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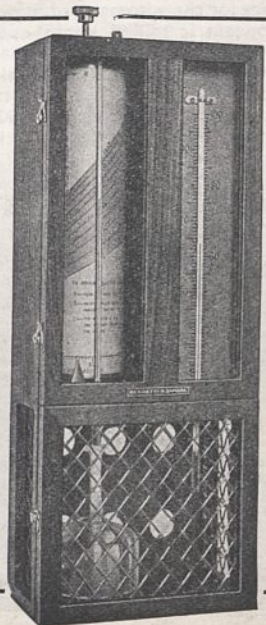
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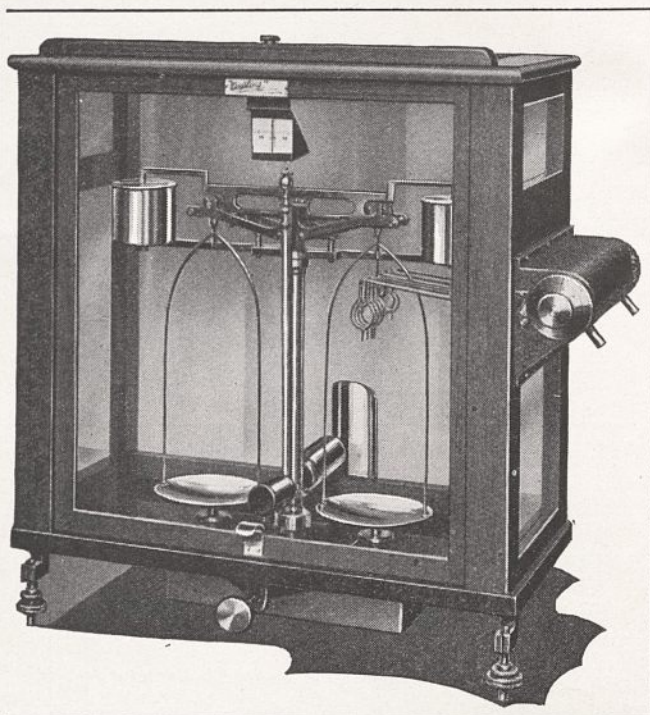


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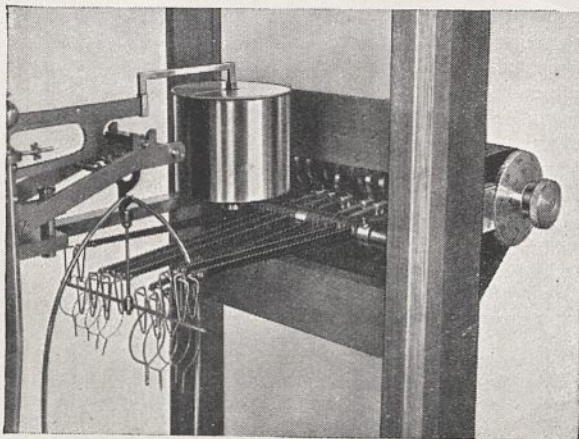
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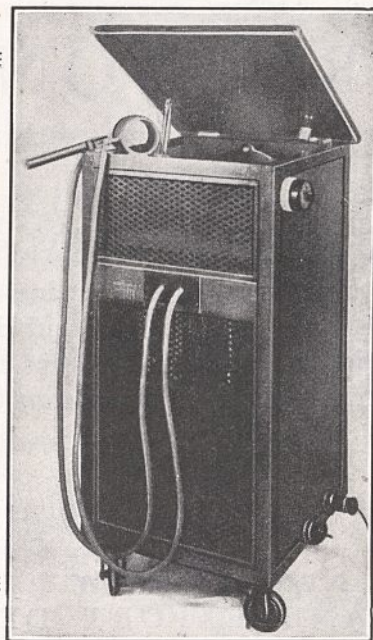


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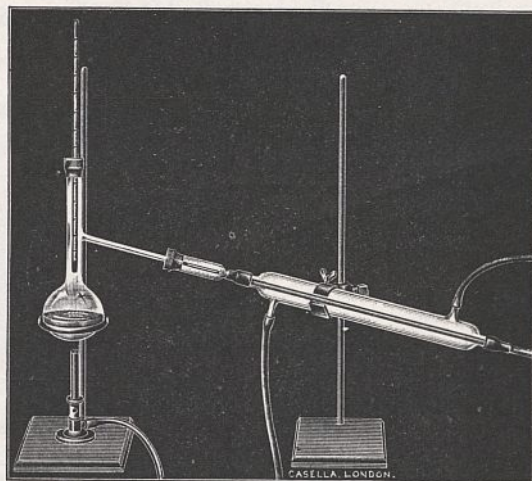
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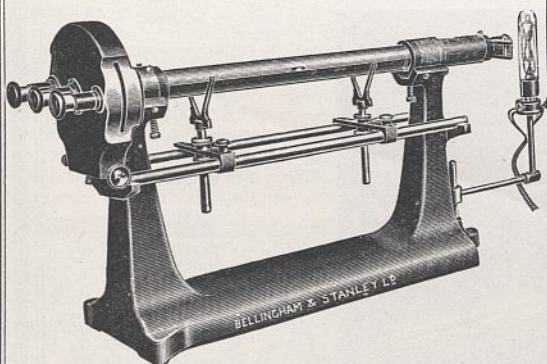


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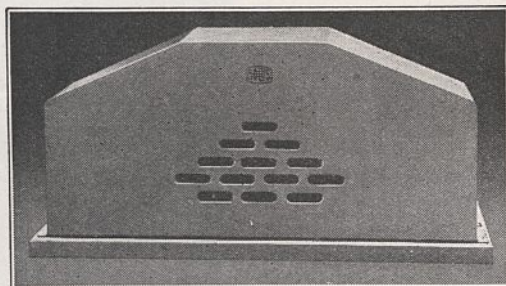
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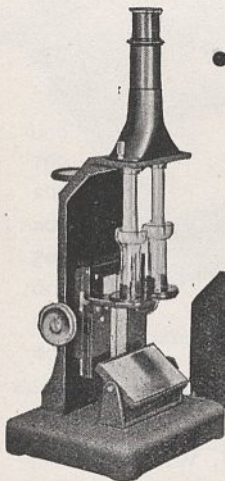
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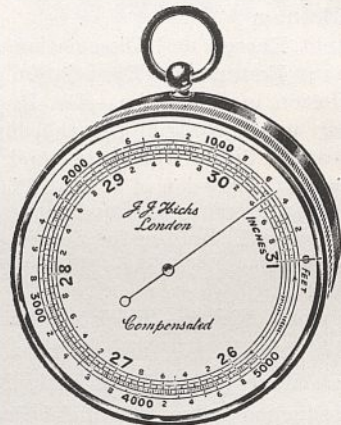
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Vol. 145

SATURDAY, JUNE 8, 1940

No. 3684

THE REPUDIATION OF TRUTH

LEADERS of the various faiths delivered no uncertain message on May 26, the Day of National Prayer. With one voice they proclaimed the Allied cause to be the cause of freedom, truth, decency, and civilization.

"We are called," declared the Archbishop of Canterbury, "to defend our land and all that we hold dear within it, the wider Commonwealth that has so wondrously grown up around it, and our common heritage of freedom. Please God, this we shall do with all our might. But more than this—we are called to take our place in a mighty conflict of Right against Wrong. The ruthless invasions of peace-loving countries . . . have shocked the moral conscience of the world, at least where that conscience is free to act and speak. They lay bare a mere unbridled lust of power, under whose pressure all the old sanctities of truth, justice, mercy, and freedom are trampled under foot. To hesitate to brand this force which has been let loose upon the world as essentially evil would be to scorn all those moral standards which have been slowly and painfully established by mankind to give security and honour to the common life."

The Archbishop of York spoke to similar effect :

"The whole future history of Europe is at stake. Upon the issue of the conflict now joined the quality of civilization in the coming period depends. Our cause is the cause of freedom and mutual trust. With the German method of the broken promise goes contempt for the rights of the weak and the small. In such a world there can be no justice and no freedom."

Cardinal Hinsley, Archbishop of Westminster, uttered a vigorous denunciation of the Nazi regime :

"Peace has been murdered between nations because the party in power in Germany has avowedly cancelled truth from its programme, and

has declared that our traditional Christian civilization is to be shattered by the might of the 'immortal Nordic race'. This new racial idolatry justifies to its votaries everything that the party wills for its own interests.

"For years past the youth of the German nation have been trained to use the discoveries and inventions of science, the fruits of industry, all their energies and talents, for the glory of total warfare. The gospel of pride and hate has been loudly preached to a large, receptive audience, unhappily comprising the mass of the German nation.

"Now at length Christians understand. No liberty is possible, no decency in human life, if a pagan people may subdue by its fury, and scourge with scorpions, the rest of mankind."

The Rev. Leslie Weatherhead, speaking in the City Temple, said :

" . . . we are placed in the dreadful dilemma of either using the awful and ghastly weapon of war—a weapon chosen by our enemies after every other means of settling differences had been tried by us ; or else enlarging—perhaps through the world—an area in which the Nazi evil is rampant ; an evil in terms of broken promises, persecution of Christian and innocent people, the torturing of Jews, the denial of freedom, the suppression of truth, the imprisonment of pastors, the idolatry and supremacy of the State over all the rights of the individual, and perhaps worst of all, the training of little children, for generations ahead, to worship the idols of war, tyranny and oppression. Whatever we may feel about our own individual attitude to war, surely we are trustees for the generations to come, and must do our utmost not to let go the liberty which is *their* birthright."

The General Assembly of the Church of Scotland on May 25 affirmed that

"the present war is not merely a clash of nations, or merely a war of defence of national boundaries

and Empire interests, but a mortal combat, the outcome of which will determine for many generations whether a large part of the world is to live under conditions of increasing freedom and honesty and truth and light. . . ."

The Chief Rabbi, Dr. Hertz, added his testimony :

"Nazism is the enemy of man, and our whole spiritual heritage—human brotherhood, human freedom, human decency—is being jettisoned by the pirate captains of the Nazi ship of State."

The World Congress of Faiths invited Hindu, Moslem and Buddhist leaders in India and Burma to join in the observance of the National Day of Prayer. Christians, Jews, Mohammedans and Hindus attended churches, synagogues, mosques and temples throughout Malaya on the same day.

Such unanimity is good evidence of the feeling of moral revulsion aroused among religious leaders of all faiths by the Nazi regime. It is clear that to them the present conflict is a struggle between civilization and barbarism. The reasons for viewing it in this light are evident. In what does civilization consist? Not in material wealth or productive power, not in the amenities and comforts of life, not in an advanced scientific technique, not in organization and machinery, not even in literacy and education. It is possible to enjoy all these benefits and be civilized, but it is no less possible to enjoy them and be barbarous. All these are external matters and do not touch the spirit of a community, and it is the spirit that is civilized or barbarous; other things are external trappings only, which may be impressive or comparatively poor; they scarcely matter. The civilized tradition seems to be characterized by, and based upon, a twofold reverence, that is, reverence for the human being as such, and for truth as a supreme value.

Where these two are respected, there civilization can be said to exist, even if there be only a modest material equipment. Neither laboratories nor factories, nor of necessity educational establishments, of themselves make a State civilized. It may be said that there have existed civilizations in which respect for the individual as such, and for truth, has been absent or in abeyance; but such cultures, if they have existed, have been alien to the tradition to which European civilization belongs, which is a tradition of tolerance and respect for truth and personality. These principles may often have guided actual practice very imperfectly; but however far the majority of

people have fallen short, they have not actually turned their backs upon them. For that we have had to wait until the present generation, and now over a considerable area of Europe, traditional ideals are denied and scorned. The unique individual has now become a unit indistinguishable from other units, a cog in the military, industrial, or political machine. As a human being he has no rights as against the divine State, for the sake of which he exists, and from which he derives any trivial value that may inhere in him.

As for truth, both in the sphere of scientific theory, and in that of public and private behaviour, it has been cynically repudiated. Science, whether in biology, anthropology, psychology, or history has been subordinated to the needs of propaganda and imposed dogma. It is inspired no longer by the love of truth but by the interests and policy of a party. As for truth in action and behaviour, it has been displaced by the most cynical lying and treachery.

The present conflict, then, is one of civilization against its negation, and is a struggle for the preservation of individual freedom of speech and thought, as well as for the preservation of the sanctity of international and other agreements. There have been many suggestions that this is a war of Christianity against Paganism, but the fact would seem to be that the principles above described as being integral to civilization, namely, respect for the individual human being and for truth, are fundamental to all spiritual and moral religions—Christian and otherwise. Spiritual religion as an activity, not only of the group but also of the individual moral personality, involves the belief in freedom, and through its claim to establish contact between the devotee and the highest reality, involves the belief in the supreme value of truth. History shows how closely ideals of freedom and truth are bound up with spiritual and moral religion, and how prominent has been the part played by religion in the development of the civilized tradition—the tradition which is now under threat of demolition.

"The essence of all great religious systems," writes Sir Richard Gregory in his recently published "Religion in Science and Civilization"*; "is belief in the attainment of high ideals by devotion of service to them. Different individuals and communities require different doctrines and rituals to bind them together in worship of any kind, but

* Religion in Science and Civilization. By Sir Richard Gregory. Pp. xiii+366+16 plates. (London: Macmillan and Co., Ltd., 1940.) 12s. 6d. net.

all such formularies are only ancillary aids to a universal faith in the possibility of ascending towards the highest good by human endeavour."

But not only is the present a struggle of true religion against idolatry (idolatry being the worship of the creature, for example, the State, and not of the Creator), but also it is a struggle of science against superstition. Not only is the Nazi doctrine of racialism, the *völkisch* philosophy of life, a pseudo-scientific dogma, but also the interpretation of evolutionary theory which the Nazis borrowed from Nietzsche, is crude and barbarous in the extreme, being what T. H. Huxley characterized and repudiated as "the gladiatorial theory of existence". Sir Richard Gregory, in the work above mentioned, quotes the noble and well-known passage from the Romanes Lecture in which those words occur, and adds, "This is the religious message of science; and all the evils of civilized life arise from the neglect of it by individuals and communities". Huxley's words have a singular relevance to-day:

"The practice of that which is ethically best involves a course of conduct which, in all respects, is opposed to that which leads to success in the cosmic struggle for existence. In place of ruthless self-assertion it demands self-restraint; in place of thrusting aside, or treading down, all competition, it requires that the individual shall not merely respect but shall help his fellows."

On the human level, the further advance of the creative process demands co-operation rather than strife; thus the Nazi doctrine is reactionary as well as puerile. As for the glorification of war, popular in Nazi and some other circles, history and anthropology give little justification for it.

"War represents only one phase in the development of civilization," writes Sir Richard Gregory, in a fine chapter on "The Cultural Aspects of War". "The contribution to advancement by peoples has not been through their warlike qualities, but by other thoughts and actions. The spiritual evolution of man, as represented by all that is best in civilization throughout the ages, and as inspired by the most exalted and ethical teachers, has not proceeded in its upward course through war but in spite of it."

But it is indeed in no spirit of glorification of war or race that the present struggle against the enemies of the European cultural tradition is being waged. The same writer makes this clear:

"When the deliberate policy of a State is to impose its system by force upon people who wish to be free and have entirely different ideals, all believers in liberty of conscience and in the principles of natural cultural development should range themselves against such aggression."

It is a bitter tragedy; but yet more calamitous would be the tragedy if the cause of civilization were allowed to go by default.

PROGRESS OF THE ROYAL SOCIETY

The Record of the Royal Society of London for the Promotion of Natural Knowledge
Fourth edition. Pp. viii+578+19 plates.
(London: Royal Society, 1940.) 21s. net.

IT is twenty-eight years since, at the 250th anniversary of its incorporation, the Royal Society last issued an edition of its "Record". A possessor of the volume of 1912 will find, on studying that of 1940, that, although the two are almost uniform in outward and inward physique and necessarily have various parts of the text in common, there is so much that is new and valuable in the present edition that ownership of the earlier volume does not exempt him from having this also. Nor should its use be limited to scientific persons: any student of the general history of our time who ignores it, or treats cursorily what it can show him, would miss something that is vital to his theme.

Those topics which are common to both editions have evidently been examined *de novo*; and no sentence, passage, or section has been reprinted unless its facts, its phrasing, and its place in the newly told story have stood against the keen scrutiny which time and the recorder have exercised. The account of the foundation and early history, which occupied 47 pages in 1912, is matched now by 85 pages—Chapter i—on the rise and growth of the Society, in which new matter of the seventeenth century is introduced in a rearranged story, and wholly new sections describe the Society in the eighteenth century (10 pp.), the nineteenth (21 pp.), and the twentieth up to the recent breakdown of that remarkable period (12 pp.). The texts and translations of charters, and the statutes, formerly in the main text, are now transferred to appendixes, as are the lists of patrons, officers, medallists and lecturers, with the complete chronological and alphabetical lists

of the fellows from 1663 until 1939 (some 6,000 in all), and an interesting table and graph of the numerical progress of the fellowship. These appendixes fill about 350 pages. The index of 9 pages is twice as long as that of 1912, and much more than twice as useful. Chapters ii-ix of the main text, covering about 130 pages, give notes on the charters and on the statutes, and describe lucidly the various funds and benefactions, the library and collections, the committees, and the publications: in all which accounts, there is maintained the nicest balance between fact and commentary, with just enough of the latter to cause the whole to cohere, and to enable the reader to see perspectives as they should be seen.

In other domains of human enterprise, it may often be noticed that a growing interest in the past marks a decline of real vigour in the present. That growth is manifest here; but emphatically not the decline. Indeed, even though the "Record" scarcely touches (except in the lists of the subjects of special lectures) upon the specific advances in science for which the Society has stood sponsor, the reader who notes those corporate activities which belong to the last twenty-eight years can scarcely fail to judge this period as being, in many ways, the most vigorous and fruitful in any of the four centuries which the Royal Society has helped to shape.

The last phrase is no hyperbole. But it is inevitable that scientific ideas and knowledge should always be anachronisms of anticipation, ahead of their historical date as this is measured by the calendar and assessed by the conventional historian; and therefore a far-sighted generation, that would cater for its own posterity's needs, does well if it encourages its scientific men. That our generation from 1912 until 1939 has not lacked persons of such foresight, as well as the

means to exercise it, can be learnt from Chapter iv, and is seen at a glance in a very concrete way from the table on p. 78 in Chapter i: the Society's funds, which in 1900 were put at £169,445 and in 1913 at £179,735, in 1937 were put at £893,134. More than three-quarters of this capital is held for the direct aid of research, producing to this end an income exceeding £30,000 yearly—some thirteen times as much as was available in 1912—with which have lately been endowed the distinguished and productive professorships and studentships, of which the purposes and the holders' names are recorded in Chapter iv. Not only have the Society's own funds thus grown (though there is still much need for additions free from restrictions other than at the Council's discretion), but also the Parliamentary grants-in-aid which the President and Council administer are much greater than formerly: for example, that for scientific investigations is now £7,000 annually, that for scientific publications £2,500; and other responsibilities have also been accepted.

The nineteen illustrations in the volume have been thoughtfully chosen; and the reproduction of portrait-subjects at full length is an artistic improvement upon the practice of 1912. A reviewer may be suspect if he have *no* cavil: all I can do to meet this is to note that an interesting part of John Wallis's letter of 1696-97 has been omitted; and, concerning Plate 11, to question whether the design of John Tate's watermark (not "wire-mark", by the way, which is a different thing) is properly described. But these things matter nothing: the review should end as it began, adding only the fact, modestly mentioned in the President's preface, that the preparation of this "Record" was mainly in the hands of Sir Henry Lyons, lately treasurer of the Society.

J. I. O. MASSON.

BIRD PORTRAITS

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Written and Illustrated by Eric J. Hosking and Cyril W. Newberry. Pp. xx+104+53 plates. (London: *Country Life*, Ltd., 1940.) 5s. net.

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naturalists. Had the camera been invented in St. John's day he might perhaps have laid aside his gun, and photographed, rather than shot, the ospreys and other rare Highland birds which he, keen naturalist though he was, did not hesitate to slay.

It is good to think that we now protect and study our remaining birds; by means of photographs their shy lives are brought vividly and faithfully before a large public prevented from seeing these birds (or at all events the rarer ones) themselves.

One of the early pioneers in bird photography, and undoubtedly the best known, was Richard Kearton, whose enthusiasm was tremendous. He photographed birds from a stuffed ox, sometimes from a stuffed sheep. Cameras, and photographic plates and films, had not reached their present-day perfection, yet if Kearton's photographs be examined, some of them, even by present-day standards, are still well-nigh perfect, although almost half a century has passed since Kearton began his work.

