel complexes would prove to be square co-ordinated has been verified in a number of different ways. The discovery of isomeric nickel glyoximes², the crystal structure of potassium nickel dithioxalate³ and investigations of crystal optics⁴ and isomorphism⁵ of other diamagnetic nickel compounds have all borne out the existence of this correlation between structure and magnetic properties. All internal nickel complexes in which four nitrogen atoms are bonded to the metal atom have proved, on investigation, to

be diamagnetic, and they may therefore be presumed to be square bonded. The nickel derivatives of various glyoximes², phthalocyanine⁶ and protoporphyrin⁷ afford examples of this type of complex. In these circumstances it becomes possible to investigate magnetically the question as to whether distortion from a square configuration gives nickel-nitrogen bonds sufficient ionic character to make a complex paramagnetic.

Porter⁸ has shown that when certain substituted pyrromethenes (with methyl groups in the α position) function as chelate groups and attempt to assume a planar configuration, as with nickel, clashing between methyl groups must occur. In a complex containing two pyrromethene molecules attached to a single nickel atom, the Ni-N bonds must be forced from their normal coplanar disposition. This occurs in nickel bis ethyl 3:3'-5:5'-tetramethyl-pyrromethene-4:4' dicarboxylate, the compound chosen for investigation. Susceptibility measurements show that the compound is paramagnetic and that the nickel atom has a magnetic moment of 3.2 Bohr magnetons. From this it may be inferred that forcing the Ni-N bonds out of the plane profoundly alters their character; they are no longer essentially covalent bonds involving the use of dsp^2 orbitals but are predominantly ionic in character.

Further details of this work will be published shortly. We are indebted to Dr. R. Lemberg for providing facilities for carrying out this and related work.

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¹ Pauling, L., *J. Amer. Chem. Soc.*, **53**, 1367 (1931).

² Sugden, S., *J. Chem. Soc.*, 246 (1932); Cavell, H. J., and Sugden, S., *J. Chem. Soc.*, 621 (1935).

³ Cox, E. G., Wardlaw, W., and Webster, K. C., *J. Chem. Soc.*, 1475 (1935).

⁴ Mellor, D. P., and Quodling, F. M., *J. and Proc. Roy. Soc. N.S.W.*, **70**, 205 (1936).

⁵ Brasseur, H., and de Rassenfosse, A., and Pierard, J., *Z. Krist.*, **88**, 210 (1934).

⁶ Klemm, L., and Klemm, W., *J. prakt. Chem.*, **143**, 82 (1935).

⁷ Coryell, C. D., and Pauling, L., *Proc. Nat. Acad. Sci.*, **22**, 159 (1936); Haurowitz, F., and Klemm, W., *Ber.*, **68**, 2312 (1935).

⁸ Porter, C. R., *J. Chem. Soc.*, 368 (1938). See also P. Pfeiffer, "Stereochemie", by K. Freudenberg, 1226 (Leipzig: F. Deuticke, 1933).

History of the Vacuum Flask

LORD RAYLEIGH states in NATURE of April 20 that Dewar's assistant, Lennox, made the first vacuum flask. As one of the few survivors directly concerned with the production of the vacuum flask from its inception, I wish to place on record the facts as I know them.

I first met C. E. Muller, the expert glassblower, in 1887 at 147 Gower Street, where he lived with his brother, Emelius, who was established there as "Artificial Human Eye Maker". At that time I had a laboratory in Charlotte Street, Fitzroy Square, W., for which Muller made the chemical apparatus. At my suggestion Muller began business, in 1887, at 26 Charlotte Street, moving to next door (28) in 1888. In 1891 he removed to 148 High Holborn, the lease of which I helped him to negotiate, where

he continued in business until about 1910, with such success that he was able to retire.

From 1887 until about 1900, when a Mr. Orme joined him as partner, I was on intimate terms with him in the conduct of his business. When Dewar in 1892 asked Muller to make for him the first double-walled vacuum vessels, they were all made of clear glass, which is sufficient proof, I think, that they were the earliest made. It was then suggested that the internal surface should be silvered, to reduce radiation influx; as Muller had no experience in this, I instructed him in the technique, and actually silvered the first two or three vessels myself.

The fact that Lord Rayleigh was unaware that Muller was in London at this time suggests to me that it must have been a considerable time after 1892 when Lennox demonstrated to him how double-wall vacuum vessels were made. By this time Lennox may have learned the technique of making them from Muller, as these vessels are very difficult to make, and no ordinary glassblower, *at that time*, would be capable of doing so.

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Economy in Education

THERE is one way in which a great many of our public schools might well economize, and that is in the building and equipment of science laboratories such as are in use at the present time. My teaching experience is confined to public schools only; but I give it as my opinion that the money spent on costly apparatus and equipment is in many cases sheer waste and out of all proportion with the science which can and should be taught in schools.

I do not stand alone in this matter, for Mr. O. H. Latter, probably the pioneer of the teaching of biology in schools, writes in the preface of "Readable School Biology" (Bell, 1926): "I hold that with classes taking Biology as a part of their *general education*, personal practical work by the pupils themselves is sheer waste of time and money".

Much of the responsibility for this waste lies at the door of the science teachers themselves, but I think that still more lies at the door of the Board of Education.

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May 12.

Points from Foregoing Letters

P. J. G. Mann and J. H. Quastel show that the addition of vitamin B₁ to isolated polyneuritic pigeon brain increases the rate of synthesis of acetylcholine when the brain is incubated aerobically in a bicarbonate-pyruvate medium containing a relatively high concentration of potassium ions. No such increase occurs when the vitamin is added to normal pigeon brain examined under similar conditions.

By successive digestion with pepsin and trypsin, an enzyme-resistant phosphopeptide of constant composition has been isolated by M. Damodaran and B. V. Ramachandran from casein in the form of its barium salt. In contrast to a similar phosphopeptide obtained by Rimington, which was claimed to contain hydroxyglutamic acid, hydroxyaminobutyric acid and serine, the substance isolated consists of glutamic acid, *isoleucine* and serine.

Normal adult and embryonic tissues explanted *in vitro* begin to proliferate after a certain latent period which varies with the age of the organism. L. Doljanski and R. S. Hoffman have investigated the latent period of neoplastic tissue (rat sarcoma and Rous chicken sarcoma) and found that tumour explants commence proliferating *in vitro* after a latent period which is very much shorter than that of normal adult tissue. In about half the experiments tumour tissue started to grow practically without any latent period.

H. Loewenthal and F. L. Hopwood find that fully capsulated young cultures of hæmolytic streptococci, when exposed to ultrasonic vibrations, provide a better antigen than overnight cultures. They point out, however, that since the disintegration of streptococci by ultrasonic vibrations liberates serologically active material from cocci possessing no demonstrable capsule as well as from the fully capsulated cocci, the observations cannot be taken as conclusive proof

that the type-specific antigen of streptococci is situated only in the capsule.

Three skulls of very young individuals of the Indian antelope (*Antelope cervicapra*) showed the presence of rudimentary upper canine teeth, which in one case had not reached the surface of the maxilla. J. Ritchie suggests that this evidence supports Forsyth Major's belief that rudimentary canine teeth may be present in all foetal and most very young antelopes, notwithstanding the evidence recently adduced by Lönnberg.

R. S. Krishnan and T. E. Banks have separated chemically the recoil fragments produced from uranium fission under deuteron bombardment and have shown that some of the activities agree with those produced by neutron fission of uranium. They have also obtained evidence of deuteron-induced fission in thorium. Excitation function measurements and chemical separation of the recoil fragments have been carried out for this case also.

The effect of temperature in the ultra-violet transparency of various glasses has been examined in detail by W. J. Arrol for two wave-lengths close to the limits of transparency in this region. A strictly linear relation holds between absorption coefficient and temperature over the range 10°-50° C.

Measurements of phase boundary potential during the melting of certain solids by C. Ockrent and W. H. Banks show that the transformation is accompanied by abrupt changes in potential.

D. P. Mellor and W. H. Lockwood have measured the magnetic susceptibility of a nickel compound in which the normal planar distribution of the bonds about the nickel atom is prevented by steric interference. They claim that the distortion changes the character of the bonds from being essentially covalent to bonds essentially ionic in character.

RESEARCH ITEMS

New Shrines on the Gold Coast

A RELIGIOUS development, which is in effect a reversion to a traditional form of belief, now taking place on the Gold Coast is described by Miss M. J. Field, Government anthropologist (*Africa*, 13, 2; 1940). In the traditional society of the Gold Coast, which still survives in certain isolated areas, the governmental unit was the extended family with the head as both ruler and priest of the family god. So also in the confederated family groups, still existing, religious organization and governmental organization are one. In other parts of the Gold Coast, for example, Akim, this traditional form has been overthrown. From the end of the seventeenth century, colonists and refugees set up a military organization which has now, with the development of the cocoa industry, become financial. The earlier cults completely disappeared. Recent social changes, more especially a great increase in venereal disease, detrimental to fertility, and marital infidelity among the women, have led to a remarkable increase in belief in the power of the witch. New protectors against this malevolent force have been sought in the Northern Territories, where there is no witchcraft, because of the power of the traditional indigenous deities. Their worship has therefore been introduced into the Gold Coast country as a protective magic, subordinate shrines being set up. All over Akim these shrines have been instituted, and some have gained a far-flung reputation. It is suggested that the prevalence of these shrines indicates a reversion to a type of organization similar to that which was broken up by intrusions two hundred years ago.

Radium and Radon Therapy

A SECOND edition of "Physical Aspects of Radium and Radon Therapy", published in May, 1939, by the Ministry of Health of the Commonwealth of Australia, goes over some ground that is already familiar; but there are several new features, notably those on the technique of radon filling and on the comparative advantages of radium and radon considered from economic and technical points of view. There is also an interesting attempt to distinguish between the total dose of radiation given to the tissues and the effective dose that results; the difference only arises because of the power of the tissues to recover from the effects of radiation while it is actually being given. The authors, C. E. Eddy and T. H. Oddie, develop this matter on simple mathematical lines, but in lieu of experimental data have to proceed as follows: "Now suppose that a dose of gamma rays delivered at any given instant decays in its effect on the tissues by x per cent in 24 hours. . . ." Granted the assumptions, the following conclusions are reached: "(a) The quantity of radon required to give the tissues the same residual dose R' in any given time as is given by one milligram of radium, is slightly greater than that required to deliver the same dose R . (b) When radon is used the residual dose R' is higher for a longer period of time than is the case when radium is used."

Cytology of Carcinogenesis

DR. PULLINGER (*J. Path. Bact.*, 50; 1940) has studied the early stages of tumour formation by polycyclic compounds. The carcinogenic compounds evoke a characteristic reaction on the second to fourth day after application; the cells and nuclei swell and the cytoplasm becomes vacuolated. This reaction is followed by multiplication of cells with progressive increase in size of cells and nuclei. Cytoplasmic degeneration appears in some of the cells while others show signs of recovery. Related non-carcinogenic compounds do not appear to produce this reaction, which may be specific.

Curious Nesting-place of Kittiwake

EVENTS in Norway have made the March number of *Naturen* the last we are likely to receive for some time to come, for the spreading of scientific news in popular form among Norwegian naturalists must give way to more vital affairs. Along with articles dealing with such varied subjects as the newer geophysical methods of assessing the underlying rock formations, and the occurrence of the jelly-fish *Rhizostoma octopus* in Norwegian waters in the Atlantic Drift, occurs an interesting account of a modification of nesting-place in the kittiwake. Instead of the usual sites chosen on the narrow ledges of sea-cliffs, Knut Schmidt-Nielsen describes how in 1928 kittiwakes (*Rissa tridactyla*) began to prospect the ledges of a wooden brewery at Røst, and how by the summer of 1939 twenty-one pairs were nesting in regular rows where suitable shelves were present on the building. The selection of so curious a site is the more remarkable because it was in close proximity to a constant stream of traffic, boats and motor-boats (*Naturen*, Bergen, 94, March 1940). An excellent photograph shows about fifteen of the nests, most of them occupied.

Stratification of Foraminifera in Marine Deposits

H. G. STUBBINGS has examined six cores obtained by the John Murray Expedition in the Southern Arabian Sea (John Murray Expedition 1933-34. *Sci. Rep.*, 3, No. 3. "Stratification of Biological Remains in Marine Deposits". British Museum (Natural History), 1939). Only the Foraminifera are described in this report, the object being to demonstrate 'climatic' classification in the Arabian Sea similar to the findings of previous workers in the Atlantic. Many pelagic species occurred and a few benthic species. Of the pelagic species *Globigerina bulloides* and *Globorotalia menardii* are the commonest, and occur in inverse relationship. *Globigerina bulloides* is mainly a cold-water species and *Globorotalia menardii* is an inhabitant of tropical and sub-tropical waters. It has thus been found possible to use these two species as a guide to changes of climatic conditions in the past. Four 'cold zones' are shown in the longest core, containing *Globigerina bulloides* in quantity, and the intermediate zones with relatively more *Globorotalia menardii* probably represent warmer interglacial periods.

Inheritance of Instinct

VERY young setters will instinctively 'point'; Siamese cats are natural retrievers, a character which is known to be dominant in cats; the wooler rabbit jumps in the air and shaker mice turn somersaults when frightened. C. E. Keeler and H. C. Trimble (*J. Hered.*, 31, 51-54; 1940) describe pedigrees of Dalmatian hounds which indicate that the position under or behind the coach automatically taken by the dog is controlled by heredity. Several interesting examples of instinctive reactions in untrained animals are given. 24 good following dogs and 3 poor followers descended from parents both of which were good coaching dogs. On the other hand, the crosses bad \times good and bad \times bad produced 7 good, 9 bad and 2 bad dogs respectively. One bitch which always ran with her head between the horse's legs was mated to a dog that trailed behind the carriage. The three pups trailed badly. The same bitch was mated to a dog which ran forward of the front axle. Of their resulting progeny, 6 pups ran in the forward position, and one insisted on running with his nose touching the horse's hind legs (see also *NATURE*, 144, 671; 1939).

Chromosome Numbers of British Plants

IN connexion with the recent co-operative work in taxonomy, genetics, and cytology, P. Maude (*New Phyt.*, 39, 17-32; 1940) has investigated the chromosome number of numerous British wild plants. Such plants as *Chenopodium album*, *Arum maculatum*, *Allium Babingtonii*, *Corydalis bulbosa*, *Sieglingia decumbens* ($2n = 124$), *Kalearia vallesiora*, *K. gracilis* ($2n = 28$ and 30), *Puccinellia (Glyceria) maritima* ($2n = 63$), various species of *Festuca* and *Bromus* and other plants were found to be polyploid. A curious feature was that seven plants of *Spirea filipendula* ($2n = 15$) from different sources had an odd number of chromosomes.