Many persons, their enthusiasm fired by the early workers, have followed their example and have published their photographs in book form. The present book, by Eric J. Hosking and C. W. Newberry, is a comparatively small and unpretentious work, yet the photographs which illustrate it are in the very first class—I doubt whether anything better of their kind has been published. It is, perhaps, a pity that the identity of the photographers is not revealed beneath each picture. For example, one is left in the dark as to whether it was Mr. Hosking or Mr. Newberry who took those really beautiful photographs of the stone curlew at home, but it is perhaps to be inferred that the joint authors of the book worked together.

The letterpress of the book is inferior to the photographs, but there are recorded interesting

first-hand observations—for example, the pied flycatchers of a valley of Wales began to nest only a few hours after their arrival at their summer haunt, and “the modern flash bulb, which gives a short flash without noise or smoke, has no disturbing effect on many wild birds, which apparently regard it as a natural phenomenon, perhaps akin to lightning” (p. 49). The authors also describe the excitement of a cock partridge, on being called to the nest by the hen, to see the first-born chick. On p. 40 is found what may be a very modest statement, “Our work was interrupted by an accident while working on a tawny owl”. Can this have been the ferocious tawny owl which attacked Mr. Hosking and caused the loss of one of his eyes? Yet even after that, Mr. Hosking, although he says nothing of it in this book, refused to admit defeat, or to harbour ill-will against the owl, but continued to photograph it after a few days' rest. The series of woodcock photographs are particularly fine, and there is an excellent buzzard series.

The authors do their best to prove that the little owl is not the villain it is generally supposed to be, but there would seem to be a good deal of contrary evidence—witness the great destruction worked by a pair of little owls among the storm petrels of Skokholm. SETON GORDON.

THE CELL THEORY

Hundert Jahre Zellforschung

Von L. Aschoff, E. Küster, W. J. Schmidt. (Protoplasma-Monographien, Band 17.) Pp. x+285. (Berlin: Gebrüder Borntraeger, 1938.) 16 gold marks.

BEFORE he can come near to understanding the complicated structures and immense variety of form encountered in the living world, the natural scientist has to reduce them to their simple ultimate components. These elementary units should be able to live by themselves, and also to combine with each other to produce more and more complex systems. The search for the fundamental unit of living matter was greatly influenced by the thought of Leibniz, while Brown, Bichat and Purkinje among others looked for such components. It was not, however, until Schleiden put forward his cell theory in 1839 that general agreement as to the nature of the elementary unit was reached. Schleiden's theory provided both a sound basis and a guiding principle for the study of the microscopic structure of plants, which were soon applied to normal animal tissue by Schwann, and to pathological material by Virchow. The

cell theory thus gave a new and vigorous impetus to microscopic investigation, as well as leading to the development of specialized techniques.

Küster, Schmidt and Aschoff have taken the opportunity afforded by the centenary of the first enunciation of the cell theory to publish a little book in which they not only trace the broad outlines of the course and general results of cell research during the last hundred years, but also examine the validity of the cell theory in the light of our knowledge to-day. On reading this book one is not only impressed by the progress made in this field since 1839, but also by the amount which was known of the structure and function of cells before ever the cell theory was formulated.

As commonly understood, the cell theory contains two main statements: (1) that the cell is *the* elementary form of life, and (2) that every organism is composed of cells and cell derivatives. While the book under review contains an adequate summary of research done during the last hundred years, that part of the book concerned with the examination of the validity of the cell theory is

rather disappointing, because of the authors' rather uncritical tendency to accept the traditional outlook. They agree that the first statement of the cell theory needs modification, since viruses cannot be regarded as cells, and that there must, therefore, be more elementary forms of life than the cell. Schmidt believes in various degrees of life and in the transition of the non-living into the living organization. Aschoff favours this conception, but does not reveal how he reconciles it with his acceptance of Virchow's law, *omnis cellula e cellula eiusdem generis*. All three authors accept the second contention of the theory, and believe that research during the last hundred years has not produced any results incompatible with it.

In considering the validity of the cell theory, one may perhaps ask whether the term 'cell' is sufficiently well defined. Most botanists, speaking of the cell, think mainly of the cellulose wall and its lignified derivatives, while the geneticist is concerned for the most part with the chromosomal structure, and the biochemist has in mind an aggregate of enzymes enclosed within a semi-permeable

membrane. Thus the very meaning of the word 'cell' tends to vary with its context. Further, the character of every actually existing cell depends on the tissue and species of organism from which it is derived, and even in tissue culture cells retain these characteristics and do not become simple living elements. Thus it is impossible to conceive of the cell as a sort of chemical atom, an elementary unit of interchangeable qualities.

It is true that no understanding of structure and form in the living world is possible unless cellular organization is taken into account, but at the same time the reduction of an organism to a combination of similar elementary units is not sufficient to explain the differentiation and functional structure of the different organs and tissues involved. Consequently a number of new conceptions, such as the field theory put forward by Child, Heidenhain's *Teilkörper* theory and the theory of functional systems, are being tried to supplement the cell theory. Unfortunately, Aschoff dismisses all these attempts as being of no importance since they can be worked into the cell theory.

A. GLÜCKSMANN.

RELATIONSHIP OF CRIME AND INTELLIGENCE

Intelligence and Crime

A Study of Penitentiary and Reformatory Offenders. By Simon H. Tulchin. Pp. xiii+166. (Chicago: University of Chicago Press; London: Cambridge University Press, 1939.) 12s. net.

THIS investigation is primarily an inquiry into the relation between crime and intelligence. But the bearing upon crime of other variables such as age, height, weight, nativity, educational record and employment is also taken into account. The subjects are 4,748 males at the Illinois State Reformatory, 5,512 males at the Illinois State Penitentiary and 153 penitentiary females. The research was carried out over a period of seven years.

No doubt this is a very painstaking piece of work, but the results are presented more as raw material for further study than as data thoroughly analysed. Three criticisms, in particular, suggest themselves. First, the control groups are inadequate. Secondly, no tests of significance are applied to the large number of differences between means; nor is any analysis of variance attempted. The reader is thus left guessing how many of the observed discrepancies are attributable to chance. Thirdly, the grouping of the criminals into only

seven types of crime is much too crude a classification for a thoroughgoing analysis. The seven types of crime are fraud, robbery, larceny, burglary, murder, sex, and a group described as miscellaneous.

In spite of these defects, the reader feels that certain important conclusions can be accepted. Serious doubt is thrown upon the traditional view of Goddard, Healy and others that there is an abnormally high percentage of feeble-minded among the criminal population. Tulchin shows, on the other hand, that the distribution of ability in his criminal subjects scarcely differs from the distribution in adequate samples from the general community in the United States as, for example, in the American Army samples. Moreover, as Murchison had found earlier, the ability of the offender is definitely related to the type of crime he will commit. The fraudulent are generally the most able. Age and height are also relevant factors in determining types of crime. Finally, scores on the tests used, far from measuring 'innate' ability, correlate significantly with environmental factors such as place of birth, length of residence in a particular region, and educational level.

J. I. COHEN.

AN EAST AFRICAN PEOPLE

The Social Institutions of the Kipsigis

By Dr. J. G. Peristiany. Pp. xxxiv+288+24 plates. (London: George Routledge and Sons, Ltd., 1939.) 18s. net.

THE Kipsigis, better known among Europeans and to an earlier generation of anthropologists as the Lumbwa, are numerically the most considerable group of Nilotic Hamites in Kenya, their nearest affinities being the Nandi, Suk, Kamasia and Turkana. With the Masai they have a traditional enmity, which they trace back to the time of their first entry into the country they now occupy. This migration, it is to be presumed, was from the north.

The literature relating to the Kipsigis, though not entirely lacking, is scanty, and from the point of view of modern anthropological method, partial and inadequate. This is the further to be regretted, since the recorded observations of the related peoples, Nandi and Suk, dating for the most part from the first decade of the present century, are both scrappy and self-contradictory. It is pointed out by Dr. E. E. Evans-Pritchard in his interesting introductory analysis of Dr. Peristiany's material to what an extent these present observations among a closely related people serve to throw light on previous obscurities in these early records. In this connexion it may be mentioned as significant of the degree of inter-tribal relation that a Kipsigis crossing into Nandiland fits into the age-set corresponding with his own, and is at once accepted as a member of it.

The social organization of the Kipsigis is of a highly complex character. The fundamental system is local. The basic unit is the village, built up from family holding and hamlet. The villages in their turn combine to form the shire, and the shires the higher unit of the province, four of which constitute the Kipsigis tribe or nation. There are no chiefs, but in each grouping, political and juridical, military and ritualistic leaders regulate the departmental affairs of the group, with the assistance of the elders, who virtually control the action of the leaders and give effect to the democratic character of Kipsigis institutions. Economic affairs stand outside this hierarchy of leadership. Here the village organization with its economic leader is the effective unit standing alone, its special function being that of facilitating and ensuring co-operation between its members. So deeply engrained is this principle of co-operation on a local basis, that assistance will be tendered to a neighbour in preference to a distant kinsman.

The complexity in a social system thus built up upon a gradation of locally organized units is intensified by other methods and systems of classification of overriding significance, which cut across local organization. Among these may be mentioned the regimental system for raiding purposes, under which each individual is born into a regiment, although it is possible to be designated to an alternative—but in either event the regimental affiliation is independent of territorial claims; the age-set, by which the whole community, including in so far as applicable the women, is divided up into three age groups of the young or uninitiated, the warriors, and the elders; and the clan system, based upon totemic non-exogamous groups, subdivided into exogamous branches, each with its distinctive totem, from which the members take their name, these sometimes being still further subdivided, the exogamous unit then becoming the lower division.

The various affiliations of which the individual is the centre or focus tend to eliminate the parochialism which might, or indeed would inevitably, result from a purely local system, and bind the Kipsigis into one people. This effect is enhanced by other institutions, such as for example the practice followed by wealthier individuals of planting out the homesteads of their various wives in different parts of the country, or depositing a number of their cattle in the keeping of friends and connexions. As to how far it would be safe to attribute outstanding importance to any one influence on the life of the individual it is difficult to say; but just as initiation, which admits to the warrior age-set, is the outstanding event of a lifetime, so the age-set, which determines the character of the social activities of every member of the community, would seem to overshadow all other affiliations. Dr. Peristiany not only gives a detailed account of the elaborate initiation ceremonies, but also discusses their place in the regulation of tribal life and conduct, while touching upon the effect of certain changes which have taken place in them in recent years.

Following on his account of this complex social organization, Dr. Peristiany has described with a wealth of detail its various ramifications and its effect on the family—marriage, economic life, inheritance and property, war, hunting, religion and other departmental institutions in the community. His scholarly study is a valuable addition to the literature relating to the less familiar peoples of East Africa.

PREVENTION OF MALARIA IN INDIA

RECENT ADVANCES

By SIR MALCOLM WATSON,

DIRECTOR, ROSS INSTITUTE OF TROPICAL HYGIENE

ALTHOUGH the primary object of my recent visit to India was to see what progress had been made in preventing malaria on estates advised by the India Branch of the Ross Institute, I took the opportunity of visiting Delhi and Hyderabad, Deccan. In all these areas astonishing progress has been made since my visit in 1928-1929.

For more than a thousand years there has been a succession of cities on the western bank of the River Jumna within six miles of new Imperial Delhi. Some of the cities were far enough from the river to escape the malarial mosquitoes which breed in pools in its bed. But three hundred years ago Shah Jehan made the mistake of building his city right on the river bank; the Western Jumna Canal irrigated its northern area; the Darhalia Nala flowed through the western suburb. In all three, *Anopheles culicifacies* bred in profusion; and at times Shahjehanabad was the most malarial military station in India. In 1903 the General Officer commanding the Division commented on "the havoc caused in the Delhi Fort garrison". Of the relieved force, 315 per 1,000 were unable to march back to Meerut, and of the remainder quite one fourth were scarcely fit to carry arms. A few years later the cantonment of Daryaganj in the south-east corner of the Fort and immediately on the Jumna was abandoned on account of malaria. New Delhi, built not quite so near to the river as its immediate predecessor, provided accommodation for myriads of *A. culicifacies* in the four hundred miles of margins of concrete tanks which adorn the new capital. Further accommodation for the anopheles was provided in pits in two hundred acres of brickfields and in innumerable artificial obstructions to natural drainage channels.

To-day a five years programme for the control of malaria is well advanced. It covers the eight miles of river bank and the various streams and canals falling into the river, the irrigated area, the brickfields and much besides: good sound work that is producing the required result. Indeed, Daryaganj, the abandoned, is now being developed as a residential area.

Not less interesting, and of great importance to India, is the control of malaria in sixty-six villages within three miles of the city, and in sixty villages

farther afield. The work is being done after careful study of the habits of the dangerous anopheles, *A. culicifacies*. Depressions have been filled, and the land sloped to run all surface water to one or more of the village tanks, where any mosquitoes that breed can easily be destroyed. While concentrating on the prevention of malaria, water supplies have been improved, and the general cleanliness of the villages has not been neglected. The co-operation of the villagers has been secured. The anti-malarial work at Delhi is under Lieut.-Colonel Covell, director of the Malaria Institute of India. It costs money—often much money—to repair mistakes that could have been avoided in the original work without additional expense. Now co-operation between the various authorities prevents more man-made malaria, and I was impressed by the economy and efficiency of the work.

The prevention of malaria by the Government of India has not been confined to Delhi Province. The Government of H.E.H. the Nizam has reduced the percentage of children suffering from malaria in the old city of Hyderabad (one of the worst areas) from 55 to 0.5; a suburb of the city, falling into decay in 1929, is now thriving and land values have risen; a completely new suburb has been built on land previously regarded as uninhabitable. Twenty years ago there were 16,000 deaths a year from plague, now there are 100 or less. Slum clearance proceeds rapidly, and there are many attractive rehousing schemes. Some of the small houses, the economic rent of which would be Rs. 3 a month, are let at Rs. 1 a month to those who abjure alcohol. These houses have pillars shaped like inverted tumblers—a reminder of the pledge. Improvements in many other ways have been made, and with its progressive Government Hyderabad is becoming a model Indian city; nor have the improvements been confined to the capital of the State.

For more than two months I toured estates in southern India; the Surma and Assam valleys; and the Dooars, an area under the shadow of the Himalayas. In many of these districts malaria had been intense and blackwater a too frequent visitant. Since I made much the same tour eleven years ago a great change has occurred. Almost

everywhere on the estates the prevention of malaria is in active progress. Confidence has replaced pessimism; on many estates managers, assistants and medical officers are full of enthusiasm at the wonderful results achieved. Although I made constant inquiry I heard of no case of blackwater fever in a European in the last two years.

Sixteen years ago, when I spent three months in Assam on the invitation of the directors of the Doom Dooma and its associated companies, the control of malaria by controlling mosquitoes was regarded as impossible. The Assam Valley, or syncline between the Himalayas and the Burma Hills, three hundred miles long and fifty miles wide, is, I am told, filled with detritus from the hills to a depth of three miles. To the eye it appears a level plain, and it well might as it was formerly an arm of the sea; even now the Brahmaputra River is navigable almost the whole length of the valley throughout the year. In the spring the melting snows of the Himalayas and vast areas of Tibet make it one of the mighty rivers of the world, five to seven miles wide. Its waters flood back into the local rivers, mere tributaries of the Brahmaputra, but some wider than the Thames at Westminster. Then with scarcely an interval come the monsoon rains—80–120 inches in less than six months. Hundreds of square miles disappear under water; for wherever possible water is stored by the Assamese, whose staple food, rice, is grown in sheets of standing water. Can we wonder that more than twenty species of anopheles have found the valley a happy home, or that to the earlier investigators the malarial problem of controlling mosquitoes seemed insoluble?

My researches in Assam, and more than twenty years experience of Malaya, led me to take another view. Between 1900 and 1910 the combination of research and practical work in Malaya showed the openings in the mosquitoes' armour. The work had included, in addition to laboratory work, large-scale experiments in which miles and years took the place of millimetres and minutes; for the malaria problem could not, in the end, be brought within the four walls of any laboratory. We had learned that, although there were many species of anopheles all of which could be artificially infected in a laboratory, few became infected when wild, and happily few areas had more than one dangerous species; that to control malaria we had to control only the dangerous species; that the larvæ of the different species lived under different conditions of light and shade, of stagnation or movement of water; that changes in these conditions or in the chemical composition of the water would change the species present; and that a method

of control 100 per cent successful against one species might be worse than a failure against another species. For example, *A. maculatus*, the larvæ of which live in hill streams, sparkling in the sunshine, required very different measures of control from *A. umbrosus*, an inhabitant of jungle-covered stagnant swamps. So came about what is known to-day as 'species sanitation'; and in 1910, at a public lecture, I stated that following the methods of limiting and changing species shown to us by Nature, "a great anti-malarial method will be evolved . . . we shall be able to play with species of anophelines, say to some 'go' and to others 'come', and abolish malaria with great ease, perhaps at hardly any expense. Drainage may become a method of the past. . . ." In addition to other methods of malaria control like site selection and oiling, Nature's methods are widely employed on estates in India to-day.

Dr. G. C. Ramsay followed up my researches in India. He proved *A. minimus* to be the only important carrier of malaria on the estates in his practice, and went on to control it. In 1930 he was appointed head of the India Branch of the Ross Institute. His scheme of training young Indians has been expanded by Dr. Manson, Dr. Fraser and other medical officers co-operating with the Ross Institute, and to-day more than five hundred trained Indians are employed on estates to identify the species of anopheles caught, to dissect them to see if they are infected with malaria, to collect anopheles larvæ and prepare maps showing the breeding places of the different species. Small field research stations have been temporarily opened in different parts of India from Cape Comorin to the Himalayas, from Sind to Assam. More than two hundred thousand anopheles have been dissected and several species have been convicted of carrying malaria. There are now one or two permanent training centres to meet the demand for trained malarial surveyors—a new and useful form of employment for the educated Indian fresh from school.

To control the different species of anopheles appropriate methods are employed. A description of some of them would be strange reading for those who were taught only of the danger of jungle, of stagnant water, and swamps, and have not been initiated into the secrets and mysteries of modern malaria control.

For example, on many estates in India, as in Delhi, much malaria has been 'man-made'. Over wide areas of both northern and southern India, the malaria is entirely due to man interfering with Nature by his clearing away jungle from streams and exposing them to the sunshine, and by his draining swamps. For by doing so he has driven out the jungle-loving or harmless species and

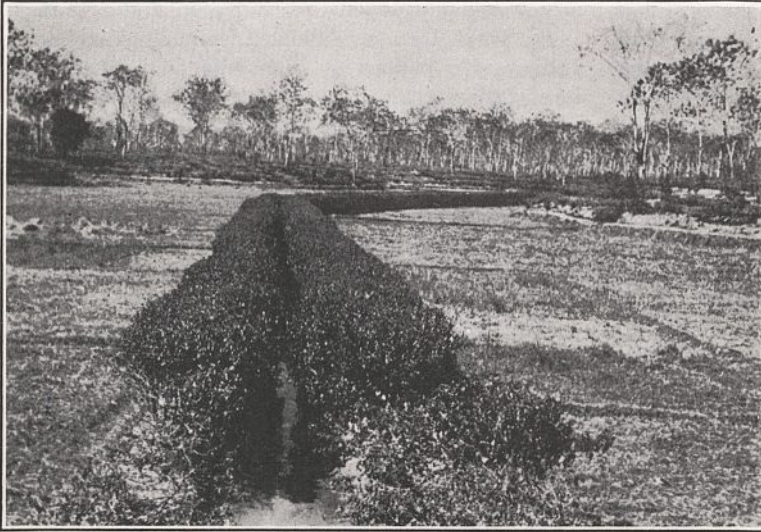
permitted the breeding of dangerous species—*A. minimus* in the north, *A. fluviatilis* or *A. culicifacies* at different elevations in the south. Inter-mittent flushing will wreck the home of even the fastest stream-breeding malaria-carrier in the world; it is much used in India. Streams are flushed by hand-operated openings in simple earth dams; by automatic tippers, costing a shilling or less, of a design that would rejoice the heart of Mr. Heath Robinson; or by more elaborate things of concrete and iron. In other places, if man holds his hand, Nature will cover up her wounds with secondary jungle, but often she is too slow and we must replant appropriate shade. So we see the strange sight of hundreds of acres of little squares of almost stagnant water growing rice in the sunshine, and down the centre of the

From a commercial point of view, a remark made by the head of one of the largest tea-producing concerns in India represents the general opinion: "We have gone carefully into the figures and are convinced of the value of malaria control"; and he added, "in fact we have some of the finest examples of the control of malaria both in north and south India", for the truth of which remark I can vouch. The following are figures from one group of estates, representative of many:

	1927 Before control	1938 After 10 years control
Population	17,770	18,670
Death-rate per 1,000	31.5	21.4
Total 'sick' days	249,306	147,993
Children with malaria (spleen-rate)	60%	14.3%

To the employer these figures mean a lower sick-rate, a lower death-rate, greater efficiency in his labour force and lower cost of production. To the labourer they mean healthier and happier homes and a higher pay packet at the end of the month: 100,000 more days pay than ten years ago, on this particular group of estates. Until the new standardized returns come into general use, we shall not be able to compute the total benefit to the Indian labourer on estates; even now we can think, without the least fear of exaggeration, in terms of a gain of more than a million days wages a year.