Cryolite as an Insecticide

FLUORINE compounds have so far proved the most effective substitutes for arsenical insecticides. Sodium fluosilicate, a by-product in the manufacture of acid phosphate, is being used extensively in the United States for baits in the control of grasshoppers and cutworms. Cryolite, a compound of sodium, aluminium and fluorine mined in Greenland, is very effective against fruit pests such as codling moth and apple flea weevil and for vegetable pests such as flea beetles. S. Marcovitch writes (*Amer. Fruit-grower*, Feb. 1940) on the use of cryolite in apple orchards. The mineral, which is used mainly in the manufacture of aluminium, is ground to a fine dust occupying about 50 cub. in. to the pound. Like lead arsenate, it acts as a stomach poison but is more effective than the former against codling moth. It has less sticking power, however, and is therefore most effective in dry seasons. It has no poisonous effect on the soil, a great advantage over arsenical compounds, which have rendered some soils in America unfit for crops. Another advantage is that it is non-poisonous in the amount likely to remain as spray deposit on apples. The amount allowed by law is 0.02 grain per lb. Fluorides present in drinking water to the extent of 1 part per million cause mottling of the teeth of residents in some parts of Arizona. Cryolite on apples has been shown to be free from this objection. In contrast to lead arsenate, cryolite appears to have no injurious effect on apple foliage. As many as seven applications in a season have been

given without causing defoliation or damage to fruit. In some seasons, however, damage to peach fruits known as 'tip end injury' has occurred.

Irradiation of 7-Dehydrocholesterol

STEROLS which have received most attention in respect of photochemical conversion into anti-rachitics are ergosterol and cholesterol, associated with lower plants and with animal materials, respectively. Crystalline ergosterol may be regarded as the precursor of vitamin D_2 (calciferol); crystalline cholesterol does not itself constitute a significant provitamin but its derivative, 7-dehydrocholesterol, when exposed to ultra-violet radiation, is converted into vitamin D_3 , found only in animal tissues. J. W. M. Bunker, R. S. Harris and L. M. Mosher (*J. Amer. Chem. Soc.*, 62, 508; 1940) have examined the photochemical activation of crystalline 7-dehydrocholesterol in ether by monochromatic ultra-violet radiation. With wave-lengths 2483, 2537, 2652, 2804 and 3025 Å., the activation is substantially uniform per quantum of energy supplied. On a quantum basis, the activation by 2967 Å. is significantly greater than for any other wave-length examined, except possibly 2894 Å. The activation by 2894 Å. appears to be intermediate between that of 2967 Å. and the other wave-lengths examined. No demonstrable antirachitic properties were produced by 3130 Å. The superior effectiveness of 2967 Å. parallels the significant superiority of this wave-length in inducing healing upon direct irradiation of depilated rachitic rats, which supports the view that 7-dehydrocholesterol is a significant precursor of vitamin D in the skin.

Spectrophotometric Gradients of some Northern Stars

AN important paper entitled "Relative Gradients of 250 Stars determined at the Royal Observatory, Greenwich" has been published by H. Spencer Jones (*Mon. Not. Roy. Astro. Soc.*, 100, 3; January 1940). The catalogue of the spectrophotometric gradients of the 250 stars includes most northern stars brighter than 4.5, the H.D. spectral types of which are *Oe5*, *B* or *A*, as well as many fainter ones of these types and a selection of bright *F*- and *G*-type stars, and completes the Greenwich colour temperature programme. The previous results were given in "Observations of Colour Temperatures of Stars", 1926-32, and a description was given in this volume of the methods used in determining the gradients. These differ very slightly from those adopted in the later programme. The 30-inch reflecting telescope has been replaced by the 36-inch Yapp reflector, and in the case of fainter stars small corrections have been applied to allow of the difference in exposure time between the stellar and the calibration exposure. More sensitive Ilford 'Astra VIII' plates have been utilized in the later work, and it is hoped that full details of the scheme will appear later in a Greenwich volume which is delayed in publication owing to the War. As a definite value of the quantity needed to convert absolute to relative gradients is not yet available, relative gradients only are given in the catalogue. In the previous work the zero to which the gradients were referred was the mean of nine specified stars of H.D. type A0, and it is thought that the value for the Greenwich zero-point may be about 1.10, which corresponds to 15,600° K., but this will be determined later. The absolute values of the gradients and hence of the 'temperatures' will be obtained when the Greenwich zero-point is finally settled.

MUCOLYTIC EFFECT OF NATURAL AND ARTIFICIAL SPREADING FACTORS

MUCOLYTIC EFFECT OF SEVERAL DIFFUSING AGENTS AND OF A DIAZOTIZED COMPOUND

By PROF. G. FAVILLI, University of Modena

CHAIN and Duthie¹ have recently reported that a purified testis extract, which contains the so-called 'spreading factor' that increases the permeability of the tissues, has a remarkable mucolytic activity: the viscosity of synovial fluid falls very rapidly when it is mixed with a tenth of its volume of the extract. The loss of viscosity is followed by liberation of N-acetyl glucosamine and reducing substances. Bacterial filtrates in which the spreading factor is present were found to have a similar action on mucin. These observations suggest that the diffusing and mucolytic activities may be due to the same factor, and it is of interest therefore to determine whether diffusing factors from other sources show a similar mucolytic effect. The solutions to be tested have been added to fresh bovine synovial fluid in a proportion of one to ten volumes and the mixtures incubated at 38° C. The following facts have been observed.

Snake venoms, which possess a very high diffusing activity^{2,3}, show a marked mucolytic effect. Venoms from the following species have been tested: *Vipera aspis*, *Vipera ammodytes*, *Bothrops jararaca* (former name: *Lachesis lanceolatus*), *Lachesis alternatus*, *Echis carinatus*, *Crotalus terrificus*. The dried venoms, dissolved in saline solution, cause a rapid fall in the viscosity of synovial fluid, measured in an Ostwald viscometer. The fall of viscosity may be almost immediate when venoms are used in dilutions varying from 1:1000 to 1:10,000, according to the species of snake. This effect was evident in dilutions as high as 1:100,000.

The mucolytic activity is almost completely suppressed when the solution of venom is heated for thirty minutes at 70° C. before it is added to the synovial fluid. The activity of the enzyme is also completely suppressed when specific antiserum in a convenient amount is added to the solution of venom: the addition of normal horse serum, on the contrary, has no inhibitory action.

Aqueous leech extracts which, as Claude⁴ reported, show marked diffusion in the dermis, proved to be actively mucolytic. An aqueous extract of the heads of several leeches was prepared by grinding this material with quartz sand in a mortar and adding saline solution in an amount equivalent to 1 c.c. per head. After centrifugation, the supernatant fluid was mixed with synovial fluid, the viscosity of which fell to a value not much higher than the viscosity of water after a short incubation.

The pH appears to have a great influence on the mucolytic action; experiments have been made with testis extract, purified by the method described by Mannozi-Torini⁵, and snake venoms prepared with buffer solutions of different pH value instead of saline. It has been observed that testis extract and snake venoms are most active at about pH 5.0; the activity gradually decreases and can be practically inhibited, at least in the case of snake venoms, when

the pH is adjusted to 8.5. These results are in agreement with those of McClean⁶.

Commercial preparations of Frey and Kraut's *kallikrein* (Padutin Bayer) have a certain diffusing activity⁷ which appears to differ in character from that of the other spreading factors so far known^{7,8}: no mucolytic effect could be detected with this substance. The observations reported above, taken in conjunction with those of Chain and Duthie, indicate that all the naturally occurring diffusing factors so far tested possess mucolytic activity.

As Chain and Duthie point out, the action of diffusing factors may be explained by the presence of a mucin-like inter-fibrillar substance in the collagen of the dermis in which these factors are active⁹. In order to support this hypothesis it seemed desirable to ascertain whether certain artificial compounds possessing diffusing power have the same mucolytic effect as the naturally occurring diffusing factors.

Following the instructions given by Claude¹⁰, who first observed the diffusing properties of an azoprotein obtained by coupling diazobenzenesulphonic acid with serum or gelatin, this compound has been prepared and coupled with horse serum. The reaction of the azoprotein was adjusted as nearly as possible to pH 7.0 by the addition of normal acetic acid, this operation being controlled electrometrically; it was then buffered by adding 2 c.c. of phosphate buffer at pH 7 to 4 c.c. of azoprotein. The final solution possesses marked mucolytic activity, when tested on synovial fluid. The fall of viscosity is not abrupt; it is most marked in the first hour, and continues gradually until the fourth hour, as is shown in the following experiment.

FALL OF VISCOSITY, EXPRESSED IN TIME OF FLOW THROUGH A VISCOMETER IN SAMPLES OF 3 C.C. TAKEN AT DIFFERENT INTERVALS FROM 30 C.C. OF SYNOVIAL FLUID INCUBATED AT 37° WITH 3 C.C. OF AZO-PROTEIN BUFFERED AT pH 7.0

Distilled water	7 min. 5 sec
Normal synovial fluid added with 1/10 vol. of distilled water	27 " 5 "
Synovial fluid added with 1/10 volume of azoprotein: immediately	26 "
Synovial fluid added with 1/10 volume of azoprotein after 15 min.	20 "
" " " " " "	30 " 17 " 5 "
" " " " " "	45 " 15 " 5 "
" " " " " "	60 " 13 " 5 "
" " " " " "	90 " 12 " "
" " " " " "	120 " 11 " 5 "
" " " " " "	180 " 10 " 5 "
" " " " " "	240 " 10 " "

Comparative experiments made with azoprotein and with naturally occurring diffusing factors have shown that the mucolytic effect of the latter is much quicker than that of the former substance, the fall in viscosity being complete after thirty minutes if the diffusing factors are sufficiently concentrated (for example, *Vipera aspis* venom diluted 1:1000). This result accords with the fact that the diffusion of naturally occurring factors, when tested in the dermis of the rabbit, is much more rapid than the diffusion of azoproteins; this might, therefore, be considered as indirect support for the hypothesis that diffusing factors act by destroying the mucin-like inter-fibrillar substance.

In several experiments the diazobenzenesulphonic

acid was neutralized, immediately after its preparation, with 2N.NaOH solution, buffered with phosphate buffer at pH 7, and tested on synovial fluid: the mucolytic activity of this compound is practically the same as that of the acid coupled with serum.

The mucolytic effect of the diazobenzenesulphonic acid, both in the form of azoprotein or of sodium diazobenzenesulphonate, is little influenced by the pH: the maximum activity has been observed at a pH of about 5.0, the minimum at pH 7.0, whereas there is a slight increase of activity at pH 8.5. This fact needs further investigation.

These results indicate that both the artificial and naturally occurring diffusing factors so far tested exhibit similar mucolytic activity, and support the hypothesis that the action on tissue permeability may be due to enzyme activity on the mucin-like inter-fibrillar substance.

Some difficulties have been encountered in attempting to decide whether the chemical action of diffusing factors on mucin, as measured by the liberation of reducing substances, is identical whatever the source of the factor. This point is of special interest in the study of the action of diazotized compounds, and the experimental difficulties encountered are under investigation.

¹ Chain, E., and Duthie, E. S., NATURE, 144, 977 (1939).

² Duran-Reynals, F., J. Exp. Med., 69, 69 (1939).

³ Tarabini-Castellani, G., Arch. Ital. Med. Sper., 2, 969 (1938).

⁴ Claude, A., J. Exp. Med., 66, 353 (1937).

⁵ Mannozi-Torini, M., Arch. Sci. Biol., 25, 473 (1939).

⁶ McClean, D., personal communication.

⁷ Christensen, J. F., J. Path. and Bact., 48, 287 (1939).

⁸ Madinaveitia, J., Biochem. J., 33, 1470 (1939).

⁹ Favilli, G., Lo Sperimentale, 89, 724 (1935).

¹⁰ Claude, A., J. Exp. Med., 62, 229 (1935).

MUCINASE AND TISSUE PERMEABILITY

By D. McCLEAN and C. W. HALE
Lister Institute of Preventive Medicine

AQUEOUS extracts of mammalian testis contain a 'spreading' factor which dramatically increases the permeability of the skin to injected fluids¹. This factor is associated with the germinal epithelium and can be extracted from spermatozoa. Factors with similar diffusing properties have been obtained from the most diverse sources, for example, from filtrates of staphylococcus and streptococcus², from organisms of the gas gangrene group and virulent pneumococci³, from extracts of malignant tissues⁴, from snake and spider venoms⁵ and from leech extracts⁶. Many of these factors have been partially purified by various methods⁷, but no one had succeeded in elucidating the mechanism whereby this diffusing effect is produced until Chain and Duthie⁸ made the important observation that purified testis extracts exhibit a remarkable mucolytic activity characterized by a rapid fall in the viscosity of the substrate and the liberation of reducing substances.

It was obviously important to confirm the observation of Chain and Duthie, to determine whether diffusing factors from other sources exhibited a similar mucolytic activity and to make a comparative study of these enzymes. During the progress of this work, Meyer *et al.*⁹ reported the hydrolysis of hyaluronic acid by bacterial enzymes, and recently a paper appeared by Robertson *et al.*¹⁰ describing an enzyme derived from filtrates of *Cl. welchii* which

hydrolyses synovial fluid; these authors had not connected the mucolytic activity of their preparations with the action on the permeability of the tissues.

In our earlier experiments vitreous humour was used as substrate, but in view of its spontaneous loss of viscosity on storage this was replaced by preparations of mucoprotein from umbilical cords; this can be purified by the method described by Meyer and Palmer¹¹. Viscosity estimations were performed with buffered solutions of standard salt concentration in an Ostwald viscometer in a water bath at 34° C. N-acetyl glucosamine was estimated by the method of Morgan and Elson¹², and total reducing substances by the method of Hagedorn and Jensen. Diffusing activity in the skin was estimated by intracutaneous injection using isotonic hæmoglobin solution as the indicator of spread.

We have confirmed the mucolytic activity of testis extract reported by Chain and Duthie; preparations of the diffusing factor purified by the method of Morgan and McClean and by those of Madinaveitia show similar activity. Purified preparations of the diffusing factor from *Cl. welchii* and *Cl. oedematis maligni* (*Vibrion septique*) are extremely active. Filtrates from a toxigenic strain of staphylococcus and from a virulent type 1 pneumococcus showed activity of the same order. All these organisms produce immediate diffusion in the dermis. On the other hand, filtrates from a virulent strain of *S. typhi*, from *Cl. tetani* and from *C. diphtheriae* which produce no diffusion also contain no mucinase. The activity of the filtrate from virulent type 1 pneumococci is of interest since one of us³ has reported that the same strain rendered avirulent by cultivation in immune serum loses its diffusing power; on the other hand Meyer *et al.* obtained their enzyme in the autolysate of a "non-encapsulated non-type-specific variant" of a type 2 strain and drew a distinction between their pneumococcal enzyme which was bound to the cell structure and that of *Cl. welchii* which was free in the fluid medium.