This work has not been confined to the European-owned estates. Already several Indian-owned and Indian-managed estates have joined the local Ross



ANTI-MALARIAL HEDGE IN A RICE FIELD (PRUNED IN NON-MALARIAL SEASON).

rice fields a stream densely shaded by a hedge; it may be of the lovely shoe flower (*Hibiscus*), the wild rhododendron (*Melastoma*), the notorious *Lantana* or other plants. The centre stream alone was the danger. The hedge has made it harmless, and an intense source of malaria has been eliminated. The accompanying photograph shows a rice field in the dry weather with the hedge pruned to make the shade denser in the rainy malarial season. There are 2,000 miles of these dense hedges now, and 4,000 miles will be effective by the end of the year.

Progress has not been confined to the prevention of malaria. I was astonished to see the general improvement in the water supplies, in latrine accommodation, in refuse collection and disposal, in housing of the labourers, in the hospital buildings and the high standard of medical work in so many of them, the care of the sick and the ante-natal work.

Institute centres, and the Governments of Assam and Madras are co-operating with the estates to improve the health of several villages. The hope has been expressed that the European estates with their trained staffs will assist their Indian neighbours to control malaria and other diseases, to the advantage of both and the removal of what is at present a source of friction.

On Dr. G. C. Ramsay, deputy director of the Ross Institute, has fallen the heat and burden of the day. He has succeeded only because of the fine co-operation of his medical colleagues and the planters and of the support of the directors in India and at home. Sometimes the question is asked: "Can any good [medical] thing come out of Britain"? So perhaps I may be excused for expressing the opinion that the work in India is the greatest achievement in the control of malaria in the past decade; that the best of it, and there is much 'best', is worthy of comparison with the

best work done at Panama or with Mussolini's great achievement in the Pontine Marshes; and in area it is vastly greater than either. Moreover, both could learn something to their advantage from India. Nor is this the whole story; for Ceylon, certain areas in British Africa, and Malaya have also fine records in preventing malaria—in Malaya begun even before Panama.

This story would not be complete without mention of how this work was made possible. The late Sir Charles McLeod, first chairman of the Ross Institute, who used to insist that "malaria,

malaria, malaria" was the great enemy, and a number of his friends in the City financed the India Branch of the Ross Institute during 1930–1933, when the responsibility was taken over by the Indian Tea Association.

During this tour I visited the humble laboratory at Hyderabad in which Ronald Ross made his immortal discovery. Often I wished he could have been with me to see how mosquito reduction had spread still farther into rural areas, which as he wrote to me in 1909 he had "never dared to moot".

THE CORROSION OF FERROUS METALS

BY DR. J. NEWTON FRIEND,

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IN 1916 a committee was formed by the Institution of Civil Engineers, under the chairmanship of the late Sir William Matthews, to investigate the "Deterioration of Structures exposed to Sea Action". The Department of Scientific and Industrial Research gave every encouragement and offered substantial financial assistance.

An important section of the work undertaken by the Committee is that dealing with the corrosion of iron and steel. This research has now been completed. Series of bars of fourteen different kinds of ferrous metal, measuring 2 feet in length, 3 inches in width and 0.5 inch in thickness, were exposed at various ports to sea air, to alternate sea air and wetting with sea water or spray, and to continuous immersion in the sea. Three sets were exposed at each port to each of these conditions, one for five years, one for ten and the third for fifteen years. The results obtained with the five and ten year bars have already been fully discussed in the Committee's Fifteenth Report (1935). As yet only the numerical data for the fifteen-year bars have been made public in the Committee's Seventh Interim Report (1938), the full report being temporarily held up on account of the War. It may be said at once that these last results support the earlier ones very satisfactorily, and it is the purpose of this article to mention a few of the more important practical conclusions to be derived from the numerous data now published.

The ports chosen for the exposure of the bars were Auckland (New Zealand), Halifax (Canada), Plymouth (England), and Colombo (Ceylon). These were selected as offering a wide variation in climatic conditions. Thus Colombo has a moist,

tropical climate, and the total loss in weight suffered by the bars through corrosion at this port was twice that experienced at Plymouth, three times that at Halifax and nearly four times that at Auckland. Nevertheless, the relative losses among comparable sets of bars were quite analogous and thus enable us to draw many useful conclusions with a high degree of confidence.

The severe nature of the corrosion at Colombo is illustrated in Fig. 1. The steel bar *B14* was perforated near its middle after exposure at half-tide level for ten years, whilst, after fifteen years exposure under similar conditions, bar *E15*, also of mild steel, was completely eaten in two.

At Plymouth three sets of bars were exposed to fresh-water action by immersion in the reservoir at Turnchapel for the above-mentioned periods.

In all cases the bars were maintained in a vertical position by embedding their ends in concrete, which was carefully punned into position so that no air holes or porous sections were left around the metals. The concrete proved an ideal material for the purpose. After fifteen years exposure the metal beneath the concrete was in perfect condition, except in a few cases where the concrete had cracked from one cause or another.

Moist concrete is not a perfect insulator, particularly when impregnated with salt water. Experiments carried out at Plymouth showed that minute electric currents undoubtedly passed through the frames when immersed in the sea. Hence a small amount of electrolytic corrosion was induced in some of the specimens. Most fortunately, measurement showed that this was too small to affect seriously the results, owing to the relatively great distance between the

experimental bars and the re-inforcing steel rods. Had the specimens been placed appreciably closer either to one another or to the tie-bars, the effect might have been serious. This is a point worth noting in future investigations; it does not appear to have been considered hitherto.

The metals selected for study comprised: (i) three rolled irons, namely, Low Moor, Swedish and ingot irons; (ii) four carbon steels, with carbon ranging from 0.2 to 0.4 per cent; (iii) five alloy steels containing respectively 0.6 and 2.2 per cent copper; 13.6 per cent chromium; 3.75 and 36.6 per cent nickel; (iv) two cast irons, exposed in their 'skins', namely, hot blast metal *Q* and cold blast metal *R*.

In an exceptionally well-illustrated paper, read before the Institution of Civil Engineers on April 4, 1922, Sir Robert Hadfield gave a detailed account of the preparation, analysis and mechanical testing of these bars. This paper was briefly summarized in *NATURE* of December 30 of the same year.

As was to be expected, the high nickel steel proved, on the average, the most resistant to all forms of attack. But its high cost and special mechanical properties obviously militate against its general adoption. The chromium steel behaved remarkably well in air and in fresh-water, but in contact with sea-water it suffered such severe localized corrosion as to render it useless.

The cast irons stood up well against aerial corrosion, the cold blast metal proving slightly the more resistant. In contact with water, however, particularly sea-water, graphitization took place, sometimes working its way so deeply into the bar as to leave only a thin core of unattacked

metal. This is well illustrated in Fig. 2; bars *Q11* and *R11*, exposed to sea air at Colombo for ten years, yielded practically perfect fractures. The fractures of the other bars, exposed at half-tide level and to complete immersion in the sea, show how deeply graphitization had penetrated. The corrosion product was hard and so firmly attached to the core that it seemed impossible to remove it by mere mechanical means. Indeed, in some cases it was not until the bars had been intentionally fractured that it was realized how seriously the cast iron had been attacked. The general appearance of the bars was most misleading and, in view of this, cast iron cannot be recommended for purposes other than aerial.

In the aerial tests, Low Moor iron was found to corrode more seriously than mild steel; in fresh-water the two metals behaved pretty much alike; at half-tide level the wrought iron was slightly superior, and when exposed to complete immersion in the sea the wrought iron was decidedly superior. An answer is thus afforded to the vexed question of iron *versus* steel, in that it is shown to depend upon the type of corrosion to which the metal is destined to be exposed. Mere averaging makes the two metals appear to behave alike.

The foregoing observations clearly prove that if we wish to know which particular metal to choose as most suitable for resisting corrosion, the particular type of corrosion must be specified. No metal is equally resistant to all types of corrosion, and so-called acceleration tests, carried out under conditions different from those to which the metal is destined to be exposed, may easily yield most misleading results. I had already pointed this out in 1911 in my book "The Corrosion of Iron and Steel" (Longmans), p. 276, and the conclusion arrived at then now receives overwhelming support.

An interesting feature of the research is afforded by the various ways in which the different metals have been attacked under the different conditions of exposure. Thus, for example, the surfaces of most of the bars exposed to sea air alone were covered with innumerable *pocks* of varying degrees of fineness or coarseness according to circumstances. The wrought irons exposed to sea-water were usually covered with furrows or narrow channels running down the full length of the bar, that is, in the direction of rolling. The appearance was

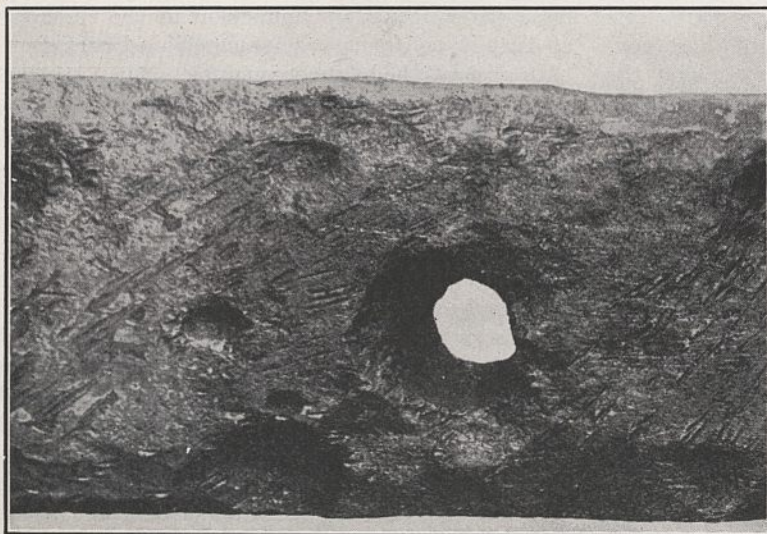


Fig. 1.

MILD STEEL BAR EXPOSED FOR TEN YEARS AT HALF-TIDE LEVEL AT COLOMBO.

characteristic and a mere glance enabled one to distinguish between the wrought irons and steels.

Whilst the wrought irons had been exposed in a cleaned condition, that is, ground free from scale, some of the carbon steels had likewise been cleaned, whereas others were exposed with their mill scale still adherent. It is instructive to contrast the behaviour of the steels under these two conditions. The following case is typical. Two mild steel bars, *A* 18 and *E* 18, of the same metal were exposed to complete immersion in the sea at Colombo for fifteen years. Bar *A* 18, which had been cleaned before exposure, was fairly uniformly attacked and its surface relatively smooth. Bar *E* 18 had been exposed with adherent scale, some of which could still be seen clinging to the metal. But where the scale had broken away, serious localized corrosion had occurred, analogous to that on *B* 14 (Fig. 1). Some of the pits penetrated more than halfway through the bar. Had two such pits happened to coincide on opposite sides of the bar, as did occur with *B* 14, the bar would have been perforated and virtually destroyed. The two bars had lost practically the same amounts in weight. Clearly it is most desirable to remove scale from steels destined to be exposed to sea action.

In the case of the bars merely exposed to sea air, it was noted that the cleaned bars usually lost appreciably *less* in weight than the others—a result that was not expected. The differences in the depths of pitting were less pronounced, it is true, but such advantage as did occur lay again in favour of the cleaned bars.

The general progress of the corrosion of many of the bars exposed at half-tide level and to complete immersion in the sea was often rendered more complex by the presence of shelly fauna. Isolated shelly growths appeared to stimulate corrosion much in the same way as isolated patches of scale. Dead shell-fish seemed particularly deleterious, probably owing to the chemical activity of the organic decomposition products. At Auckland the bars were covered with a thick layer of shelly fauna which appeared to exert a mechanical protective action on the underlying metal. The fauna consisted mainly of barnacles and oysters; the former covered the bars whilst the oysters rested on top of the barnacles. In one case only was an oyster found to be in direct contact with the metal, and the position it had

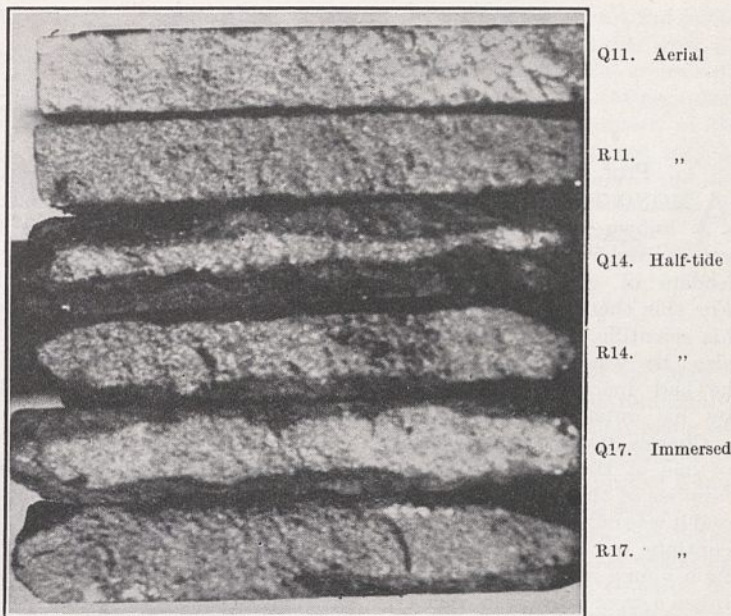


Fig. 2.

CAST IRON BARS EXPOSED FOR TEN YEARS AT COLOMBO.
Q = HOT BLAST; R = COLD BLAST.

occupied was faintly discernible, after cleaning, as a slight depression on the steel.

Turning now to the alloy steels, it may be mentioned that the presence of 0.6 per cent copper greatly enhanced the resistance of the steel to sea air and to fresh-water. In contact with sea-water, the effect either way was small. Increasing the percentage of copper to two did not, in general, effect much improvement; indeed, in some cases it seemed disadvantageous. Any added cost thereby entailed would certainly not be justified.

The addition of 3.75 per cent of nickel effected a very great reduction in the corrosion of the bars exposed either to sea air alone or to fresh-water. At half-tide level and when completely immersed in sea-water, the nickel steel still proved superior to the copper steel, but less markedly so.

One point in connexion with the alloy steels would appear to be important, namely, that in general they show a greater tendency to localized corrosion or pitting than do ordinary carbon steels in contact with sea-water. Mention has already been made of the severe localized corrosion suffered by the chromium steel.

The full report of the Committee, when published, will contain valuable material. In a brief summary such as this, it is obviously possible to deal with only a few of the interesting results obtained. The present chairman of the Committee is Mr. W. T. Halcrow, and it is to be sincerely hoped that this valuable work may be continued as soon as circumstances permit.

OBITUARIES

Prof. Charles Barrois, For.Mem.R.S.

AMONG French geologists whose names are well known in England, that of Charles Barrois stands high with those of the great pioneers and leaders of geology which France has produced. For this there are many reasons, for not only were his scientific attainments of the highest order, but also he was always a staunch Anglophile and he had made himself known in his early days by his outstanding work in England itself.

Charles Barrois was the son of one of the great industrial families of the north of France, and it was natural that he should continue in the family business. As a young man he had always taken a great interest in geology, and when he came to England to study English methods of manufacture and become a fluent linguist, he found that his interests lay much more in geology than in the mills, with the result that he spent all his spare time studying his hobby.

About this time, at the age of twenty, Barrois decided to devote himself to science, and in 1871 he joined Prof. Jules Gosselet at the University of Lille in the newly formed Geological Department. Five years later he was granted a doctorate of science at the Sorbonne for his work on the Upper Cretaceous strata of England and Ireland. In this great work he showed that the palaeontological zones recently established in France could be applied equally well in Britain. This work forms the basis on which all the subsequent zonal work on the Upper Cretaceous in Britain has been built.

About this time, Barrois was attached as a *collaborateur principal* to the Service de la Carte Géologique. The area which fell to him to investigate was the highly complex area of the Armorican Massif. His name appears on many of the sheets of the geological maps of Normandy and Brittany. Besides the maps themselves he wrote numerous papers, some descriptive and some of considerable theoretical importance, based on his studies of this highly complex area. Although essentially a stratigrapher, he wrote on such problems as the emplacement of granites and general petrographical problems. In the later years of his life he frequently returned to this area to revise his earlier maps.

It is natural that since his university was in the neighbourhood of the coalfields of the Nord and Pas-de-Calais, Barrois should have joined Gosselet in applying his geological knowledge to the problems of that complex field. As knowledge accumulated and the correlation of the various beds and seams was established, the structure of the field was elucidated. These studies led to the founding of the Musée houiller de l'Université de Lille in 1908, with models of many of the chief collieries made on plates

of glass giving a wonderful three-dimensional picture of the extraordinary complex structures revealed in the process of mining.

In 1919, Barrois, with Prof. P. Pruvost, his pupil and successor to the chair of geology at Lille, carried the knowledge learned in the north of France to a study of the coalfields of Lorraine and the Sarre. In 1902 he succeeded Gosselet as head of the Geological Department.

Besides the work in France and England, Barrois worked in Spain and was a well-known member of numerous geological excursions and congresses in many parts of the world.

During the War of 1914-18, Barrois felt it his duty to remain with his collections in Lille and spent four years there under the German occupation. During this period his old master, Gosselet, died; now again under the shadow of war, Lille has lost another of its great geologists.

Prof. Barrois received many honours. In France he was

created Chevalier of the Legion of Honour at the age of thirty-seven and in 1923 was promoted to Commander. He was elected to the Paris Academy of Sciences in 1904 and became its president in 1927. Outside France he was also honoured; he was a foreign member of the Royal Societies of London and Edinburgh, and he was senior foreign fellow of the Geological Society of London, receiving its highest award, the Wollaston Medal, in 1901. He was foreign member of many societies and academies, of the United States, Belgium, Spain and Germany, and he was also a member of the Pontifical Academy.

Barrois died at the age of ninety-one on November 5, 1939, in Normandy, but was buried at Lille, where the funeral service, conducted by the Cardinal Archbishop of Lille, was held in his parish church of Saint-Maurice-des-champs, a suburb of Lille.



REPRODUCTION (FULL SIZE) OF A MEDAL STRUCK IN 1924 BY THE SOCIÉTÉ DE L'INDUSTRIE MINÉRALE (DISTRICT DU NORD) TO COMMEMORATE THE PROMOTION OF ITS PRESIDENT TO BE COMMANDER OF THE LEGION OF HONOUR.

The Rev. F. C. R. Jourdain

THE death of the Rev. F. C. R. Jourdain at his home in Southbourne, Bournemouth, on February 27 at the age of seventy-four is a grievous loss to European ornithology. Jourdain was generally recognized as the leading authority on the breeding biology of the birds of the Palearctic region, and the accuracy and comprehensiveness of his knowledge of the subject has not been equalled by any ornithologist past or present. His great collection of the eggs of Palearctic birds was formed in a truly scientific spirit unfortunately too rare among collectors of eggs, and its value for comparative purposes is unrivalled, so that it is greatly to be hoped that it may be preserved intact. But although Jourdain was an enthusiastic collector, he was intensely interested in every aspect of the breeding biology of birds, and his mastery of his subject was based on a happy combination of wide field experience and an encyclopædic knowledge of the literature. For many years he had made a collecting expedition almost annually, visiting in this way almost all of the more ornithologically interesting parts of Europe (excluding Russia) and North Africa, and these trips resulted in a number of valuable faunistic papers in the *Ibis* and elsewhere.

Jourdain tabulated and classified with amazing industry the whole mass of data on the breeding of Palearctic birds from the extensive literature, supplemented by his own experience and that of a wide circle of correspondents, and his sections on breeding habits in the "Handbook of British Birds", now appearing, are marvels of concise and exact information which could have been written by no other ornithologist. Moreover, the enormous increase in detailed knowledge of the subject recorded in the "Handbook" as compared with its smaller predecessor, the "Practical Handbook of British Birds" (1919-23) is in very large measure directly due to the stimulus given to further investigation by his orderly systematization of the facts then known in the older work. He was also responsible for the sections on food, distribution abroad, and (jointly with me) on display. It is sad that he did not live to see the completion of this crowning achievement of his life's work in ornithology; but it is gratifying to know that his sections in the final volume will be completed mainly from his own comprehensive notes. References to the various other standard works on British ornithology in which he collaborated and to his many notes and papers on British birds will be found in the longer notices in *British Birds* or the *Ibis*.