Russell's viper venom, which diffuses in the dermis, causes a rapid fall in the viscosity of mucoprotein. Since this venom promotes the coagulation of hæmophilic blood, and the chemical constitution of heparin is closely allied to that of muco-poly-saccharide, it was of interest to determine whether this venom and the mucinases from testis or from bacteria exerted any destructive effect on heparin. So far as we have been able to determine by indirect experiments using the coagulation time of heparinized plasma as an indicator of the integrity of the heparin molecule, none of these substances has any direct action on heparin. This confirms the observation of Meyer *et al.* that their bacterial enzymes do not hydrolyse heparin.

The enzymes obtained from testis extract, from all the bacterial enzymes so far tested and from viper venom are most active at about pH 4.5. The rate of the reaction decreases sharply on the acid side of this and more gradually as the pH approaches neutrality.

The mucolytic activity of the bacterial enzymes is completely inhibited by appropriate antisera. Sera had been prepared against the purified diffusing factors of *Cl. welchii* and *Vibrion septique*. It has already been shown³ that such sera neutralize the diffusing activity in the dermis and that the immunized animals are themselves resistant to the diffusing activity. This neutralization is strictly specific. We

have now been able to establish that these sera completely inhibit the action of the homologous enzyme on the viscosity of the substrate and the liberation of reducing substances; there is no cross neutralization of this activity.

It is of considerable interest that, although these enzymes cause an immediate fall in the viscosity of the substrate, no reducing substances can be detected for some hours. With a preparation of the diffusing factor of *Cl. welchii*, which causes a marked fall in viscosity in a few minutes, only a trace of N-acetyl glucosamine can be detected after four hours and the maximum is not attained until after 18–24 hours incubation. At first it was thought that enzymes from different natural sources differed qualitatively as well as quantitatively in their capacity to liberate reducing substances; when, however, the concentration of enzymes from testis, *Cl. welchii* and viper venom was adjusted so that the reaction times for the reduction of viscosity were comparable, it was found that the amount of enzyme necessary to liberate detectable reducing substances was approximately the same whatever the source. The time lag in the liberation of reducing substances compared with the fall in viscosity suggests that two separate mechanisms may be involved. This possibility requires further study.

We have confirmed Favilli's observation, reported above, that diazotized compounds reduce the viscosity of mucin. We have encountered the same difficulties as he has in deciding whether N-acetyl glucosamine or other reducing substances are liberated by these preparations. These difficulties arise from the coloured nature of the diazotized compounds and the difficulty of removing the soluble protein. Preliminary experiments to overcome these difficulties indicate that no reducing substances are liberated, but these observations require confirmation.

Robertson *et al.*¹⁰ state that the spontaneous loss of viscosity of vitreous humour is due to the activity of vitamin C. We have examined the diffusing and mucolytic activities of ascorbic acid in freshly boiled buffer at pH 7.0 and with the addition of one and

two molecular equivalents of hydrogen peroxide. All three preparations cause a rapid fall in the viscosity of the substrate, the activity of the preparation with one equivalent of hydrogen peroxide being slightly greater than either of the others. No N-acetyl glucosamine could be detected following the fall in viscosity. The increased diffusion in the dermis following the injection of these substances is marked, but it is of the same type as that caused by diazotized compounds; that is, the increase is not apparent in the first few minutes but develops during a period of three hours. The preparation with one equivalent of hydrogen peroxide spreads over a greater area than either of the others. Thus the mucolytic activity of ascorbic acid and its oxidation products is also associated with an increased diffusion in the dermis.

An explanation of the physiological function of the mucinase in testis extract and spermatozoa is provided by the observation of Kurzrok and Miller¹³ that semen contains a mucolytic enzyme whereby the spermatozoa are enabled to penetrate the plug of mucus normally present in the cervical canal of the uterus. The part played by bacterial mucinase in the metabolism of these organisms in artificial culture and on their invasive properties in the tissues is under investigation.

¹ Hoffmann and Duran-Reynals, *J. Exp. Med.*, **53**, 387 (1931); McClean, *J. Path. and Bact.*, **33**, 1045 (1930); **34**, 459 (1931).

² Duran-Reynals, *J. Exp. Med.*, **58**, 161 (1933).

³ McClean, *J. Path. and Bact.*, **42**, 477 (1936).

⁴ Duran-Reynals and Stewart, *Amer. J. Cancer*, **15**, 2790 (1931); Boyland and McClean, *J. Path. and Bact.*, **41**, 553 (1935).

⁵ Duran-Reynals, *J. Exp. Med.*, **69**, 69 (1939).

⁶ Claude, *J. Exp. Med.*, **66**, 353 (1937).

⁷ Morgan and McClean, *J. Soc. Chem. Ind.*, **51**, 44, 912 (1932); Claude and Duran-Reynals, *J. Exp. Med.*, **65**, 661 (1937); Madinaveitia, *Biochem. J.*, **32**, 1806 (1938); **33**, 347 (1939); **33**, 1470 (1939).

⁸ Chain and Duthie, *NATURE*, **144**, 977 (1939).

⁹ Meyer, Hobby, Chaffee and Dawson, *J. Exp. Med.*, **71**, 137 (1940).

¹⁰ Robertson, Ropes and Bauer, *J. Biol. Chem.*, **133**, 261 (1940).

¹¹ Meyer and Palmer, *J. Biol. Chem.*, **114**, 689 (1936).

¹² Morgan and Elson, *Biochem. J.*, **28**, 988 (1934).

¹³ Kurzrok and Miller, *Amer. J. Obstet. and Gynec.*, **15**, 56 (1928); **24**, 19 (1932).

APPLICATIONS OF ELECTRICITY IN IRON AND STEEL WORKS

A REVIEW by H. G. Weaver of the progress made in the applications of electricity in iron and steel works during the last four years appears in the March issue of the *Journal of the Institution of Electrical Engineers*.

It appears to be now admitted that whereas Ward-Leonard control affords the most efficient method of providing the drive for the hoist and long-travel motions, the additional weight involved in the carrying of the conversion set on the crab is considered to outweigh its advantages, and a plain direct-current series drive has proved the most popular, the motors being of the steel-clad mill pattern, with roller bearings and split frames.

The main point of interest with recent installations of drives for coal-handling plant is the universal adoption of totally enclosed, fan-cooled motors. The controls have a system of sequence interlocking,

which ensures that the stopping of certain conveyors will always automatically ensure the stopping of any other conveyors that are feeding them. More attention has recently been paid to the enclosure of the motors used in these plants, owing to the deleterious effect of the gases in the atmosphere. Special castings are used so far as possible, care being taken to see that they are free from porosity. Gas-proof gaskets and varnish are used for all frame and cover joints, and the windings carefully sealed with varnish and given extra coats of enamel.

In modern practice, the electrical equipment of blast furnace skip hoists is of the balanced type with two hoist motors on each. The weight of each basket empty is 12,000 lb., and the weight of each ore charge is 18,000–20,000 lb. The skip travel is 200 ft., at a speed of 450–600 ft./min. with an angle of incline of 53° from the horizontal. Each hoist is driven by

two 200 h.p., 220 volt, direct-current, steel-works type motors, with a speed range of 0 to 570–762 r.p.m., by shunt control, which are forced ventilated by motor-driven blowers, mounted on the top of the motor frame. The two motors are connected in series across a 310 kw., 440-volt generator. The two skip hoists are arranged by switching to run from any two of three motor-generator sets, each set comprising a 310 kw., 440-volt generator driven by a 450 h.p., 3-phase, slip-ring induction motor.