Jourdain was an unsparing critic of inaccuracy in matters of fact with regard to birds, or support of theories which he believed to be contrary to the evidence, and his frequently witty, but withering style in controversy made him enemies in some quarters. This fighting trait was very characteristic, but the reputation which it gained him gave many a quite wrong impression of his real character. This was much more truly displayed in his unflinching willingness to assist and advise every serious student of birds who asked for his help, and above all in his constant and generous encouragement of the younger

generation of ornithologists, which found full scope in the years following the War of 1914-18, when he was rector of Appleton, near Oxford. The prominent part played by Oxford in recent years in the organized study of the bionomics of birds, now centred in the Edward Grey Institute of Field Ornithology, may be traced directly to his influence, and this is not the least of his contributions to the scientific study of birds to which he devoted his life.

B. W. TUCKER.

Mr. E. E. M. Joyce

ERNEST E. MILLS JOYCE, who died on May 2 at the age of sixty-five, was one of the remarkable group of naval ratings chosen by Captain Scott for the National Antarctic Expedition of 1901, and his name will live with those of Frank Wild and Edgar Evans among the sailor explorers of his time.

On the *Discovery* expedition Joyce developed qualities of independence and self-reliance which led Sir Ernest Shackleton to persuade him to leave the Navy, where he was a chief petty officer, and to join the *Nimrod* expedition of 1907. To him Shackleton confided the responsible task of laying out the depot at the Bluff in a fixed position, with provisions for the last lap of the homeward journey. This was done after Shackleton's departure on his great southern journey, and the success of the return journey was due to the perfect performance of this duty. During the winter of waiting at the base Joyce became skilled as a printer and he produced "Aurora Australis", the only book ever printed and bound in the Antarctic regions. This book is now one of the rarest finds for any collector.

Joyce was employed by Sir Douglas Mawson when equipping the *Aurora* expedition in 1912 to select Greenland dogs in Denmark and convey them to Tasmania. He remained in Australia until 1914, when Shackleton called on him to undertake the transport arrangements of the Ross Sea branch of that Imperial Trans-Antarctic Expedition which he had planned in a too optimistic spirit. The *Aurora*, under the command of Captain Aeneas Mackintosh, took the party to Macmurdo Sound, in order to lay out a line of depots as far as the Beardmore Glacier with supplies for Shackleton and his party, who were expected to cross the Antarctic plateau from the Weddell Sea by way of the South Pole. The captain, who was in charge, and other members of the sledge party were overcome by scurvy on the way to the Beardmore Glacier, and Joyce assumed command. The sick men had to be carried on the sledges during the return and one died; but Joyce, under tremendous difficulties, laid out the depots exactly as planned, and if Shackleton had been able to land in the Weddell Sea he would have found his last stage easy. Joyce's enormous strength and ruthless determination enabled him to achieve this feat and to bring all but one of his party safely to the advanced base. He has given a grim but vivid description of this terrible journey in his "South Polar Trial", published in 1929.

HUGH ROBERT MILL.

Prof. Edoardo Maragliano

PROF. EDOARDO MARAGLIANO, the famous Italian physician, whose death recently occurred in his ninety-first year, was born at Genoa on June 1, 1849. He received his medical education at Naples, where his principal teachers were Salvatore Tommasi and Arnaldo Cantani, and qualified in 1870 with a thesis "of exceptional merit" on some diseases of the nerve centres. He started his career by being assistant to Prof. Enrico de Renzi at Naples for a few years, and then became lecturer in general pathology at Genoa from 1877 to 1881. He was then elected professor of clinical medicine at Genoa, and held this post for forty-three years.

Maragliano succeeded in making his clinic at Genoa one of the most celebrated in Italy, and it was attended by practitioners from all parts of the country and abroad. Though he always subordinated laboratory examinations to clinical observation, he established a number of laboratories in connexion with his clinic to deal with the various problems connected with clinical medicine. His excellence as a teacher is shown by the fact that eight of his pupils afterwards obtained professorial chairs in various Italian universities.

Maragliano's writings ranged over all fields of internal medicine, including pneumococcal infections, cholera, and disorders of the blood and heart, but the disease in which he was most interested was pulmonary tuberculosis, and particularly prevention of the disease by a vaccine containing dead bacilli. Although the value of this method has not been proved, he did good work in conducting an active campaign against tuberculosis in Italy and he was largely responsible for a decline in its prevalence.

For seven years Maragliano was president of the Medical Faculty of Genoa and for more than ten years rector. In 1900 he was elected senator of Italy. His other activities consisted in the foundation of the Genoa Academy and an Italian Society of Internal Medicine in conjunction with Cantani and Bacelli, as well as of a post-graduate school for tuberculosis at Genoa which was attended by numerous practitioners from all parts of Italy. He was also founder of *Archivio Italiano di Clinica Medica* (1893), *Annali dell' Istituto Maragliano per lo Studio e la Cura della Tuberculosis* (1904) and *Archivi di Biologia* (1924). During the War of 1914-18, in which he was given the rank of major-general, he was appointed director of the military clinic at Padua.

J. D. ROLLESTON.

Mr. W. S. Furneaux

MANY a school-boy of forty years ago and many younger school-boys and former pupils will be sorry to hear of the death of W. S. Furneaux. He had the knack of writing just the sort of succinct and well-illustrated practical book which stimulated the young collector to hunt for spoils and afterwards to pore over the naming of them; and his publishers aided and abetted with that profusion of coloured plates

which added attractiveness to utility. "The Outdoor World" (1893), one of the best of the series, was followed by accounts of "Life in Ponds and Streams" (1896), "The Sea Shore" (1903), and "Field and Woodland Plants" (1909), and these and his other works, such as "British Butterflies and Moths" (1894), must have opened up new worlds for young naturalists of two generations. It says something for their quality that they are still amongst the best of British books for their purpose.

Furneaux was born at Devonport in 1855, and was educated at Cheltenham College. Eventually he came to London, where he taught science successfully and with appreciation for many years, first as lecturer at the Pupil Teachers' Training Centre and principal of the Science and Art Evening Institute at Peckham, and later as lecturer in the Teachers' Day Training College at Islington. He retired in 1913 and settled in Felbridge, Sussex, and there his own love of Nature was exercised in the skilful and enthusiastic way in which during the course of years he transformed a bare meadow into a secluded woodland retreat.

He died on April 9, 1940, in his eighty-fifth year.

J. RITCHIE.

Dr. W. E. Sumpner

THE death took place on May 8 of Dr. W. E. Sumpner, principal of the Birmingham Technical College during 1895-1930, in his seventy-sixth year.

He was appointed when the College (or School as it was originally called) was only four years old, and it was owing to his work and vision that it became such an important institution in this great industrial centre.

Sumpner was primarily a physicist and electrical engineer, and he was well known in scientific circles. In his early days he was connected with the City Guilds of London. In 1885 he took first-class honours in both mathematics and physics, and four years later he took the London D.Sc. He was then appointed fellow of University College, London, and fellow of the City and Guilds Institute. He was also fellow of the Physical Society, serving as vice-president for a time. For some of us in Birmingham perhaps he was best known and regarded as the genial president of a small scientific symposium known as the R^3 , founded originally by the late Prof. Poynting, of the University of Birmingham, for those teaching science in the city. He married in 1901 Miss Lucy Weekes, who survives him with a son and a daughter.

J. H. REYNOLDS.

WE regret to announce the following deaths:

Prof. W. Blackadder, Jackson professor of engineering in the University of Aberdeen, on May 14, aged sixty-one.

Mr. E. R. Gunther, zoologist to the "Discovery" Committee, aged thirty-seven.

Prof. J. H. Muirhead, F.B.A., emeritus professor of philosophy in the University of Birmingham, on May 24, aged eighty-five.

NEWS AND VIEWS

Scientific Advisory Committee on the Nation's Food

THE Lord Privy Seal, as chairman of the Food Policy Committee of the War Cabinet, has appointed a committee "to consider and advise upon problems of national food requirements and of home food production with special regard to the shipping and foreign exchange likely to be available for imports of food and animal feeding-stuffs, and the labour and other resources likely to be available for home production".

The committee has been constituted as follows:

Chairman, Sir William Bragg, president of the Royal Society and director of the Royal Institution; *Deputy Chairman*, Sir Alan Anderson; *Members*, Prof. A. W. Ashby, professor of agricultural economics, University College of Wales, Aberystwyth; Prof. E. P. Cathcart, F.R.S., regius professor of physiology, University of Glasgow; Dr. Henry Clay, formerly professor of social economics, University of Manchester; Prof. F. L. Engledow, F.R.S., professor of agriculture, University of Cambridge; Mr. W. Gavin, agricultural adviser to the Ministry of Agriculture and Fisheries; Sir Edward Mellanby, F.R.S., secretary of the Medical Research Council; Sir John Boyd Orr, F.R.S., director of the Rowett Research Institute, Aberdeen; Prof. J. A. Scott-Watson, professor of rural economy, University of Oxford; *Secretary*, Prof. D. M. S. Watson, F.R.S., Jodrell professor of zoology and comparative anatomy, University College, London, and member of the Agricultural Research Council.

Chair of Physics at Sheffield: Dr. W. Sucksmith, F.R.S.

DR. W. SUCKSMITH, reader in magnetism in the University of Bristol, has been appointed to the chair of physics in the University of Sheffield. Dr. Sucksmith was educated at Hipperholme Grammar School and the University of Leeds where, after four years of service with the Army in the War of 1914-18, he graduated with first class honours in physics in 1921. He then joined the staff of the University of Bristol as assistant lecturer in physics, and was appointed lecturer in 1924 and reader in magnetism in 1939. He was awarded the D.Sc. degree of the University of Leeds in 1930, and has

been elected a fellow of the Royal Society this year. Dr. Sucksmith is particularly distinguished for his work in experimental magnetism. Following a determination of the gyromagnetic ratio for ferromagnetic substances by the direct measurement of the mechanical rotation which accompanies magnetization, carried out by Chattock and Bates at Bristol, he confirmed their results with a null method. He later extended his measurements to deal with paramagnetic substances.

This required experimental skill of a very high order, as the measurements were very much more difficult than those with ferromagnetic substances. In the course of this work it was necessary to measure the susceptibilities of paramagnetic oxides, and to this we owe the design of the Sucksmith ring balance, which has proved useful in many researches.

During the session 1933-34 Dr. Sucksmith held a Rockefeller fellowship at the Federal Technical College in Zurich, where he measured the gyromagnetic ratio for a series of nickel-copper alloys with low Curie points at temperatures above the latter, using the technique previously employed with paramagnetic oxides. Dr.

Sucksmith has also made substantial contributions to our knowledge of the specific heats of ferromagnetic substances and of the magnetic properties of single crystals of nickel. More recently he has been engaged on experiments on the magnetic properties of ferromagnetic substances at high temperatures and on the saturation intensities of magnetization of a large number of ferromagnetic alloys, in which his ring balance has again been put to good use. Since 1937 he has been a member of the Permanent Magnet Subcommittee of the Electrical Research Association.

Prof. S. R. Milner, F.R.S.

WITH the retirement in September of Prof. S. R. Milner, F.R.S., from the chair of physics, the University of Sheffield will lose the services of an eminent man of science and of an outstanding personality, who, during the past forty years, has been untiring in his efforts alike for the advancement of science, for his students, and for the University. A Yorkshireman by birth, Milner spent his early years in Retford, where he attended the King Edward VI

FOR purposes of economy, the sections "Seventy Years Ago" and "Points from Letters" will be suspended after the termination of the present volume of NATURE, that is, June 29.

The Editors are particularly anxious to maintain the amount of space devoted to the more important sections of the journal. This applies especially to the correspondence columns; and, here, contributors are again asked to collaborate by reducing their communications to the absolute minimum. Letters should not exceed five hundred words in length, which corresponds to a column of text.

Monthly supplements of Short Reviews will also be suspended.

School. He then became a science student at University College, Bristol, and graduated from there in 1895. He spent two post-graduate years as an 1851 Royal Exhibition Scholar working under the late Prof. A. P. Chattock, for whom he has always retained warm feelings of admiration and affection, and a third year under Prof. Nernst at the Institut für physikalische Chemie in the University of Göttingen. During 1898–1900 he was a demonstrator in physics at the University of Manchester, and he recalls with pride that Sir Arthur Eddington was one of his students there. Milner left Manchester to take up a lectureship in physics at Firth College, later the University of Sheffield, under Prof. W. M. Hicks, who was successively principal of the College and the first vice-chancellor of the University, so that much of the work and organization of the department fell to Milner's lot. During the War of 1914–18 he served as assistant radiographer to the Third Northern General Hospital until 1917, when he was appointed acting professor of physics, on Prof. Hicks vacating the chair. Since 1921 he has been professor of physics, and in 1922 he was elected to the fellowship of the Royal Society.

In his research activities, Prof. Milner has shown himself to be a physicist in the widest sense, his researches having ranged over many fields, only some of which can be mentioned here. His earliest work was on the thermal conductivity of water (with Prof. Chattock). Later work was concerned with interference phenomena, with the non-reversible character of the formation of soap films, with the electric discharge in mercury vapour (in which connexion he discovered the principal series of mercury), and with the mechanism of the spark discharge, involving the analysis of lines in a rotating mirror and the characteristics of the oscillatory spark. By his pioneer work on the theory of strong electrolytes he anticipated the work of Debye. His more recent work has been concerned with the properties of the electromagnetic field in four dimensions, especially the theory of tubes of force and action in their four-dimensional aspects, and with the properties of Eddington's wave matrices. An experimentalist of no mean order, Prof. Milner is also a self-made theoretical physicist, so that his approach to theoretical work is always characterized by the physical rather than the purely mathematical outlook. Primarily due to this fact he has the rare ability of presenting intelligibly abstruse advances in modern physical theory to a general scientific audience. Many of his old students now occupy prominent positions in the scientific world, and all who know him or his work will join in wishing him many years of happiness and good health in his retirement.

Dr. W. L. H. Duckworth

THE election of Dr. Wynfrid Laurence Henry Duckworth to be Master of Jesus College, Cambridge, which was announced on May 28, is a well-deserved recognition of a devotion to the service of his College and University which is well-nigh lifelong. Dr. Duckworth, who is reader in anatomy, went to the

University as a scholar of Jesus College, after receiving his earlier education in Birkenhead and at Dinan, Brittany. He graduated with first-class honours in both parts of the Natural Sciences Tripos in 1892–93, and during 1898–1920 was University lecturer in physical anthropology. His laboratory demonstrations and organization and arrangement of the museum specimens which came within his province contributed markedly to placing the Cambridge school in a unique position in anthropological studies; while so long ago as 1902, Dr. Duckworth's merit as an original thinker and teacher in anthropology were widely recognized on the publication of his two books "Morphology and Anthropology" and "Studies from the Anthropological Laboratory" (Cambridge). In the same year Dr. Duckworth was invited by a committee of the British Association to join the archaeological expedition then excavating in Crete, for the purpose of investigating the racial characters of the ancient and modern inhabitants of the island. The report which he eventually produced is still of standard authority on this question. Dr. Duckworth, who was born on June 5, 1870, represented his University on the General Medical Council during 1923–26.

Colonial Development and Allied Co-operation

CERTAIN matters of no little moment in relation to scientific research and its application to problems of colonial development were mentioned in the debate on the second reading of Mr. Malcolm MacDonald's Bill to which it was not possible to refer in NATURE of June 1 (see p. 853). Mr. MacDonald had stressed the facilities which the Bill would afford not only in erecting buildings for clinics, hospitals and schools, to which grants under the existing Colonial Development Act are confined, but also in assisting their maintenance after erection, as well as steadily increasing the opportunities for medical and veterinary research and of health measures of all kinds. The importance of the assistance in maintenance was more fully brought out by Sir Francis Fremantle, who stressed its importance in relation to education, which he urged should be directed towards the objects which appealed to the natives, namely, agriculture and health. His experience as a sanitary officer in Mesopotamia during the War of 1914–18 brought him into relation with various races whose intelligence—even of the most primitive of them—in malaria prevention after even a short course of instruction had astonished him. After referring to the results and needs of research on leprosy, he went on to point to the achievement on exiguous resources of small hospitals and clinics in Zuzuland. In research he urged that a great deal could be done in regard to the native population, especially in the matter of psychology.

An important aspect of the problems to which research in Africa, for example, will be directed was presented by Sir Jocelyn Lucas, who, in speaking of progress in the study of tropical diseases, stressed the importance in this, as well as in other respects, of co-operation with our French Allies. How far the War has fostered co-operation between French and

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THE ALLOYS OF IRON AND CHROMIUM

Volume II

High Chromium Alloys

By A. B. Kinzel

Chief Metallurgist, Union Carbide and Carbon Research Laboratories, Inc.

and Russell Franks

Union Carbide and Carbon Research Laboratories, Inc.

559 pages, 9 × 6, 133 illustrations, 40/- net

(Alloys of Iron Research Monograph Series)

THIS volume, complete in itself, is a review of published and unpublished data on steels and cast irons containing more than 10 per cent chromium. In addition to a review of available data on the constitutional diagrams of iron-chromium-nickel and other complex systems, there is a comprehensive discussion of the manufacture and properties, including corrosion resistance, of unmodified high-chromium steels containing low, medium, and high carbon; and also of those modified by large or small amounts of nickel, silicon, molybdenum, tungsten, titanium, columbium, aluminium, and other alloying elements. Five chapters are devoted to the manufacture and properties of the chromium-nickel austenitic and the chromium-manganese semi-austenitic steels.

Chapter Headings

Preface	Constitution of Complex Iron-Chromium Alloys
Acknowledgments	Manufacture and Fabrication of Austenitic Chromium-Nickel Steels
Introduction	Properties of Austenitic Chromium-Nickel Steels
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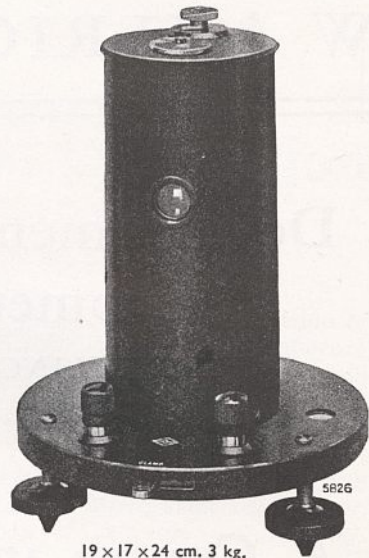
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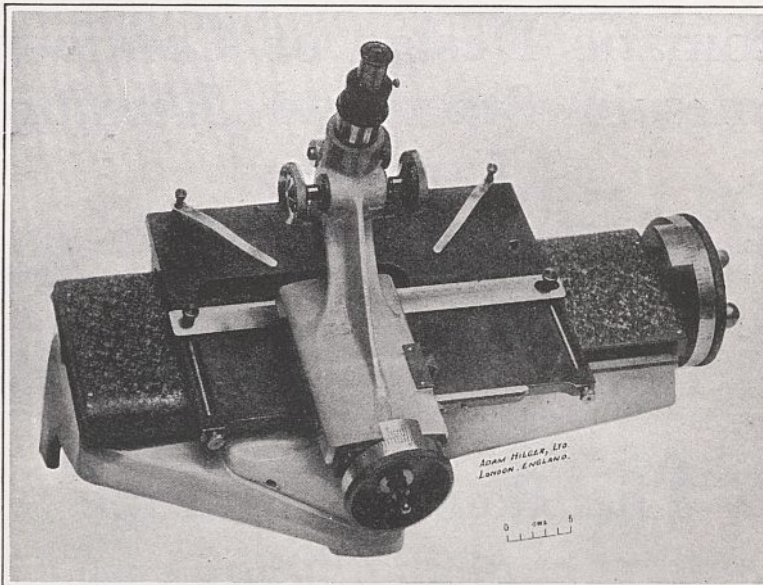


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British medical and scientific men is indicated by "Medicus M.P. in France" (*Lancet*, June 1, p. 1031), who speaks of the constant consultations taking place between medical officers of divisions of the two forces and the meetings of French and British consultants, including distinguished civilians, at G.H.Q., at which views are exchanged, leading with numerous other facilities to a far greater degree of co-operation than during 1914-18. This readiness to co-operate and unity of purpose, it may be anticipated with no little confidence, will inspire the co-operation in Colonial administration in the future upon which the two Governments have agreed. Now that the resources of the Belgian Congo and Mandated Territory, upon which the Belgian Government has lavished expenditure, have been placed at the disposal of Belgium's allies, a valuable opportunity has arisen for laying the foundations of future research and co-ordinated action.

Blood-Group Tests and Paternity

IN view of the application of blood-group tests in medico-legal problems involving disputed blood-relationship, it is interesting to note results of the test in a series of fifty cases which have been recorded by Dr. David Harley and Dr. G. Roche Lynch (*Lancet*, May 18, 1940). Most of the cases were affiliation cases; in these, as is well known, the blood test, while not establishing paternity, does eliminate false accusation by establishing non-paternity, the expected rate of establishment on the assumption that all men are falsely accused being approximately 32 per cent. In the present series, non-paternity was established in eight cases, or 16 per cent, a figure which suggests that about half the men were falsely accused, while half were in fact the fathers. The authors point out that while the percentage is not likely to be so high in the 5,000 affiliation cases heard in England and Wales in the course of a year, since in many of them paternity is not in dispute, but merely the amount of compensation, yet the fact that an appreciable number of men prefer to go to prison rather than pay suggests that the number of false accusations is by no means negligible. With improvement in the technique of identifying sub-groups, the utilization of these factors should add to the value of the test in such proceedings by raising the percentage of exclusions possible.

National Collections in London or in the Country?

A MATTER of very great importance to scientific workers in Great Britain and throughout the world is raised by Dr. Percy R. Lowe in an article discussing the threatened removal of the ornithological collections from the British Museum (Natural History) to Tring (*Museums J.*, 49; May 1940). It is there stated that "the Trustees of the Museum seriously contemplate transferring the national ornithological collections from South Kensington in London to Tring in Hertfordshire". That would indeed be a serious step, for no expert studies bird skins without using the books referring to the group upon which he is working. So that the ornithological library

would have to follow. But many bird papers appear in journals not specifically devoted to ornithology; would the series of these journals also have to go, or would the expert be left in the lurch? That seems to be a problem not easily solved; Dr. Lowe discusses others. But indeed the proposal bristles with so many difficulties that it may be taken for granted that the Trustees will seek advice from scientific workers who are accustomed to study ornithological or other systematic collections, and will make no decision even for the future without the fullest inquiry and consultation.

The British Pharmacopœia: Emergency Monographs

THE need for an addendum to the "British Pharmacopœia" which is now ready for official publication was dictated by war-time circumstances which deprived Great Britain of unfettered access to supplies of cod liver oil and olive oil and made it desirable to sanction the use of substitutes for both. The outstanding new monograph in the Addendum is on *oleum vitaminatum*, a vitaminized oil which is a solution of vitamins A and D containing 1,000 units of vitamin A activity and 100 units of antirachitic activity (vitamin D) in 1 gm. It is clear that the object of the Pharmacopœia Commission was to provide a standard for a substitute for cod liver oil which, in respect of its vitamin contents, should approximate to the natural product. The vehicle for the vitamins may be "a suitable vegetable oil" the choice of which is left to the manufacturer, with the suggestion that arachis oil would answer the purpose at least as well as any other. Provided the preparation responds to the characters and tests for purity laid down in the monograph, vitaminized oil may consist, alternatively, of a suitable fish-liver oil, or blend of fish-liver oils, thus allowing to commercial firms a generous latitude which is justifiable, and indeed advisable, in a time of emergency. Of the nine other new monographs in the Addendum, seven are related to the cod liver oil problem; they include standards for concentrated solutions of vitamins and for emulsions of cod liver oil itself and its substitute.

The only new monograph which is unrelated to cod liver oil is that on tetanus toxoid, which is officially described as "tetanus toxin, the sterile filtrate of a culture on a suitable medium of *Clustringium tetani*, or material derived therefrom, the specific toxicity of which has been completely removed by the action of chemical substances in such a manner that it retains efficient properties as an immunising antigen". Tetanus toxoid may occur as a simple solution of tetanus toxin or as alum-precipitated tetanus toxoid. The Addendum amends five monographs of the Pharmacopœia. The object of the alterations in some cases, namely, liniment of camphor and compound ointment of mercury, is to authorize the use of arachis oil, cottonseed oil or sesame oil in place of olive oil in making these preparations. In the case of capsicum ointment, the use is sanctioned of a simple ointment prepared with yellow soft paraffin in place of the present base which contains lard. A new formula is presented as a

standard for tannic acid ointment. Five appendixes to the Addendum revise existing directions for as many processes; they relate to the determination of (1) ultra-violet absorption, (2) iodine value, (3) unsaponifiable matter in fixed oils and fats, (4) aldehydes or volatile oils, and (5) the assay of vitamin A.

Biological Films

THE Gaumont British Instructional Films Bureau has recently added some interesting biological films to its already extensive collection. "Climbing Plants" portrays clearly the many different devices for climbing adopted by plants in their struggle for existence, including 'scramblers', thorn, petiole and aerial root climbers, as well as types that climb by means of tendrils and stems. The photographs of circumnutation in the bean seedling are as excellent as the rest of the film. In "The Swan", the photographer has captured some entertaining 'shots' of the famous swannery at Abbotsbury, near Weymouth. Courtship and breeding are carefully presented, as well as pleasant recordings of cygnet development. "The Life-Story of a Fern" includes photographs of royal, hart's-tongue, male and bracken ferns, indicating methods of spore production and liberation. In this film some informative pictures of fertilization processes in the ferns are particularly noteworthy.

"The Emperor Moth" describes the complete life-cycle of the insect from the egg to the emergence from the pupal case. The value of this film, as of many other insect films, is that the activities and development of the insect over a period of weeks may be seen as a coherent picture within a few minutes. In "Marshland Birds" various island builders like the dabchick, great crested grebe, the coot, swan and moorhen are seen in various stages of their life-history, as also are shore-builders such as the snipe, wild duck, bittern, yellow wagtail, bearded tit, reed warbler and heron. Photographs of predators like the short-eared owl and the harrier are included in order to introduce an ecological concept. In this film the photographer has secured many pictures which must be ranked well outside the usual. The appearance of these five films bears witness to the continued technical progress that is being made in the production of biological films.

Observation of Chimpanzees

AN experimental laboratory for the observation of behavioural development and adjustment, growth and maturation of chimpanzees has recently been established at the Yale Laboratories of Primate Biology, Orange Park, Florida. Infants are to be separated from their mothers at birth and reared under controlled conditions as subjects of a special research by Dr. Henry W. Nissen, assistant director. Up to March 1940, Prof. R. M. Yerkes records (*Science*, 91; April 5, 1940), 34 infants have been born in the colony, which contains 27 individuals of known birth-date and recorded life-history out of a total population of 47, ranging in age from four days to twenty-seven years. Several of these chimpanzees have resided in

the colony for 8-14 years. Though the normal life of this great ape in captivity has not been determined, it is indicated that the reproductive life may exceed thirty years, while probably in favourable conditions the individual may live for fifty years. The average interval between generations in the breeding colony is almost exactly nine years.

With regard to the special problems of behaviour, it may be noted that of two primiparous mothers, neither accepted nor cared for their infants at birth. Each behaved as if surprised and bewildered, while lacking suitable, ready-to-hand patterns of behaviour for the novel emergency. Nor did either consume the afterbirth. By contrast, multiparous mothers usually eat at least part of the afterbirth and almost invariably treat the new-born infant as a familiar object, handling it skilfully and ensuring its welfare. The structurally determined maternal behaviour of the primiparous chimpanzee is importantly supplemented by acquisitions resulting from individual reproductive experience and also by social tradition.

Control of Weeds and Grassland Experimentation

THE Imperial Bureau of Pastures and Forage Crops, Aberystwyth, has recently published three new bulletins. No. 27, "The Control of Weeds" (7s. 6d.), is a symposium dealing with the various aspects of the problem as it occurs in different parts of the world, particularly in the British Commonwealth and the United States. Increasing attention is being paid to this question; extensive research work on cultural, chemical and biological means of control is in progress, and important results are already available. The practices characteristic of each country make interesting comparison. The outlook regarding chemical measures of control, for example, is very different in the United States and Germany, stress being laid on the value of cultural methods in the latter case. In Australia and New Zealand biological means have been used, with spectacular success in the eradication of prickly pear in Australia. Poisonous weeds are the subject of an article from South Africa, while Canada's contribution is chiefly ecological.

Bulletin No. 28 (2s. 6d.) describes the "Technique of Grassland Experimentation in Scandinavia and Finland". This includes both the technique for the quantitative measurement of grass production and that of stock-grazing trials. The methods of grassland analysis are chiefly contributed from Denmark and Sweden, while the grazing experiments described were carried out in Norway and Finland. Bulletin No. 29 (5s.) is entitled "Grassland Investigations in Australia". This publication may be regarded as a continuation of Bulletin No. 14 issued in 1934, which dealt with a similar subject. The enormous variation in climate naturally raises very diverse problems in the different parts of the country, but in general the pasture investigations cover two main features, natural pasture maintenance and regeneration, and the treatment of sown pastures, together with the problems of the winter and summer rainfall zones.

Fifteen special articles are included in this bulletin, as well as brief abstracts of recent publications on grassland in Australia.

Power Development in Turkey

ENERGETIC steps are now being taken by the Government to open up the market in the south-east corner of Europe to British industry. According to the *Electrical Times* of May 2, one of the first results of this active trade policy was shown by the recent announcement of the signing of a contract between the Turkish Government institution known as the Eti-Bank and the Metropolitan-Vickers Electrical Co., Ltd., which has a value of approximately one and a half million pounds. A few details of the contract are available. It covers the electrification of a large and important area, including the construction of a power station at Catalagzi on the Anatolian coast of the Black Sea. One of the main objects of the scheme is the provision of electric power for the modernization and expansion of the Turkish coal industry, and the site of the power station has been chosen for its proximity to the Zonguldak coal basin, from which the station fuel will be derived. The present contract includes the building and equipment of a 60,000 kw. steam power station, and the provision of switchgear, overhead lines and three substations for a transmission system about 16 km. in length. Provision is to be made for the extension of the scheme at some future date.

The initial generating plant will consist of three 20,000 kw. turbo-alternator sets, to operate at 3,000 r.p.m., with Metrovick central flow condensers and four-stage feed-heating, incorporating low-pressure evaporators for make-up supply. Sea-water will be used for cooling and will be supplied from a separate pump-house to be constructed on the shore. The main alternators will generate at 11,000 volts; and each set will include a 1,500 kw. house-service alternator. A 375 kw. Diesel engine set will also be provided for stand-by service to the station auxiliaries. Transmission to the substation will be at 66,000 volts, the station output being stepped up to this voltage in an outdoor transformer and switching station adjoining the power station and controlled from an indoor controlled board. The main transformers will be 25,000 kva., 11/16 kv., 3-phase units. The equipments of the substations will include nine 6,400 kva., 66/15 kv. outdoor transformers and 15 kv. indoor switchgear.

Alluvial Gold Dredging in the Gold Coast Colony

AN interesting account is given in the *G.E.C. Journal* of February of the electrical equipment for the Bremang Gold Dredging Co., Ltd. This company dredges for alluvial gold on the Ankobra River, one of the larger rivers of the Gold Coast Colony, which flows roughly north and south and pours itself into the Gulf of Guinea. Many of the shallows of the river are sufficiently rich in alluvial gold deposits to warrant commercial development, and the Bremang Gold Dredging Co., Ltd., has installed equipment at two of these points for dredging mud and gravel

from the river bed from which the gold is recovered. The dredges are electrically operated and are supplied from individual substations fed by a 55 kv. overhead transmission line from the power station of Ankobra Junction, a distance of about twenty miles.

The power station and the various camps from which the dredging operations are conducted are situated some 6° north of the equator in what was originally bush country with a humid tropical climate, but very great improvements in living conditions have been made in recent years. The bungalows provided for the accommodation of the European staff are of the most up-to-date type, with modern sanitary arrangements, electric light, fans, and running water supplied from specially constructed tanks. As regards diet, most of the vegetables are canned, but fresh potatoes are obtainable from Madeira, and green vegetables, such as lettuce and cabbage, can be grown locally provided the soil is adequately watered and sheltered from the sun. Cheese and butter are also available, and can now be kept in good condition almost indefinitely as a result of the installation of domestic refrigerators in the bungalows. Wireless programmes are provided by a local company at Prestea, and a relay station has been instituted in each camp with loud speakers in the individual bungalows. The native labour employed is recruited from local villages.

New Type of Rubber Paving Block

IN *Roads and Road Construction* of May 1 it is stated that Marylebone Borough Highways Committee reports that Universal Rubber Paviments, Ltd., of Manchester, have offered to provide and lay, free of cost to the Council, approximately 300 square yards of a new type of rubber paving block. The Council has already approved of the renewal of the concrete foundation and wood paving in Duke Street (Wigmore Street to Edward's Mews) which is considered to be a suitable site for the rubber paving. Other alternatives have been considered, but as the paving is to be subjected to skidding and other tests by the Ministry of Transport, it is necessary for the whole width of the carriageway to be paved with rubber and the section of Duke Street in question is of the desired width and length for the tests. The acting borough engineer reports that the new type of block appears to be an improvement on those laid by the same Company in Allsop Place, by Clarence Gate, some six years ago. By accepting the offer, the Council will save approximately £400 on the provision of wood blocks for the section of the carriageway in question.

National Radium Trust and Radium Commission

THE tenth annual reports of the National Radium Trust and Radium Commission (1938-1939) follow the general form of previous reports, but constitute, owing to special difficulties in planning for future developments, a more tenuous publication than usual. One of the most important events external to the chief work of the Commission has been the passing of the Cancer Act on March 29, 1939; this naturally receives

a welcome from the Commission, and has been followed by an enlargement of the personnel of that body. As is generally known, the effect of the Act is to throw upon the major local authorities, county and county borough councils, the duty of securing proper facilities for cancer treatment on behalf of people in their areas; this will of necessity call for close collaboration with members of the Radium Commission whose knowledge and experience of radiological methods as practised in all the important centres in the country should secure a high level of efficiency in treatment and economy in practical methods.

Mortality in New York Hospitals

DURING 1938, the mortality-rate in the New York City hospitals for contagious diseases fell to 1.8 per cent, the lowest to date. This figure compares favourably with a 4-6 per cent mortality in general hospitals. There were 2,109 cases of whooping-cough admitted to hospitals in 1938, or more than for any year in the last two decades. Of all the cases of diphtheria notified to the Health Department in 1938, 43.7 per cent were admitted to hospital, while 31 per cent of the scarlet fever cases, 8 per cent of the measles cases and 16.1 per cent of the whooping-cough cases were sent to hospital.

Antiquities from the Eumorfopoulos Collections

ONE of the most interesting and important items in the sale of part of the Eumorfopoulos collections which took place at Messrs. Sotheby's rooms during May 28-31 was a third century B.C. toilet box. This was purchased by the National Arts Collection Fund for presentation to the British Museum (Bloomsbury). It is described as circular, with a diameter of 8½ inches and a height of 5½ inches. It is decorated in greenish-red lacquer on a thin layer of fabric. The straight sides and domed top are ornamented with scrolls, birds and stylized animals, while on the sides of the cover are represented a horseman, a tiger and a charging bull on a chocolate brown ground enriched with silver inlay. With the box was a bronze mirror of the Warring States period (c. 481-221 B.C.) which had been found inside it. Among other antiquities of special interest was an example of the remarkable and rare bronze-covered wine vessels of the little-known Shang Dynasty (? 1766-? 1122 B.C.), this specimen having a silvery-green and red-brown patina, a Kmer female torso in grey limestone of the eleventh century of our era, a period of perhaps the greatest efflorescence of the Kmer art of south-eastern Asia, and the magnificent gold furnishings of a fifteenth century Ming emperor's tomb.

Recent Earthquakes

DURING May 18-19, fifty people were killed and many injured at Mexicali near the border of the United States, where houses and Government buildings were damaged. Fifteen earthquakes were felt. In Africa strong shocks were felt on the night of May 19 on the Zululand coast, in Natal, in the

Transvaal and in the Limpopo area. The epicentre may have been off the Zululand coast. Local tremors were felt in the Rand. About 23.55 G.M.T. on May 18 local tremors were felt at Deganwy, North Wales, by Mr. Willoughby Gardner, who reported the matter to *The Times*. These may have been due to movement along the Conway fault system.

Over the same week-end strong shocks were recorded on Mr. J. J. Shaw's seismographs at West Bromwich, and Father Rowland states that the seismograph at Stonyhurst College Observatory recorded a strong shock lasting about three hours, commencing on May 19 about 4.40 G.M.T. At Kew the seismographs commenced recording on May 19 at 4h. 48m. 53s. G.M.T. and finished at 7h. 45m., with a maximum ground amplitude at Kew of 0.029 mm. A second shock was registered at Kew at 15h. 29m. approximately on the same day, though this was only small.

Announcements

It is announced that the British Association has reluctantly decided to cancel the Conference on Science in National and International Aspects which was to have been held at Reading during July 25-27.

MR. T. L. ASQUITH, chemist, Royal Ordnance Factory, has been appointed an additional member of the Civil Division of the Order of the British Empire, for services in connexion with an explosion at the Royal Ordnance Factory on April 2.

THE following officers for 1940-41 of the Royal Aeronautical Society have recently been elected: *President*, Dr. A. H. R. Fedden; *Vice-Presidents*, Mr. Griffith Brewer and Air Vice-Marshal R. M. Hill; *Honorary Treasurer*, Major D. H. Kennedy; *Honorary Librarian*, Mr. J. E. Hodgson; *Secretary and Editor*, Captain J. Laurence Pritchard.

MR. DONALD C. BRADFORD has been appointed seismologist at the University of Pittsburgh. The seismological station is in the basement of the "Cathedral of Learning", a skyscraper close to the main traffic arteries of the city. It has been found that the two Wenner horizontal seismometers and the Benioff vertical seismograph function quite satisfactorily, contrary to expectations before 1931 when the site was tested and recording began.

THE sixth University in the Argentine Republic has recently been founded at Mendoza.

MORE than 9,000 natives died from malaria in the Transvaal during the year ended March 31, 1939. According to the Department of Public Health the heavy rains at the end of 1938 and the beginning of 1939 made conditions favourable for malarial mosquitoes. The chief difference between this epidemic and that of 1937 was not one of severity but of extent, the 1939 epidemic reaching over a greater area and going so far south as Pretoria.

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. 901.

Excited States of Stable Nuclei

WE have recently carried out some experiments on the scattering of protons by light elements, using the proton beam provided by the Liverpool cyclotron and detecting the scattered particles by the photographic method.

A proton beam of about 10^{-8} amperes, with a divergence of one degree, is defined by a system of stops, and emerges from an attachment to the vacuum tank of the cyclotron into the 'camera' through a mica window covering a hole $\frac{1}{8}$ in. in diameter. In the camera this narrow proton beam passes down the axis of a tube, which is interrupted for a length of 3 mm. to allow the scattered particles to emerge. A flat photographic plate is placed so that its surface is parallel to the axis of the beam and at a distance of 1 cm. from it. The protons scattered by the gas with which the camera is filled emerge through the interruption and enter the plate at a small glancing angle. This arrangement has the advantage that a single plate can contain the information for determining the probability of scattering from about 15° to 150° , providing for each angle regions containing a suitable number of tracks for counting purposes. At the same time, the energy of the scattered particle can be determined from the length of its track in the photographic emulsion.

Once the difficulties of defining the beam in the stray field of the magnet had been overcome, we found that suitable exposures could be obtained for some six to eight different scattering gases per day.

We have taken plates of the scattering from eleven elements which could be obtained either as elementary gases or in the form of suitable gaseous compounds. The energy of the incident particles at the point of scattering was about 4 million volts. The plates for hydrogen, deuterium and helium are satisfactory, and work is proceeding on these; but we wish to direct attention here to the inelastic scattering which accompanies the elastic scattering from the heavier elements, and gives information about the excited states of the stable nuclei in a particularly direct way.

The distributions in energy of the protons scattered through 90° from the gases oxygen and neon are shown in Fig. 1. In oxygen a single peak appears, corresponding in energy to protons elastically scattered through 90° . With neon, in addition to the elastically scattered group, there is a peak at lower energy which we attribute to inelastic scattering from ^{20}Ne . This view is supported by the fact, deduced from the analysis of the neutron spectrum

of fluorine under deuteron bombardment, that ^{20}Ne has an excited state of 1.4 Mev., for the difference in energy of the two groups of scattered particles is just of this amount.