New features are continually being introduced in the electrical operation of the winch equipment for the charging bells of blast furnaces. In a recent example, the large bell is driven by a 17 h.p., d.c., compound wound motor, and the small bell by a 10 h.p. motor of the same type and speed. In each case the motor speed when raising the bell is 540 r.p.m., and when lowering the bell 840 r.p.m. The control is by contactors and resistances, and is so arranged that in the event of slack cable, the bell-lowering contactors are opened and the winch is automatically reversed, so taking up the slack cable; then after a short time interval the bell is automatically caused to lower again, and this operation is repeated until the bell falls away freely or the operation is tripped by hand. There is also complete interlocking of the bells so that one bell must have completed its full travel and also sealed before the other bell moves.

The production of iron in a modern blast furnace is a continuous process, and the main essential of furnace operation is therefore smooth and regular working, with as few stops as possible. The most difficult problem has been the development of a satisfactory method of stopping up the iron tapping hole when required without the necessity of shutting off the blast. An electrically driven clay gun has recently been introduced for this purpose. The gun itself is suspended from a boom, which swings it into position and holds it against the hole while plugging is taking place. The gun is driven by a 20 h.p. motor and the boom by a 10 h.p. motor. They are switched direct on to the line without any overload or other type of protection, but limit switches are provided on both motions to prevent mechanical damage due to mal-operation of the controllers. The stalling torque of the 20 h.p. motor is 1.6 times full load torque and of the 10 h.p. 1.35 times full load torque, in each case when taking 2.5 times full load current at full line voltage. The boom motor is stalled when holding the gun against the hole. Very high ambient temperatures are encountered, and the motors have to be capable of withstanding stalling for half a minute under these conditions without excessive heating. They have 3 per cent nickel-steel shafts running in ball and roller bearings and are of welded steel construction throughout. The rotor windings consist of bronze bars secured in semi-enclosed slots, which are lined with anodized aluminium.

One plant for producing aluminium sheets has been equipped with a soaking pit furnace for ingots, a chain-conveyor furnace for slabs, cylindrical pit-furnaces for coil annealing and salt-bath furnaces for the heat treatment of sheets, all electrically heated and capable of dealing with aluminium. A particularly interesting development which is gaining ground more and more is the nitriding process, that is, the treatment of steel in an ammonia atmosphere, for the production of specially hardened parts.

SEVENTY YEARS AGO

NATURE, vol. 2, June 2, 1870

Effects of Alcohol on the Human Body

A PAPER was read before the Royal Society on May 19 "On the Effects of Alcohol (*Ethyl Alcohol*) on the Human Body", by Dr. Parkes and Count Cyprian Wollowicz. The experiments were undertaken with a view of testing the physiological and especially the dietetic effects of alcohol. The subject was a healthy and very intelligent soldier of twenty-eight, 5 ft. 6 in. in height, weighing 134–136 lb., with a clean, smooth skin, a clear bright eye, good teeth, largely developed powerful muscles, and but little fat. As he had been accustomed to smoke, he was allowed half an ounce of tobacco daily, lest the deprivation of it might disturb his health.

From the general results of the experiments, it appears that any quantity over 2 oz. of absolute alcohol would certainly do harm to this man, and that as every function was performed perfectly without it, its use was wholly unnecessary. Yet the experimenters recognize "the great practical benefit that may be derived from the use of alcohol in rousing a failing appetite, exciting a feeble heart, and accelerating a languid capillary circulation, though, for these objects to be fulfilled satisfactorily, there is necessity for great moderation and caution".

Excessive and Depraved Appetite

PERHAPS the most extraordinary instance of excessive and depraved appetite on record is that of a French soldier, named Tarare, whose case is described in vol. XXI of the *Dictionnaire des Science Medicales*. . . . At 17 years of age, when only weighing 100 lb., he could eat 24 lb. of beef in as many hours. From the day of his admission to the army, he was ordered quadruple rations, with pickings and waste meat, but often slipped into the dispensary to finish off a poultice or two. One day he was observed to seize a large cat; and, after sucking its blood, left, in a very short time, only cleanly picked bones, the hair being rejected in the course of about half an hour. He was fond of serpents and eels, swallowing them whole. On another occasion he consumed in a few minutes a repast, spread out for fifteen German workpeople, of milk, etc., after which he was blown out like a balloon. . . . He fell under suspicion of having eaten a child fourteen months old.

Whence come Meteorites?

PROF. N. S. MASKELYNE, F.R.S., has an article under this title in which he discusses views put forward by M. Stanislas Meunier, of the *Jardin des Plantes*, Paris. "Whether M. Meunier's theoretical conclusions are to be looked on with the same favour that we heartily accord to his practical work is what we are about to discuss".

M. Meunier supposes meteorites to be the shattered morsels of a satellite smaller than and perhaps subordinated to the moon, which has run its course and been broken up by internal throes of volcano and earthquake. The fragments are thought to be "careering in every direction, retrograde as well as direct, around our world" and falling to the earth's surface in the order of their densities. Thus iron masses have already descended, stony fragments are now arriving, and the character even of these will change as time goes on.

FORTHCOMING EVENTS

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

Monday, June 3

EUGENICS SOCIETY (at the Linnean Society), at 4.30 p.m.—Sir Bruce Bruce-Porter: "The Importance of the Child".

Tuesday, June 4

ROYAL INSTITUTION, at 5.15 p.m.—Dr. J. C. Spence: "The Feeding of Children".*

APPOINTMENTS VACANT

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

LECTURER IN GENERAL ELECTRICAL ENGINEERING SUBJECTS—The Registrar, Municipal College, Portsmouth (June 8).

ASSISTANT SECRETARY OF EDUCATION—The Secretary for Education, Education Office, Barking Road, East Ham, E.6 (June 8).

LECTURER (WOMAN) IN GEOGRAPHY at the Bingley Training College—The Education Officer, County Hall, Wakefield, Yorks (June 10).

PROFESSOR OF METALLURGY—The Registrar, University College, Singleton Park, Swansea (June 11).

LECTURER IN EDUCATION—The Registrar, The University, Manchester (June 15).

LECTURER IN BIOCHEMISTRY—The Secretary, The University, Aberdeen (June 15).

PROFESSOR OF PHILOSOPHY in the University of Durham—The Registrar, 46 North Bailey, Durham (June 15).

STUDENT-DEMONSTRATOR IN BOTANY—The Principal, Royal Holloway College (University of London), Englefield Green, Surrey (June 29).

LECTURER IN BOTANY at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 29).

SENIOR DEMONSTRATOR IN THE DEPARTMENT OF ANATOMY AND EMBRYOLOGY—The Secretary, University College, Gower Street, W.C.1.

ASSISTANT ENGINEER for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9306).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Library Catalogue of Printed Books and Pamphlets on Agriculture published between 1471 and 1840. Second edition. Pp. 294. (Harpenden: Rothamsted Experimental Station.) 12s. [85]

Family Allowances. Pp. 32. (Aylesbury: The *Lancet*.) 3d. [95]

School Canteen Handbook. Prepared by the National Union of Teachers and the Gloucestershire Training College of Domestic Science in collaboration. Pp. 48. (Cheltenham: National Union of Teachers.) 6d. [95]

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 5: The Geology of Ardgour, Argyllshire. By Dr. H. I. Drever. Pp. 141-170+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 4s. [95]

Proceedings of the Royal Irish Academy. Vol. 45, Section B, No. 17: Three Anomalous Dolphins from Blacksod Bay, Ireland. By Dr. F. C. Fraser. Pp. 413-455+plates 32-38. 4s. Vol. 46, Section B, No. 1: The Succession of Rocks in the Dingle Peninsula, Co. Kerry. By Dr. Robert M. Shackleton. Pp. 12+3 plates. 1s. 6d. Vol. 46, Section B, No. 2: Studies in Irish Quaternary Deposits—Some Lacustrine Deposits near Dunshaughlin, Co. Meath. By G. F. Mitchell. Pp. 13-38+plate 4. 2s. Vol. 46, Section B, No. 3: The Morphology of the Human Sperm and Egg. By J. Brontë Gatenby and Olive Aykroyd. Pp. 39-51+plate 5. 1s. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [105]

Report of the Marlborough College Natural History Society for the Year 1939. (No. 88.) Pp. 60. (Marlborough: Marlborough College.) 3s.; to non-Members, 5s. [145]

Strangeways Research Laboratory. Report for 1939. Pp. 24. (Cambridge: Strangeways Research Laboratory.) [165]

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 24: New Observations on the Life-History of *Callitris*. By W. J. Looby and J. Doyle. Pp. 241-256. 1s. 6d. Vol. 22 (N.S.), No. 25: Atmospheric Pollution in Dublin during the Year 1939. By A. G. G. Leonard, Bridget P. McVerry and D. Crowley. Pp. 257-266. 1s. Vol. 22 (N.S.), No. 26: Studies in Peat, Part 8: Preliminary Note on Irish Peat Wax (Mona Wax). By J. Reilly and J. A. Emlin. Pp. 267-272. 6d. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [205]

Journal of the Society for the Bibliography of Natural History. Vol. 1, Part 10: A Facsimile of R. H. Beddome's articles on Indian Reptiles, 1862-1870. By Malcolm Smith. Pp. 273-334. (London: Society for the Bibliography of Natural History.) 15s. [205]

Report for 1939 (No. 52) of the Marine Biological Station at Port Erin, Isle of Man. Drawn up by Prof. J. H. Orton. Pp. 32. (Liverpool: University Press of Liverpool.) 1s. 6d. net. [215]

The Fitzwilliam Museum, Cambridge. Annual Report for the year ending 31 December 1939. Pp. 10. (Cambridge: Fitzwilliam Museum.) [225]

London Shellac Research Bureau. Supplement to Bulletin No. 5: The Hot Spraying of Shellac: a New Method of Coating Surfaces. Pp. 4. (London: London Shellac Research Bureau.) [225]

Fourth Report from the Select Committee on National Expenditure. Pp. 60. (London: H.M. Stationery Office.) 1s. net. [235]

Other Countries

International Institute of Agriculture. Studies of the Principal Agricultural Products on the World Market, No. 6: Olive and Olive Products, Production and Trade. Pp. v+224+19 maps. (Rome: International Institute of Agriculture.) 25 lire; 1.30 dollars. [95]

The Archaeological Survey of the High Western Plains. Twelfth Report: Further Research Work in the Black's Fork Basin, South-west Wyoming, 1938-1939. By E. B. Renaud. Pp. 93+3 plates. (Denver, Colo.: University of Denver.) [145]

Proceedings of the United States National Museum. Vol. 88, No. 3080: *Cestocrinus*, a New Fossil Inadunate Crinoid Genus. By Edwin Kirk. Pp. 221-224. (Washington, D.C.: Government Printing Office.) [145]

Brooklyn Botanic Garden Record. Vol. 29, No. 2: Twenty-ninth Annual Report of the Brooklyn Botanic Garden, 1939. Pp. 15-156. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [145]

Lucknow University Studies. No. 13: Two Dimensional Potential Problems connected with Rectilinear Boundaries. By Prof. B. R. Seth. Pp. iv+124. (Lucknow: Lucknow University.) 2.12 rupees. [145]

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 32: Studies in the Preservation of Fruit Juices. 1: Some Observations on the Preparation and Preservation of Citrus Fruit Squashes. By Lal Singh and Dr. Giridhari Lal. Pp. 25+1 plate. (Delhi: Manager of Publications.) 1 rupee; 1s. 6d. [145]

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 186: A Singular Transformation in the Surface Layer of the Fe-Ni-Al System. By Syûiti Kiuti. Pp. 559-580. 55 sen. No. 187: Intense Combination-Tones produced by the Flutter of an Airscrew. By Jûichi Obata, Major Yûzô Matsumura, Ryô Kanayama and Yûhei Yosida. Pp. 26. 45 sen. (Tôkyô: Kôgyô Tôsho Kanayama Kaisha.) [145]

The Rockefeller Foundation. A Review for 1939. By Raymond B. Fosdick. Pp. 72. (New York: The Rockefeller Foundation.) [145]

U.S. Department of Agriculture. Circular No. 555: Fumigation of Vetch Seed for the Vetch Bruchid. By A. C. Johnson, J. S. Pinckney, J. W. Bulger and A. M. Phillips. Pp. 11. 5 cents. Leaflet No. 195: Mealworms. By R. T. Cotton. Pp. 5. 5 cents. Miscellaneous Publication No. 371: A Revision of the North American Aphids of the Genus *Myzus*. By Preston W. Mason. Pp. 31. 5 cents. (Washington, D.C.: Government Printing Office.) [145]

Bureau of Education, India. Progress of Education in India, 1932-1937. Eleventh Quinquennial Review. Vol. 1. Pp. x+286. 3.2 rupees; 5s. Vol. 2: Statistical Tables and Appendices. Pp. vii+270. 4.4 rupees; 6s. 9d. (Delhi: Manager of Publications.) [165]

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Tests on the Liquefaction of Canadian Coals by Hydrogenation. By T. E. Warren and K. W. Bowles. (No. 798.) Pp. viii+106+2 plates. (Ottawa: King's Printer.) 25 cents. [205]

Fouad I University: Faculty of Science. Annual Report, 1938-1939. Pp. iv+56. (Cairo: Fouad I University.) [205]

Union of South Africa. Report of the South African Museum for the Year ended 31st December 1939. Pp. 20+2 plates. (Pretoria: Government Printing Office.) [205]

Comité National français et Comité National marocain de Géodésie et Géophysique. Année 1938. Compte rendu publié par le Secrétaire général du Comité français, G. Perrier. Pp. 148. (Paris: Comité National français de Géodésie et Géophysique.) [215]

Annales de l'Institut de physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurier. Tome 17. Pp. iv+124. (Paris: Les Presses universitaires de France.) [215]

Dominion of Canada. Report of the Department of Mines and Resources, including Report of Soldier Settlement of Canada for the Fiscal Year ended March 31, 1939. Pp. 351. (Ottawa: King's Printer.) 50 cents. [215]

Geological Survey of British Guiana. Bulletin No. 14: Report on Gold and Manganese Deposits of the Lower Barama River, Northwest District. By Dr. D. A. Bryn Davies. Pp. iv+32+6 plates. (Georgetown: Geological Survey of British Guiana.) 24 cents. [235]

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- Solubility and Swelling of High Polymers in Ternary Mixtures. By J. N. Brønsted and K. Volqvartz.
- A Note on the Correlation of Upper Electronic States of Homologous Molecules. By R. F. Barrow.
- A New Type of Flow Meter for Slow Rates of Flow. By A. E. L. Marsh.
- A Note on the Bonding Powers of Groups of *d* Electrons. By W. G. Penney.
- On the Calculation of Ionic Heat Capacities in Solution. By D. H. Everett and C. A. Coulson.
- Permeability of Organic Polymers. By R. M. Barrer.