We have examined the variation of the probability of scattering with angle for elastic and inelastic scattering in neon, and the results are shown in Fig. 2. It will be seen that in the range from 40° to 80° the elastic scattering follows very closely that expected from pure Coulomb scattering. In contrast with this, the inelastically scattered particles are distributed spherically symmetrically about the centre of mass of the system, to within the present accuracy of the measurements. This suggests that the inelastically scattered protons have been 'evaporated'

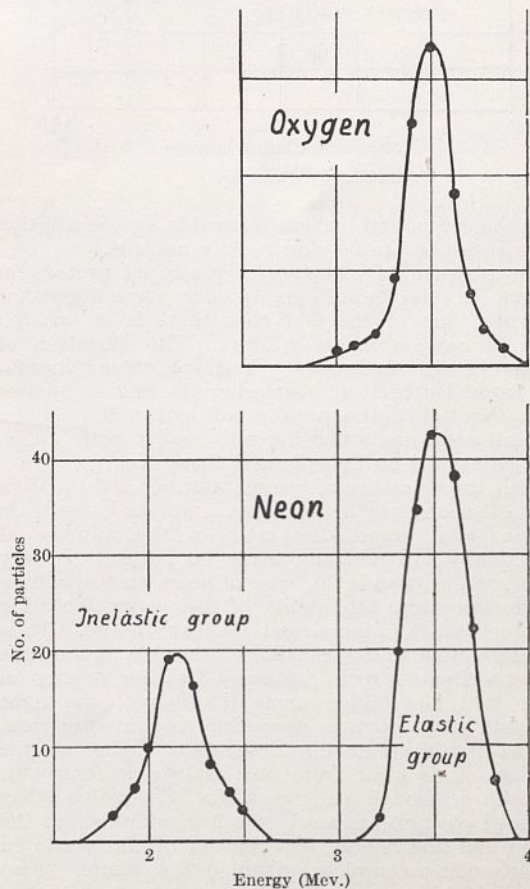


Fig. 1.

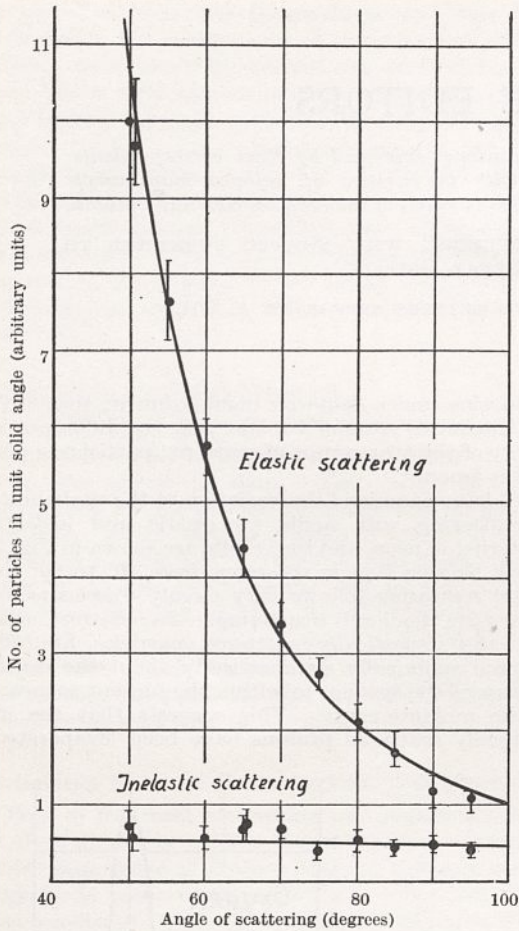


Fig. 2.

from the compound nucleus formed in a close collision of an incident proton and a ^{20}Ne nucleus.

The absence of inelastically scattered protons in oxygen in the conditions of our experiments is evidently due to the fact that there is no excited state of oxygen below 4 Mev. The variation of scattering with angle shows, however, strong anomalies from Rutherford scattering at angles greater than about 45° , the number of scattered particles per unit solid angle varying only slowly with angle. This point will be investigated further.

With the elements of atomic number greater than that of neon which we have examined, such as chlorine and argon, the ratio of the number of inelastically to elastically scattered particles is very much smaller than in the case of neon, corresponding to the decreasing probability of the protons entering the nucleus with increasing nuclear charge. It is therefore evident that it will be desirable to continue the experiments with protons of higher energy in order that the higher excited states of the light elements may become accessible to investigation, and to obtain results for elements of higher atomic number. It is clear from our experience, however, that the method is very powerful, the plates being obtained with an exposure of a few minutes and the analysis of the energy distribution of the scattered protons being complete within a few hours. Also the use of what are essentially gas targets gives the advantage of purity control and absence of effects

associated with energy loss in the target. We may expect these advantages in experiments of a similar character with high-energy deuterons, where the scattered primary particles may be accompanied by disintegration products.

In general, we may conclude that, using the photographic method of detection, it becomes possible to take advantage of the high-energy particles provided by the cyclotron to make experiments of the kind which have hitherto only been undertaken with direct current generators at relatively low energies.

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Photographic Plates as Detectors of Mesotron Showers

DURING the last two years we have been using photographic plates (Ilford R_2 and New Halftone) for the study of cosmic rays at different altitudes. Both treated and untreated plates have been used for the purpose. In the present communication is reported the results obtained by keeping for five months untreated New Halftone plates in cardboard containers, vertically on their long sides, at Darjeeling (Mayapuri Research Station, elevation 2,130 m.) and at Sandakphu (Dak Bungalow, elevation 3,660 m.).

In the plate kept at Sandakphu, on an area of 0.5 cm.^2 were observed 40 long single tracks, 15 double, 8 three-star, 12 four-star, 3 five-star, and one each of six- and seven-star tracks. Blau and Wambacher¹, whose technique we have followed, kept similar untreated plates at Hafelekar (2,300 m.) for five months. They obtained a large number of long single tracks and also a number of stars, but apparently no double tracks. On the assumption that the tracks are due to protons, they have calculated their kinetic energies. For this purpose they have used a calibration curve expressing the kinetic energies of the ionizing particles as a function of the mean grain distance along their tracks. The maximum energy for a star was found to be $103 \times 10^6 \text{ ev.}$, with a mean energy of $16 \times 10^6 \text{ ev.}$ per track.

In the absence of such a calibration curve, we have calculated the energies of the particles in our plate from their measured track lengths on the emulsion. We also made the tentative assumption that the tracks are due to protons, and their kinetic energies were found to be of the order of 10^6 ev. This represents a minimum estimate of their kinetic energies. In view of the recent discussions on the nature of the small-angle penetrating showers, attributed to mesotrons by Bothe and Schmeiser², our attention was first directed to the pair tracks found in the plate kept at Sandakphu. Of the fifteen pair tracks, thirteen had angles between 6° and 21° , and one had an angle of 24° and the other 35° . Their kinetic energies varied from 2 to 4 Mev. It appeared plausible to make the assumption that these tracks were due to mesotron pairs, and to apply to them the formula

given by Wentzel³, limiting the angular spread θ of such showers, where $\theta \lesssim \frac{\lambda}{a} \lesssim \frac{hc}{\epsilon a}$, in our case

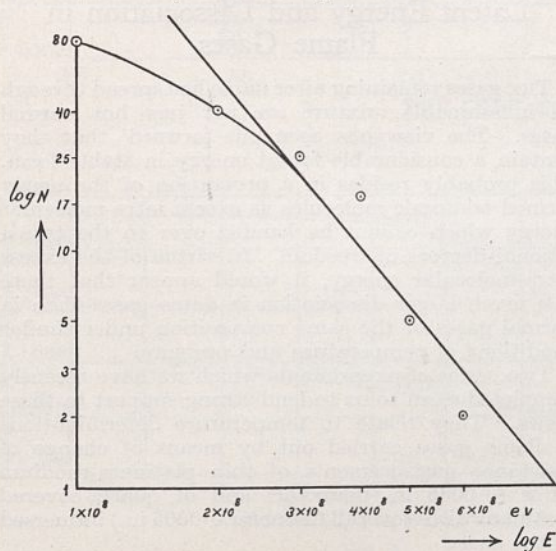
$\epsilon = z(x + \bar{\epsilon})$ where x is mass energy of a mesotron $\sim 10^8$ ev., $\bar{\epsilon}$ is average kinetic energy of mesotrons in these pairs, $\sim 2.9 \times 10^6$ ev.; and θ is mean angle of scattering, $\sim 8^\circ$.

In view of the relative order of magnitudes of x and $\bar{\epsilon}$, not much error is introduced in calculating $\bar{\epsilon}$ on the assumption that the tracks are due to protons and not mesotrons. For low velocities, the densities of ionization along the tracks of protons and mesotrons, for equal range in air, are of the order of 1.3 to 1.

We have calculated the value of a , the linear dimension of the scattering centres inside a nucleus on which mesotron packets, created by the impact of high-energy cosmic-ray particles on nuclear protons or neutrons, are scattered. The value of a is found to be 6.7×10^{-13} cm., which is comparable with the electron radius 2.8×10^{-13} cm.; it is of the right order of magnitude.

Next we proceed to the consideration of the origin of the star-like tracks. All of them contain tracks of the same nature, but in a few can be seen in addition one or two tracks due to heavier charged particles. For calculation we have assumed them all to be due to mesotrons. It is not clear whether the reasoning used by Wentzel can be applied to a multiple track shower. We have therefore made use of the hypothesis of multiple particle emission introduced by Heisenberg⁴, according to which during the impact of a high-energy cosmic-ray particle with a nuclear proton or neutron, a part of the virtual mesotron field of the latter is radiated away as a mesotron wave packet. The latter is confined initially to a very small volume, but due to interference between parts of the wave packet, a number of secondary mesotrons are produced. If ϵ is the energy made available during the impact, then on an average \bar{n} mesotrons will be produced where $\bar{n} = \epsilon/n \log \epsilon/x$, and the mean energy of a mesotron is $x \log \epsilon/x$, which is nearly a constant. To a first approximation our results appear to be in agreement with the above. Each star on our plate represents an energy transformation, $\epsilon = n(x + \epsilon^*)$, where $n = 1, 2, \dots, 7$, and $\epsilon^* \sim 10^6$ ev.

In the accompanying graph, we have plotted the curve $N = A\epsilon^\gamma$, where N represents the number of



stars with energies greater than ϵ . The value of γ , the tangent to the straight portion of the curve, comes out to be 2.5, which is of the accepted order, as others have found it to vary from 1.8 to 2.5.

It therefore appears probable that the tracks found in the Ilford Half-tone plates are mostly due to secondary mesotrons. We have computed the total energies of these mesotron tracks per unit area of the plates kept at Sandakphu and at Darjeeling; their ratio is found to be 2.3, which is near the value of 2.0 obtained for the ratio of the ionization at these two altitudes from the curve given in Swann and Danforth's paper⁵.

The soft component of the cosmic radiation may be considered to be responsible for their origin. The pair tracks give no indication of being due to any fast primary ionizing particles, and are probably of photonic origin. Their kinetic energies are of the order of $10^6 - 10^7$ ev., and they are of the same nature as the slow mesotrons postulated as accompanying fast mesotrons by Maier Leibnitz⁶. That a portion of these slow mesotrons can be of photonic origin is admitted by the latter. Further evidence about the existence of these slow mesotrons will be found in Bothe's paper. A detailed account will be published in the *Transactions of the Bose Institute*.

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April 6.

¹ Blau and Wambacher, *Wien Akad.*, Abt. II A, **146**, 469, 623 (1937).

² Bothe, *Rev. Mod. Phys.*, **11**, 282 (1939).

³ Wentzel, *Phys. Rev.*, **54**, 869 (1938).

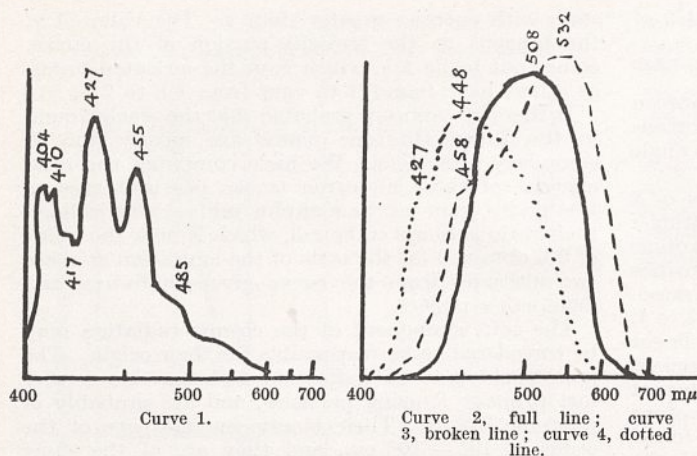
⁴ Heisenberg, *Z. Phys.*, **113**, 61 (1939).

⁵ Swann and Danforth, *J. Franklin Inst.*, **48** (1939).

⁶ Maier Leibnitz, *Z. Phys.*, **112**, 569 (1939).

Some Physico-Chemical Properties of 3 : 4-Benzopyrene

IN contrast with the characteristic fluorescence spectrum (Curve 1) which 3 : 4-benzopyrene always emits when it is dissolved in solvents, we have observed three different types of fluorescent spectra (Curves 2, 3, 4) when the hydrocarbon was excited in the solid state. The needles of a commercial benzopyrene (La Roche) emit a green fluorescent light and we call it therefore the 'green' form. Curve 2 exhibits a broad rather symmetrical band with its flat maximum between 500 and 510 $\mu\mu$. On pouring an acetone solution of the green form of benzopyrene into cold water there results the well-known colloidal suspension of benzopyrene which emits a yellowish fluorescence. The spectrogram of this 'yellow' form has its maximum between 530 $\mu\mu$ and 540 $\mu\mu$, and a typical inflection at the short wave-length side of the band (Curve 3). On heating the green form in an evacuated tube, a white sublimate is formed on the tube walls which fluoresces brightly blue. The spectrogram of this 'blue' form shows a maximum between 445 $\mu\mu$ and 450 $\mu\mu$, and an inflection on the short-wave-length side which appears as a contrast band at about 425 $\mu\mu$ (Curve 4). The sublimed crystals are small plates with typically curved edges. We believe that they are identical with the modification of benzopyrene which Iball² obtained from a solution in amyl acetate. According to his X-ray analysis, they are orthorhombic, while the needles (our green form) belong to the monoclinic system. Iball did not examine the fluorescence of either form.



PHOTOMETRIC CURVES OF THE SPECTROGRAMS ON PANCHROMATIC PLATES OF THE FLUORESCENCE OF 3 : 4, BENZPYRENE (1) DISSOLVED IN ACETONE AND (2-4) IN VARIOUS SOLID FORMS. THE GRAPHS WERE RECORDED WITH GOLDBERG'S¹ (1910) DENSOGRAF, WHICH SERVED AS A PRIMITIVE MICROPHOTOMETER.

The three modifications of benzpyrene undergo several spontaneous transformations. (1) The green form is transformed into the blue form at high temperatures. The lowest temperature at which we observed the disintegration of the clear original needles was 67°. (2) The blue form is changed into the green form at low and moderate temperatures. This change of the plates into the needles can be easily seen under the microscope if one moistens the crystals of the blue form with a drop of any solvent. We observed it still at 65°. (3) The yellow form goes over into the blue form on keeping the colloidal suspension for a few hours at 100°. It is also quickly transformed into the green form at ordinary temperature by moistening the dry residue from the evaporated colloidal suspension with a drop of amyl acetate.

It follows from (1) and (2) that the green and blue forms are enantiomorphous modifications of benzpyrene with a triple point at about 66°. According to the thermodynamics of heterogeneous systems, the work done during the spontaneous transformation of one mole is :

$$W = RT \ln \frac{p_{bl}}{p_{gr}} = RT \ln \frac{s_{bl}}{s_{gr}},$$

where p_{bl} , p_{gr} , s_{bl} , s_{gr} are the vapour pressures and solubilities of the blue form and the green form, respectively. Because below 66° the green form is more stable than the blue form, the solubility of the blue form is greater than that of the green form, and *vice versa* above 66°. This is true for any solvent, and in particular we know now which form has at a given temperature the higher solubility in water, though the solubility of neither form has been directly determined.

From the transformation (3) it follows that the yellow form has the highest solubility of the three forms at all temperatures. This is consistent with the assumption that the yellow form is a microcrystalline form of the green form. The order of the solubilities below 66° is $s_y > s_{bl} > s_{gr}$, and above 66° $s_y > s_{gr} > s_{bl}$. In the same order the modifications may undergo spontaneous transformations with release of free energy.

We have also examined mixtures of colloidal suspensions of benzpyrene with cholesterol. With large amounts of benzpyrene the spectrum was the same as that of the yellow form (Curve 3). With decreasing amounts the composition of the mixed spectrum shifted from Curve 3 to Curve 4 and then to 1. The fluorescence colour of these mixtures was liable to a typical change which happened very slowly at room temperature but more quickly at elevated temperatures. The spectrum approaches more and more that of the blue form.

Because we know that the blue form represents below 66° an intermediate stage between the quite unstable yellow and the stable green form of benzpyrene, it follows from the experiments that this intermediate blue stage can be stabilized by the presence of cholesterol. The stabilization cannot be but temporary owing to the tendency of the blue form towards spontaneous transformation into the green form with release of free energy.

It is possible that these facts account for the biological activity of benzpyrene. It may be that, as with cholesterol, the lipoids of the cell coming into contact with benzpyrene stabilize its unstable form temporarily. The spontaneous transformation into the stable form may release energy for biological action. Experiments from this point of view are in progress with various carcinogenic compounds.

The research was supported by a grant from the British Empire Cancer Campaign for which we are very grateful. We are indebted to Prof. C. K. Ingold and Dr. C. F. Goodeve for the loan of a spectrograph.

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¹ Goldberg, E., *Z. Reprod. Techn.*, No. 4 (1910).

² Iball, J., *Z. Kryst.*, A, 94, 7 (1936).

Latent Energy and Dissociation in Flame Gases

THE gases remaining after flame has spread through an inflammable mixture are not just hot normal gases. The view has been put forward¹ that they contain a considerable latent energy in stable form. This probably resides in a proportion of the newly formed triatomic molecules as excess intra-molecular energy which cannot be handed over to the translational degrees of freedom. In virtue of the excess intra-molecular energy, it would appear that there is a much larger dissociation in flame gases than in normal gases of the same composition under similar conditions of temperature and pressure.

Two series of experiments which we have recently completed seem to us to lend strong support to these views. They relate to temperature determinations in flame gases carried out by means of change of resistance measurements of thin platinum-rhodium wires (0.0005 in. diameter) and of quartz-covered platinum wires (overall diameter 0.0005 in.) immersed in the gases.

The first series of experiments was made during the pre-pressure period in large closed-vessel explosions of mixtures of carbon monoxide and air of various mixture strengths. During this period, as is well known, a considerable volume of inflammation takes place at sensibly constant pressure. The results of these experiments are summarized in the curves in Fig. 1. It will be noticed that for very over-rich mixtures (50 per cent carbon monoxide and more) the two wires show the same temperatures, but for weaker mixtures the plain wire temperatures are much greater than the quartz-coated wire temperatures—nearly 400° C. greater for the combining proportions mixture. The shape of the quartz-coated wire temperature curve suggests abnormally large dissociation of the carbon dioxide in the products of combustion, which tends to be more and more suppressed as the concentration of carbon monoxide is increased. The high temperatures of the plain wires appear to result from the combination on their surface of the abnormally dissociated carbon dioxide.

In the second series, the temperature distribution was determined by means of the two types of wire along the radius of a sphere of 18 in. diameter after the completion of the explosion of a centrally ignited inflammable mixture consisting of 10 per cent carbon monoxide plus 7 per cent hydrogen and air. The curves in Fig. 2 summarize these measurements. It will be seen that the temperature gradient from the centre outwards as shown by the quartz-covered wire is not very large, but the point to which we wish to direct special attention is that whereas the difference between the plain and the quartz-covered wire temperatures is relatively small towards the end of the radius, it is very large (amounting to some 300° C.) near the centre. In order to explain

these results it appears to be necessary to assume that the abnormal dissociation is greatest in the gases first ignited and decreases in those ignited later. Experimental results previously reported suggest that the latent energy in the flame gases left behind the flame front decreases with distance of flame travel from the igniting sources^{1,2}, and, assuming that the amount of abnormal dissociation varies with the latent energy, the results now reported would appear to be in line.

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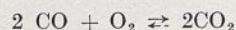
¹ David, *Phil. Mag.*, 23, 345 (1937).

² David, *Engineering*, 531 (Nov. 12, 1937).

Latent Energy and Dissociation in Explosions

THE suggestion has been put forward by Prof. David and Mr. Pugh¹ from the results of flame temperature experiments that the large latent energies found in flame gases, due probably to excess intramolecular energy in the triatomic molecules formed during combustion, facilitate the dissociation of the products, with the result that excessive dissociation is observed. The results of a number of closed-vessel explosion experiments confirm this view, and also indicate that the degree of such dissociation is, as would be expected, dependent on the amount of latent energy associated with the products of combustion.