JUNE, 1940

- Molecular Interaction at Oil/Water Interfaces. Part I: Molecular Complex Formation and the Stability of Oil in Water Emulsions. By J. H. Schulman and E. G. Cockbain.
- Molecular Interaction at Oil/Water Interfaces. Part II: Phase Inversion and Stability of Water in Oil Emulsions. By J. H. Schulman and E. G. Cockbain.
- Studies of the Structures of some Inorganic Pentahalide Molecules in the Vapour Phase, by Electron Diffraction. By H. A. Skinner and L. E. Sutton.
- Studies of the Structures of Bismuth Chloride and Bromide Molecules in the Vapour Phase, by Electron Diffraction. By H. A. Skinner and L. E. Sutton.
- The Ultra-Violet Absorption and Chemical Constitution of Substituted Urea and Thioureas. By A. Clow and N. L. Helmrich.
- Experiments on Increasing the Chemical Activity of Cadmium Iodide by Irradiation. By J. Hedvall, F. Wallgren and S. Mansson.

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Particulars concerning admission to the College and of the entrance scholarships may be obtained from the undersigned.

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SUDAN GOVERNMENT

The Director of Education invites applications for the following posts:

1. MATHEMATICAL TUTOR in the Khartoum Secondary School (late Gordon Memorial College). Candidates should have a University Degree in Mathematics, Physics or Engineering.

2. LECTURER IN CHEMISTRY in the School of Science, Khartoum. Candidates should have a University Degree in Chemistry.

Candidates for both these appointments should be under the age of 30 and unmarried, but older candidates may be considered. Some teaching experience is desirable. The appointments will be on contract, with an initial salary of £E.480 per annum, though a higher initial salary may be offered in recognition of age, experience and qualifications (£E.1=£1 0s. 6d.). At present no income tax is payable in the Sudan.

The selected candidates will be required to take up their posts in the Sudan on or about January 1, 1941; but it may be possible, if circumstances so warrant, to advance this date by a period of not more than 2-2½ months.

Further particulars are obtainable from the University Appointment Boards, and from the Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1, to whom applications should be submitted not later than June 15, 1940. Selection will be made during July. Envelopes should be marked "Mathematical Tutor" or "Lecturer in Chemistry."

THE COLONIAL SERVICE, PALESTINE

A vacancy exists for a Chief Fisheries Officer, Palestine.

Salary £750 a year, consolidated pay. Candidates should be British subjects of European parentage, preferably between 30-40 years of age. They should hold an Honours Degree in Natural Sciences of a British University with Zoology as a principal subject, or equivalent qualifications, and should have had at least five years' postgraduate experience of different types of fishing craft and methods. The appointment will be on agreement for three years in the first instance, but may later be made permanent and pensionable.

Further particulars and forms of application may be obtained from the Director of Recruitment (Colonial Service), 29 Queen Anne's Gate, London, S.W.1. Completed applications must reach the Director of Recruitment not later than June 22, 1940.

THE UNIVERSITY OF SHEFFIELD ASSISTANT LECTURESHIPS IN PHYSICS (TEMPORARY)

The Council is about to appoint two Assistant Lecturers in Physics (temporary). Salary at the rate of £900 per annum. Applications should reach the undersigned (from whom further particulars may be obtained) not later than June 10.

W. M. GIBBONS,
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Persons desirous of being considered for the office are requested to lodge their names with the Secretary to the University on or before June 15, 1940.

The conditions of appointment and form of application may be obtained from the undersigned.

H. J. BUTCHART,
The University, Aberdeen. Secretary to the University of Aberdeen.

DERBY TECHNICAL COLLEGE

Applications are invited for the post of Head of the Chemistry Department. A good honours degree in Chemistry of a British University is required. Teaching and industrial experience are essential. Salary £480—£580. The selected candidate will be required to take up his duties on September 1, 1940. Application forms, which must be returned not later than June 15, 1940, may be obtained from the undersigned.

F. C. SMITHARD,
Clerk to the Governors.
Technical College,
Normanton Road,
Derby.

UNIVERSITY COLLEGE OF SWANSEA

The Council of the College invites applications for the post of Professor of Metallurgy. Salary £1,000 per annum. The appointment will date from September 2 or October 1, 1940.

Further particulars may be obtained from the undersigned, by whom applications must be received on or before June 11, 1940.
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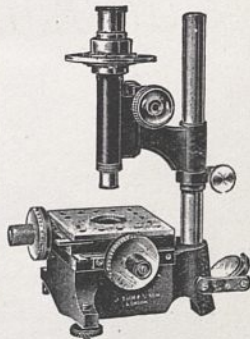
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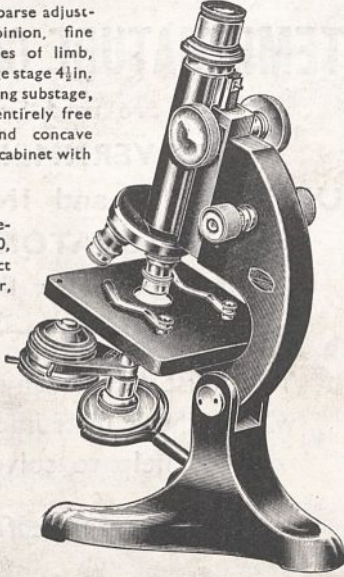
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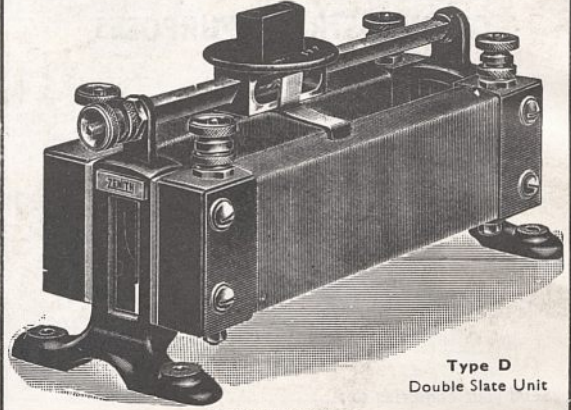
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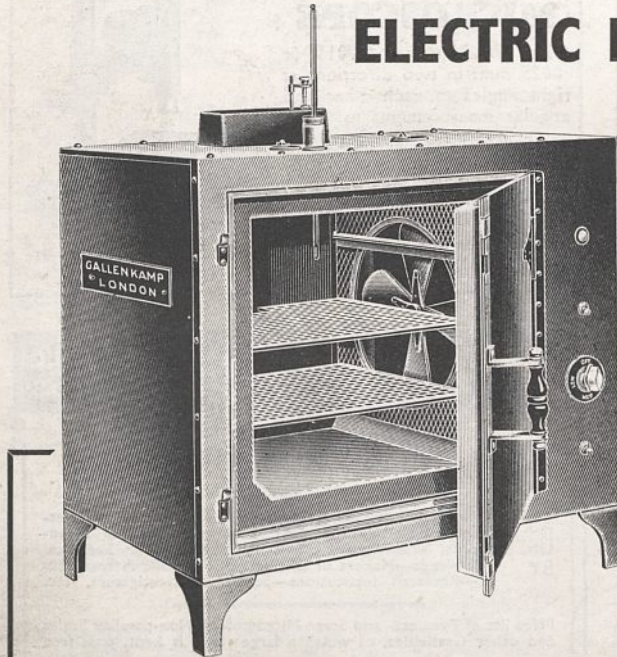
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