It has been shown by David, Brown and El Din², and David and Leah³ that the latent energy in explosions is dependent on the size of the explosion vessel used and also upon the initial density of the inflammable mixture. Series of explosions of carbon monoxide and air mixtures recently carried out in re-designed apparatus at initial pressures of $\frac{1}{2}$, 1 and 3 atmospheres in two spherical vessels of 6 in. and 17.45 in. internal diameter may be used to determine the equilibrium constant for the reaction



by the method of Fenning and Tizard⁴. The average latent energy varies with the initial conditions and an interesting correlation can be made.

The results are shown in the table below. The initial pressures are given in the first column, the maximum temperature attained in the second column and $\log_{10} \frac{Kp \text{ obs.}}{Kp \text{ theor.}}$

$Kp \text{ obs.}$ being the calculated equilibrium constant and $Kp \text{ theor.}$ the theoretical quantum value, in the third column. In the last column the average latent energy found is given. Comparison of the figures given in the last two columns shows the

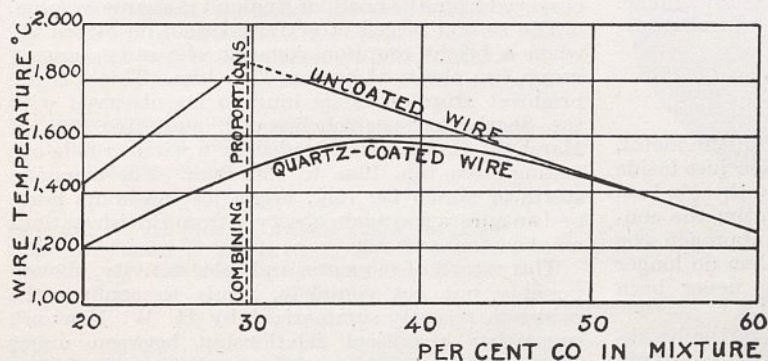


Fig. 1.

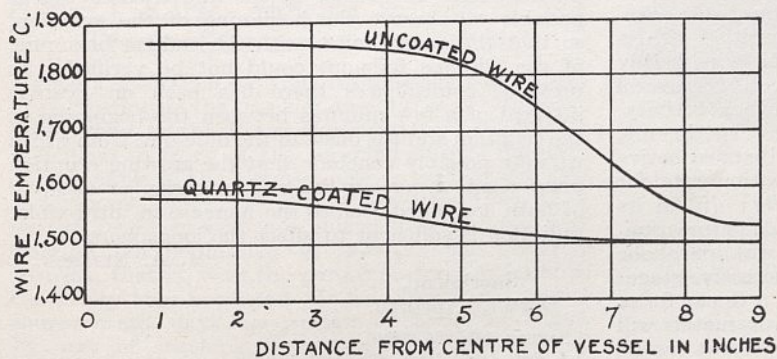


Fig. 2.

<i>P</i> Atmos.	<i>T</i> m° K.	log ₁₀ $\frac{Kp \text{ obs.}}{Kp \text{ theor.}}$	L. E. % heat of combustion
Large Explosion Vessel			
$\frac{1}{4}$	2590	0.47	5.0
1	2650	0.40	3.5
3	2750	0.32	2.5
Small Explosion Vessel			
$\frac{1}{4}$	2510	0.81	7.0
1	2585	0.67	6.0
3	2645	0.73	5.5

remarkable proportionality between $\log_{10} \frac{Kp \text{ obs.}}{Kp \text{ theor.}}$ and the latent energy, indicating the dependence of abnormal dissociation upon latent energy.

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¹ See preceding letter.

² *Phil. Mag.*, (7), 14, 764 (1932).

³ *Phil. Mag.*, (7), 22, 513 (1936).

Proc. Roy. Soc., A, 115, 318 (1927).

Diffusion in Palladium

THERE has been considerable discussion^{1,2,3} as to why the rate of diffusion of hydrogen through metals, instead of reaching a limiting constant value, continues to obey a \sqrt{p} -law even when the pressure p is several hundred atmospheres. Recently the view was advanced³ that although the pressure outside the metal may be high, owing to a slow rate of transport through the boundary

adsorbed layer \rightarrow metal

as compared with a rapid diffusion within the metal, there is always only a small concentration just inside the metal, which is built up according to the \sqrt{p} -law. If, however, it can be built up sufficiently, the concentration just inside the metal will approach the saturation value, and the \sqrt{p} -law can then no longer hold. This condition has previously never been realized.

Two circumstances would contribute to the breakdown of the \sqrt{p} -law: (a) a very high rate of supply of atoms to the metal surface; (b) a high rate of transport across the surface.

To achieve (a) caustic soda solutions were electrolysed (at considerable current density) with a palladium tube as cathode. (b) requires a freshly oxidized and reduced palladium surface⁴. Of several tubes, only one gave the desired surface activity, which decreased successively between experiments, and gave the following results: (i) in its most active state the palladium showed a permeation rate for hydrogen independent of current density; (ii) in its next most active state the curve between permeation-rate and \sqrt{I} (I is current density) was parabolic (convex to the \sqrt{I} axis); (iii) with successive stages of deactivation the curve approached a linear form.

These and other results on diffusion in metals will shortly be discussed more fully. The present results afford very satisfactory evidence of changes in the

relative velocities of phase boundary reactions and of diffusion with time, and of the theory of diffusion discussed earlier³.

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April 23.

¹ Smithells, C., "Gases and Metals" (Chapman and Hall, 1937), p. 105.

² Wang, J., *Proc. Camb. Phil. Soc.*, 32, 652 (1936).

³ Barrer, R., *Phil. Mag.*, 28, 353 (1939).

⁴ Lombard, Eichner and Albert, *Bull. Soc. Chim.*, 3, 2203 (1936).

Solar and Terrestrial Relationships of March 23-29, 1940

IT is of interest to compare Father Rowland's account¹ of the great magnetic storms in the last week of March with the record of disturbances in the solar chromosphere during the same period.

The first bright chromospheric eruption of great intensity was observed with the Greenwich spectrohelioscope in $H\alpha$ light on March 23 at 11h. 30m.² The area covered by this eruption included the group of sunspots which was at the time three days before central meridian passage. A simultaneous wireless fade-out on wave-lengths below 50 metres was reported by the Cable and Wireless Co., starting at 11h. 8m. and lasting for 1½ hours. It is significant that this fade-out only occurred in the channels of communication on the sunlit side of the earth. Communications through the opposite hemisphere were normal. The first of the magnetic storms followed approximately 26 hours later, beginning on March 24 at 13h. 45m., and a brilliant aurora was observed from the north of England the same evening.

The second period of activity began on March 27, when a bright eruption covering the same sunspot group was observed here at 17h. 10m. This was the brightest eruption of its kind so far observed with the Sherborne spectrohelioscope, and, like that of March 23, it was accompanied by a wireless fade-out lasting from 16h. 19m. to 18h. 30m. The magnetic storm of March 29, 16h., began just 48 hours later, and an aurora was again observed from British stations on the same evening.

This record of magnetic and solar activity, though possibly not yet complete, tends to confirm the evidence, recently summarized by H. W. Newton³, suggesting a critical relationship between major chromospheric eruptions and 'great' magnetic storms, with an average time lag of 1½ days between the two phenomena. In neither of the above cases was it possible to observe the beginning of the eruption, so that the synchronism with the sudden beginning of the wireless fade-out could not be verified. In previous coincidences there has been an average interval of a few minutes between the beginning of the eruption and the onset of the fade-out, from which we may possibly conclude that the growing eruption must reach a certain limit of intensity or area, or of both combined, before the increase in ultra-violet radiation is sufficient to affect the ionosphere.

M. A. ELLISON.

Sherborne,
Dorset. April 26.

¹ NATURE, 145, 625 (1940).

² *J. Brit. Astro. Assoc.*, 202 (April 1940).

³ *The Observatory*, 62, No. 787

Intestinal Sugar Absorption and Phosphate Metabolism

It has been shown in previous work that the selective absorption of sugars from the intestine of rats is strongly affected by iodoacetate¹: after administration of this poison all hexoses are absorbed at the same rate. This has been interpreted as due to the fact that phosphorylation of sugars accelerates their absorption. It was shown that extracts of intestinal mucosa phosphorylate those sugars which are selectively absorbed; furthermore, that iodoacetate inhibits this phosphorylation² and that organic phosphate in the intestinal mucosa increases during sugar absorption³.

It has now been found that absorption of any monosaccharide from isolated loops of the small intestine causes inorganic phosphate to enter the intestine, whereas absorption of sodium chloride or amino-acids has no such effect. Sugars which are not selectively absorbed also increase intestinal phosphates, but the change of concentration with time is different; with glucose the intestinal phosphate content is maximal already after 15 minutes and then falls off to about zero in about 1½ hours, whereas with xylose it rises slowly to about the same level in 45 minutes. After iodoacetate administration this difference disappears, and the phosphate content of the intestine after 45 minutes is the same for xylose and glucose. Also after adrenalectomy the reabsorption of phosphate during glucose absorption is suppressed. Thus entry and reabsorption of phosphate seems related to the selective absorption of sugars.

Experiments on the role of various endocrine glands which control intestinal sugar absorption are at present being carried out. It is also hoped that future work along the same line may throw light on the problem of phosphate metabolism in the bones. The results will be published in detail later.

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April 30.

¹ Wilbrand, W., and Laszt, L., *Biochem. Z.*, **259**, 398 (1933).

² Laszt, L., *Biochem. Z.*, **276**, 44 (1935).

³ Laszt, L., and Süllmann, H., *Biochem. Z.*, **278**, 401 (1935).

Effect of Inversion of a Small Piece from the Fruit-Body of *Ganoderma lucidus* (Leyss.) Karst. growing *in situ* on the Trunk of *Casuarina equisetifolia*

BRACKET-SHAPED sporophores of *Ganoderma lucidus* were growing on the trunk of an old tree of *Casuarina equisetifolia* in the Royal Botanical Gardens, Sibpur (Calcutta) in front of the superintendent's quarters on the bank of the Ganges. From each of the two sporophores, one growing over the other (Fig. 1), a narrow sector was cut out almost in the middle and inserted (on September 6, 1939) in the inverted position, that is, with the porous surface upwards in the cavity thus produced. It was found that in the course of nine days regeneration of the hyphæ began by way of stitching from two sides (Fig. 1). A number of interwoven hyphæ developed between the

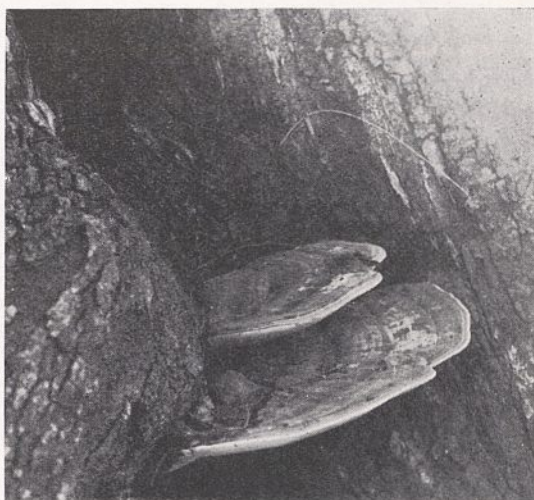


Fig. 1.
TWO SPOROPHORES OF *Ganoderma lucidus*, ONE GROWING ABOVE THE OTHER ON THE TRUNK OF *Casuarina equisetifolia*.

old sporophore and the new piece. The hymenial surface of the specimens was perfectly white in

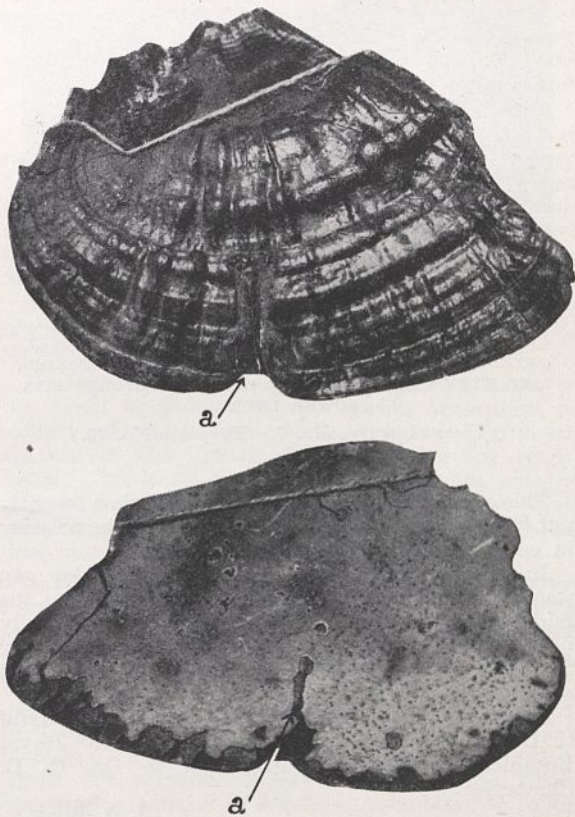


Fig. 2.
ABOVE—UPPER SURFACE OF THE SPOROPHORE OF *Ganoderma lucidus* SHOWING THE DEVELOPMENT OF LACCATE CRUST ON THE UPPER FACE OF THE CUT-OUT SECTOR AT *a*.
BELOW—HYMENIAL SURFACE OF THE SAME SHOWING FLANKING-OVER HYMENIAL GROWTH FROM TWO SIDES ON THE CRUST OF THE CUT-OUT SECTOR AT *a*.

September; copious spore-discharge continued for about two months, the adjoining areas of the trunk becoming dusted over with *Ganoderma* spores. Gradually, the lower surface turned pinkish and finally brownish with stoppage of spore-discharge by the following December. In the course of these three months the porous area on the upper face of the cut-out sector became gradually covered with the typical laccate crust-growth of the upper surface (Fig. 2, above) and its lower surface was at the same time flanked over with hymenial growth from two sides (Fig. 2, below). A section of the present upper face of the sector showed the typical thick-walled palisade hyphæ in close cluster with a number of brown shot-out spores here and there under the new crust (Fig. 3).

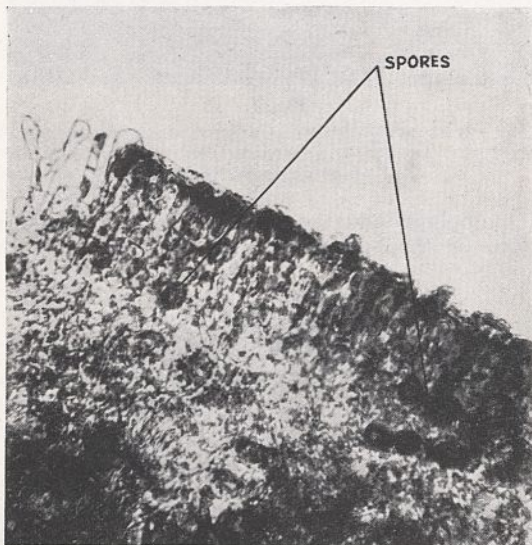


Fig. 3.

PHOTOMICROGRAPH OF A SECTION OF THE NEWLY DEVELOPED CRUST SHOWING THICK-WALLED PALISADE-LIKE HYPHÆ AND A NUMBER OF BROWN SPORES AT A LOWER LEVEL.

(Leitz objective No. 7. Eyepiece No. 75.)

This experiment lends support to the view recently put forward by Némec¹ and Lohwag² that the polarity in cases of some Polypores is convertible.

In another sporophore a narrow triangular gap was caused by removing a thin slice from about the middle; it was found that the gap was gradually bridged over in the course of about two months by numerous young hyphæ growing from two sides all over, except the outer thick crust.

For the photographs of Figs. 1 and 2 I am grateful to Dr. K. P. Biswas, superintendent of the Royal Botanical Gardens, Calcutta, and to Dr. D. B. Chatterjee.

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Gynospore Formation in *Sequoia sempervirens*

IN spite of the intrinsic interest of the redwoods and mammoth trees of California their gametophytes and embryogeny were poorly known until recently. Lawson's¹ account of *Sequoia sempervirens* was unsatisfactory and incomplete and only a cursory reference by Arnoldi² was available for *S. gigantea*. Looby and I³, however, described recently fertilization and proembryo formation in *S. gigantea* for the first time and also extended and amended Lawson's¹ account of these features in the redwood; while Buchholz⁴ afterwards dealt with the embryogeny in both types. It is clear from the results recorded that development in these two trees is so different that they can no longer be retained in the one genus.

Except for the doubtful account by Lawson¹ of gynospore formation in *S. sempervirens*, no accurate description has yet been given of the early origin and development of the gynospores in either case. Collections have now been made to cover these phases and so complete the full life-history; and these phases also are quite different in the two plants. Details will be published in due course, but it seemed advisable to put on immediate record the unique condition found in *S. sempervirens*. A number of gynospore mother cells are commonly formed, of which up to eight (or more?) may form tetrads. The members of a spore tetrad may form a linear row, but more frequently the gynospores are in compact groups of four, arranged symmetrically in one plane or in a tetrahedron, the whole being surrounded by a definite tapetum, usually of one cell layer. A transverse section of the ovule at this stage resembles a young pollen sac in a remarkable way.

In no other conifer is the sporangial nature of the nucellus so clearly shown. As these tetrads are only a little larger than the pollen tetrads this condition in the redwood is a further cogent argument against the continued use of the terms mega- and micro-spore for the spores of the conifers, with all that the use of these terms commonly implies.

J. DOYLE.

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May 3.

¹ Lawson, *Ann. Bot.*, 18, 1 (1904).

² Arnoldi, *Bull. Soc. Nat. Moscow*, 14, 449 (1900).

³ Looby and Doyle, *Sci. Proc. Roy. Dub. Soc.*, 21, 457 (1937).

⁴ Buchholz, *Amer. J. Bot.*, 26, 93 (1939).

Destruction of Cabbage White Butterflies by Birds

THE enormous numbers of 'Large Cabbage Whites' (*Pieris brassicae* (L.)) which entered England last summer were preyed upon very frequently by birds, and this Department received many dismembered wings picked up in gardens, etc. The offspring of these immigrants have been much in evidence this month, and have also been destroyed in large numbers by birds.

Mr. A. H. Hamm, A.L.S., has kindly collected dismembered wings in a churchyard in east Oxford, and examination gives the following result:

¹ Némec, B., *Bull. Internat. Acad. Tscheque, C. Math. Nat. et. Med.*, 36 (1935).

² Lohwag, K., *Ann. Mycol.*, 37, 169 (1939).

FRONT WINGS COLLECTED OVER A WIDE AREA OF THE CHURCHYARD

	Male		Female	
	L	R	L	R
May 18	15	23	5	4
" 19	4	6	6	7
" 20	4	9	2	2
" 21	4	1	-	3
	27	39	13	16

Hind wings are disregarded as it is often impossible to assign their sex.

COLLECTED ON BARE GROUND A FEW YARDS SQUARE IN THE CHURCHYARD

		Male		Female	
		L	R	L	R
May 18.	12.30 p.m.	6	4	8	7
" 19.	1.10 p.m.	2	2	-	1
" 20.	10.40 a.m.	1	2	-	-
" 20.	2.10 p.m.	2	1	-	1
" 21.	11.55 a.m.	5	5	2	-
" 21.	4.15 p.m.	-	1	1	-
		16	15	11	9

The figures show that in four days birds had destroyed at least 54 males (the number of right front wings found), and 24 females (the number of left front wings found). A churchyard is not, of course, a place where females would congregate to lay eggs. The wings had been seized by the bases and pulled

off; the bases are usually much rubbed, but in some cases a clear individual imprint of the bird's beak can be seen.

This is the case in 22 of the front wings and 10 of the hind wings; in most cases the imprint corresponds with the beak of a house sparrow, but in one at least it seemed to be that of a chaffinch (see Collenette, *Proc. Zool. Soc., Lond.*, Part 2, Pl. 1; 1935).

G. D. HALE CARPENTER.

Department of Entomology,
University Museum,
Oxford.
May 24.

Binocular Vision

I NOTICE in the current number of the *Proceedings of the Royal Society* (vol. 128, p. 552) the question raised "Do two eyes see better than one?"

I would refer those interested in the question to my note in the *Transactions of the Ophthalmological Society* (vol. 44, p. 183; 1924) which contains a simple demonstration of the fact that they actually do.

Dalry Veed,
Barley,
Royston, Herts.

JOHN GRAHAM KERR.

Points from Foregoing Letters

C. F. Powell, A. N. May, J. Chadwick and T. G. Pickavance describe experiments on the scattering of fast protons of about 4 Mev. energy by some light elements. The scattered particles were registered by the photographic method, which enabled the energies of the scattered particles to be determined at the same time as their angular distribution. With neon as scattering element, two groups of scattered particles were found, one corresponding to elastic scattering, the other to inelastic scattering in which the neon nucleus had been raised to an excited state. Attention is directed to the possibilities of this method for obtaining information about the excited states of atomic nuclei.

The results of exposing photographic plates for five months at altitudes of 2,130 m. and 3,660 m. in India are described by D. M. Bose and B. Chowdhry. Various tracks were found, which are believed to be due mainly to mesotrons.

F. Weigert and J. C. Mottram describe three solid modifications of 3:4,benzpyrene which are distinguished by their fluorescence colours, green, yellow and blue, their relative stability and their solubilities. In the presence of cholesterol the intermediate stage of the blue form is stabilized temporarily. It is suggested that a similar stabilization occurs in cells which come into contact with benzpyrene. This would make available free energy for biological action.

Considerable differences in the behaviour of quartz-covered platinum wires and plain platinum wires immersed in flame gases, are believed by W. T. David and B. Pugh to confirm the view that a proportion of the newly formed tri-atomic molecules hold an excess of intra-molecular energy which cannot be handed over to the translational degrees of freedom. In virtue of this excess intramolecular energy, a much larger dissociation obtains in flame gases than in normal gases. A. S. Leah describes experi-

ments which lend further support to this view and shows that the observed dissociation constant varies with the amount of excess intra-molecular energy.

It has been demonstrated by R. M. Barrer that rates of diffusion of hydrogen through palladium may be independent of current density. This implies that the metal just inside the ingoing surface is saturated, which in turn requires that the rate of transport across the ingoing interface no longer controls the rate of diffusion.

M. A. Ellison describes the bright chromospheric eruptions of March 23 and 27, together with the terrestrial disturbances accompanying them.

During sugar absorption from isolated loops of the small intestine, but not during absorption of sodium chloride or amino-acids, inorganic phosphate appears in the intestinal lumen, according to L. Laszt. With selectively absorbed sugars, rate of appearance and reabsorption are different from those with other sugars. Iodoacetate as well as adrenalectomy suppress the phosphate reabsorption.

S. R. Bose reports the result of cutting out a sector from a bracket-shaped Polypore, inverting the sector and replacing it. The upper and lower surfaces of the sector developed the characteristics of the adjoining tissue.

J. Doyle finds that *Sequoia sempervirens* forms, in the young ovule, up to eight groups of gynospore tetrads, frequently tetrahedral in arrangement. These are surrounded by a tapetum, the whole appearance, unique in conifers, resembling a young pollen sac in section.

The large numbers of the destructive large cabbage white butterfly destroyed by birds are shown by the wings found lying in gardens, etc. G. D. Hale Carpenter supplies data from Mr. A. H. Hamm proving that in a certain churchyard birds had destroyed in four days at least 54 males and 24 females.

RESEARCH ITEMS

Rostro-carinates in Africa

IN an important paper (*Trans. Roy. Soc. South Africa*, 27, Part 3, 287-319), H. B. S. Cooke and J. Desmond Clark describe, among other discoveries, an industry located at the base of the Kalahari Sand of the Victoria Falls region. This industry, which is found on and in a carstone rubble bed below the sand, is probably of Lower Pleistocene age, and is composed of typical rostro-carinates, and nosed, and other implements made from chalcedony. The flakes exhibit, usually, unfacetted striking platforms and have been struck from cores showing signs of having been afterwards used as tools. The artefacts, which are unabraded, were evidently made upon an ancient land surface existing prior to the deposition of the Kalahari Sand. This discovery of rostro-carinates affords yet another instance of the occurrence in Africa of these specimens under conditions precluding their production by glacial and other natural forces, such as are invoked by some investigators to account for these implements when found in England.

Concealing Coloration Tested by a Sparrow Hawk

LLOYD C. INGLES made use of a young Californian sparrow hawk, *Falco sparverius*, to test its acuteness in discovering and feeding upon grasshoppers (*Triemerotropis*) under different conditions (*Condor*, 42, 104; March-April 1940). Three experiments were devised to test the protective value of the colour, and the part played by movements of the grasshoppers in revealing them to the hawk. The author concluded that when all protective resemblance to the background was removed, the hawk readily found the grasshoppers even though they did not move, for they were dead. Individuals which did not move (dead) in grass were seldom seen and captured, even after the lapse of a much longer time. Movement in the grass was probably what led most frequently to an attack, but strikes made by the hawk at insects in grass were occasionally failures, whereas no failure was recorded on nearly twice as many strikes made on a non-protective background. The author suggests that sparrow-hawks and possibly other predaceous birds may occasionally obtain their prey by flushing it from cover where it is otherwise relatively safe because of its protective resemblance and motionlessness.

Alcohol and Mental Disease

THE January issue of *Mental Hygiene* contains an interesting paper on the use and effect of alcohol in relation to alcoholic mental disease before, during and after prohibition by Horatio M. Pollock, of the New York State Department of Mental Hygiene, Albany, New York. His paper is based on the study of 662 patients admitted to State hospitals during the periods 1920-23 inclusive and the years 1936-37 inclusive. The first period covered four years of comparatively effective prohibition and the second period two years under State and local regulation. The difference in the number of first admissions in the two periods is striking, the four years under prohibition yielding only 817 alcoholic first admissions or an average of 204 per year as compared with 1,703

or an average of 852 per year in the two years under the present licence system. The writer's principal conclusions are as follows: (1) The onset of alcoholic mental disease as a rule occurs only after several years of excessive drinking, which averages about twenty-two years in men and about fifteen years in women. (2) The average age of alcoholic patients on admission to a State mental hospital is approximately forty-five years. (3) Whisky and beer are the principal beverages that cause mental disease. Whisky either alone or in combination is by far the most potent factor. (4) Although alcoholic mental disease may result from regular or from periodic drinking, nearly 70 per cent of the writer's patients were regular drinkers. (5) In the great majority of cases a fixed habit of excessive drinking with frequent intoxication preceded the onset of mental disease. (6) Reduction of efficiency and loss of position commonly precede the onset of alcoholic mental disease. (7) Impairment of physical health frequently results from excessive drinking prior to the onset of mental disease. (8) A history of delirium tremens was obtained in 23.5 per cent of the 1920-23 group and in 29.4 per cent of the 1936-37 group.

Development of Aristapedia

THE recessive character aristapedia transforms the bristle on the antenna of *Drosophila melanogaster* into a tarsus. W. Braun (*Genetics*, 25, 143-149; 1940) has transplanted imaginal disks from normal to aristapedia flies and vice versa at an early stage of development of the larva. Transplants of aristapedia disks into normal flies from 2½ days old led to the formation of leg-like structures on the antennæ, while transplants of normal disks into aristapedia flies led to development of normal antennæ. The author studied the combination of genes affecting leg structures with aristapedia. Both dachs and thickoid affected the type of tarsus-like antennæ of aristapedia flies. On the other hand, aristaless which reduces the normal antennæ had no observable effect on the aristapedia. These facts are taken to support Goldschmidt's view that the gene aristapedia shifts the development of the antennæ to an earlier stage, and this brings the antennal disks within the influence of a leg-evocating stimulus.

Genetical Studies in *Carica Papaya*

J. D. J. HOFMEYER (*Science Bull.*, 187, South African Dept. of Agric. and Forestry; 1938) describes his experiments on sex determination in the papaw. There are staminate, carpellate and hermaphrodite plants and intergrades in this species. The author suggests that the crosses carpellate × staminate and carpellate × hermaphrodite give 1:1 ratios for the parental types, while the cross hermaphrodite × staminate gives a ratio of 1 staminate:1 carpellate:1 hermaphrodite. A simple practical hypothesis of $M_1m = \text{staminate}$, $M_2m = \text{hermaphrodite}$, $mm = \text{carpellate}$, where M_1M_2 and m are allelomorphous is suggested. The genes $Y:y$ for flower colour are in one linkage group with M . The linkage values are $M, 25Y$. The practical applications of the studies are discussed.

Oxides of Niobium

CHEMICAL and X-ray investigations of the niobium-oxygen system have recently been carried out by G. Brauer (*Naturwiss.*, 28, 30; 1940). They indicate the existence of three oxides with the formulæ Nb_2O_5 , NbO_2 , and NbO . The pentoxide occurs in at least two different forms, one of which is obtained when niobic acid, precipitated from aqueous solution, is dehydrated at 600° – 800° . Powder diagrams of this form show many lines. On heating it to higher temperatures, a new form with a different X-ray pattern is produced. The dioxide, NbO_2 , is obtained by reduction of the pentoxide with hydrogen or niobium. Hydrogen, even at 1600° , is unable to carry the reduction further than the dioxide stage. Contrary statements in the literature can be traced to the use of impure hydrogen. According to Goldschmidt, NbO_2 should possess the rutile structure, but powder diagrams of the purest dioxide show weak lines in addition to those corresponding with this structure. Apparently the structure is closely related to the rutile type, though not identical with it. When powdered niobium is heated with the dioxide to 1750° in an atmosphere of argon, the monoxide NbO is obtained. It is a grey solid with a metallic appearance, and crystallizes in the cubic system.

Remagnetizing Magnets used in D.C. Meters

THE commonest cause of D.C. meters registering outside allowable limits is deterioration of the strength of the field magnet. The usual error curve for a meter thus affected shows a rapidly falling line from 1/20 to full load; so even if the gearing ratio be adjusted to be correct at half load, the full load error will still be slow and the light load error fast. This follows since the driving torque is proportional to the magnetic flux density and the braking torque is proportional to the flux density multiplied by speed; thus the maximum differences of registration are at the opposite ends of the meter range; the full load error will still be slow and the light load error fast. In the *Electrical Times* of May 16, a cheap and efficient method of remagnetizing the magnets is described by R. Callender which should lead to appreciable economies in service. The meter element is taken out of the case and the register removed. A large current is then 'flashed' round the magnet; the field strength being now too great, it is reduced slightly to near the normal working value. This is accomplished by passing instantaneously a reduced current in the reverse direction. This is effected by inserting a suitable copper fuse in the circuit and proceeding to 'flash' as before. The meter element must then be laid aside for a month or two before it is reassembled. In order to bring the magnet field strength to normal working value, the magnets are further artificially aged by passing a short-circuit current through the meter. This should be done twice when the meters are connected in series for test, suitable fuses being used. The first operation reduces the field strength by about two per cent and the next by about a half per cent. Subsequent short circuits should have little, if any, effect.

Absorption of Hard Cosmic Rays and Mesotron Decay

It has several times been suggested that the observation that the absorption of hard cosmic rays is less in a medium of low density such as air than in the same mass of a denser material may be explained by the spontaneous decay of the mesotron

into an electron. The loss of mesotrons by decay becomes appreciable when the time taken for the mesotron to traverse the absorber becomes comparable with the mean life of the particle. The experimental evidence in this sense has been made much more definite by the work of B. Rossi, N. Hilberry and J. B. Hoag (*Phys. Rev.*, 57, 461; 1940). The vertical intensity of hard rays was measured by a counter system containing 13 cm. of lead. The intensity was measured at several heights up to 4,300 metres, and the absorption in a thick graphite block placed above the counters was measured at the higher station and thus compared directly with that of air. Carbon was chosen as having an atomic weight and number close to that of air; the effect of scattering and of showers was carefully considered. The results showed the excess absorption referred to above, and the average life of the mesotron was found to be about 2×10^{-6} sec. It was not found possible to establish the increasing range of the mesotrons predicted by theory as the mesotrons become more energetic on filtration through the atmosphere; but it is not certain that a sufficient increase in mesotron energy by filtration actually occurs in the range studied. E. Fermi (*Phys. Rev.*, 57, 485; 1940) finds theoretically that the loss of energy of any fast particle due to ionization of the atoms in its path is less in a dense than in a rarefied substance. This effect is due to the screening effect of the polarization of surrounding molecules. It is in the same sense as the effect attributed to the decay on the mesotron in cosmic rays. A calculation on classical lines indicates that the effect is large at very high particle energies. At moderate energies the effect is not sufficient to explain the results obtained by Rossi, Hilberry and Hoag, which are therefore probably correctly attributed to mesotron decay.

Electric Potential Gradient of the Lower Atmosphere

MEMOIR No. 8 of the Commonwealth Solar Observatory, Canberra, describes the results of the potential gradient observations made at Mount Stromlo during the years 1933–38. The electric potential gradient of the lower atmosphere at this station has now been the subject of continuous study for twelve years. C. W. Allen, in discussing the latest results, deals chiefly with the diurnal variation and its relation both to local and to world-wide factors. The local diurnal variation consists mainly of a sharp increase of gradient at sunrise to a maximum 5 hours later, and then a gradual decrease until the next sunrise, interrupted only by a slight depression at the intervening sunset. Its effect on the observations is nearly eliminated by examining only days of "continuous wind", that is, days on which the wind is constant in direction with a minimum velocity 5 m.p.h. for more than twenty-four hours. Correction of the Canberra observations for the local variation gives a "world variation" agreeing well both in phase and amplitude with ocean observations: a sharp minimum of about 84 per cent of the mean value occurs at 4h. U.T. and is followed by a slow rise to a maximum (120 per cent of the mean value) which is retarded from 18.5h. U.T. in January to 20.5h. U.T. in July. The curve showing the annual variation at Mount Stromlo indicates that the gradient is at a minimum in May and at a maximum in August; the elimination of local variations, however, removes both these, and the resulting curve is featureless. There is no evidence of any secular variation with the sun-spot cycle.

BONE AND STONE INDUSTRIES OF EARLY MAN IN CHINA

SINANTHROPUS

FOR the first recognition of the fact that Sinanthropus had made and used implements of bone the archaeological world is indebted to the Abbé Breuil. Before 1930, it was not known that the Choukoutien cave, in which the osteological remains of Peking man had been discovered, was an archaeological site; but in that year Dr. Breuil recognized that the base of the antler from the cave, shown to him in Paris, had been burnt and fashioned into a tool by blows of a stone implement. Further discoveries of quartz flakes and burnt bones followed, and were in turn succeeded by the discovery of the rich cultural layer at the base of the Kotzetang in 1931. A visit to the site in that year by Dr. Breuil led to the identification of a large number of tools fashioned of bone or antler; and as these were not universally accepted without question, he was invited to make a further and more detailed study of them, of which the results are now made available*. It is to be noted that material found later than 1934 is not included in the report.

For the present purpose, the significant facts of the Choukoutien site may be summarized as follows: Locality 1, a completely collapsed cave filled with debris to a depth of 50 metres, shows five horizons each of which yields evidence of Sinanthropus. At the base of Level 4 is the famous cultural layer in Kotzetang. Three further sites only have yielded cultural remains of Sinanthropus age: Locality 13, older than Locality 1, but only a few flakes and a single but fine chert artefact; Locality 15, possibly connected with the eastern slope of Locality 1 and containing a remarkably rich and advanced lithic industry; and Locality 4, still under excavation and yielding, at present, nothing but a few atypical broken stones.

No remains other than those of Sinanthropus occur from top to bottom of the deposits of Locality 1, and there is, therefore, no valid reason for assuming the existence of another inhabitant of the cave, as do some prehistorians. Nor does the predominance of cranial remains support the suggestion of the practice of head-hunting, which belongs to a more advanced stage of culture, while in the only certain prehistoric example known (Ofnet, Bavaria) in all the specimens, as a rule young or feminine, the first two cervical vertebrae are retained and show marks of having been sectioned by a flint. At Choukoutien only one atlas, loose, has been found. The explanation here offered is that it is a deformation, an aberrant evolution from reverence for the family skulls as ensuring ancestral protection.

Certain criteria distinguish animal action on bones from that of man. The most likely to give rise to uncertainty are the hyæna, the beaver and the porcupine. The crushing action of hyæna jaws is difficult to distinguish in effect from the hammer-anvil blow of man, though a hyæna never splits a bone lengthwise. A single bite by a beaver or porcupine may make a double or single incision which resembles a notch made by a metal tool, while their action in gnawing the end of a bone may look like

a point chopped by man. This is the origin of the so-called 'worked' elephant bones of Piltdown.

From the point of view of the toolmaker, three stages in fossilization are to be distinguished: (a) when still fresh the bone breaks cleanly and can be used readily for implements; (b) in the first stage of fossilization disintegration predominates over mineralization, bone is brittle, tends to crumble and has an irregular fracture; (c) complete fossilization renders it capable of being broken cleanly and sharply, but the outside and inside being usually of a different colour, breaks can easily be seen. The bones found at Choukoutien all belong to Stage (a).

In considering the industries of the earlier palæolithic periods, while it is admitted that, in addition to stone, man must have used wood, which has perished, it is usually overlooked that in bone man had at hand a convenient and adaptable material most of which also must have disappeared. The bone industry was first developed but was not invented in Upper Palæolithic times.

From the days of Sinanthropus, man has used horns of antelope, gazelle, goat and young ibex (ox horns being too big) antlers and stag-horns, skulls, jaw-bones, long bones, whole or broken, fragments of diaphyses, and flakes, short bones, chiefly astragals, carpus, tarsals and phalanges, vertebrae, ribs, iliac bones and shoulder blades, which in the Upper Palæolithic show evidence of having been used as shovels or scrapers.

This bone was used whenever a hard substance was needed, exactly like any stone, from the dawn of human toolmaking. The facts at Choukoutien confirm exactly observations at Castillo, Santander, Spain, as against the contention that the palæolithic bone industry is confined to the Upper Palæolithic and some rare Mousterian objects.

The material used at Choukoutien and identified includes horns and skulls of deer and ruminants, jaw-bones and teeth of deer, wild boar, fragments of elephant ivory, maxillæ of Carnivora (hyæna, leopard, tiger, bear), body and leg bones, including shoulder blades, humerus, radius, femur and tibia of deer, horse, rhinoceros, hyæna, bear, etc. The anatomical origin of a large number of flakes is difficult to determine.

An interesting and important point to emerge is that the state of the deer antlers points to a seasonal migration among them. All except two of the antlers of *Pseudaxis* are attached to the skulls and must have been so born when the animal was killed, while in *Euryceros* the majority of antlers have been shed. The antlers being shed at the beginning of winter after the rutting season, evidently the *Euryceros* migrated from the highlands to avoid the cold and occupied the country of the *Pseudaxis*, which retired before them until they retreated in the following year. The absence of half-grown antlers suggests that during the five months until the end of summer, Sinanthropus either left his cave or did not eat animals.

THE UPPER CAVE

The Upper Cave at Choukoutien, when discovered in 1930 during the search for Sinanthropus remains, was considered of relatively little importance; but

* Bone and Antler Industry of the Choukoutien Sinanthropus Site. By Henri Breuil. Translated by Miss M. E. Boyle. *Palæontologia Sinica*, N.S.D., No. 6, Peking, 1939, pp. 40+26 plates.

when it was fully excavated in 1933-34, it was found to be of unique character in Chinese prehistory. In it were found not only artefacts of an Upper Palaeolithic culture, but also the skeletal remains of a number of individuals representative of Upper Palaeolithic man in China, who hitherto had been unknown. The results of the excavation of the cave are to be described in a series of monographs, of which that dealing with the archaeology by W. C. Pei is the first to appear*.

The Upper Cave, previous to excavation, was completely covered by the superficial soil of the hill and filled with deposits, consisting of a grey loam mixed with fragments of collapsed rock. This was completely removed down to the red and hard breccia of the Choukoutien formation, in which further excavation would have been unprofitable. The cave consists of an upper room, a lower room and a lower recess, a narrow cavity three metres long and one metre wide, forming the lowest part of the cave. Five cultural layers were distinguished. It is possible that the Lower Room, in which human remains, including three complete skulls, were found, may have been a burial place only and not a dwelling site. In the lower recess an accumulation of animal bones and skeletons alone was found.

* The Upper Cave Industry of Choukoutien. By Pei Wen Chung. *Palaeontologica Sinica*, N.S.D., No. 9, 1939, pp. 41+8 plates.

Occupation lasted up to the complete filling of the upper room. The Upper Cave industry is characterized by a poorly developed, or at least poorly represented, lithic industry in which chert, sandstone, quartz, all foreign to the site but found in the vicinity, are in use. The types of implements include scrapers, choppers, as well as pebble implements. A notable feature is the use of personal ornament-perforated pebbles, stone beads with large perforation and one ground surface. The bone, antler and shell industries, mostly reserved for ornamental purposes, are most characteristic, and being usually left in natural shape are typical of a 'primitive' industry. A remarkable find is a bone needle, such as was not known hitherto to have occurred in China before Neolithic times. The technique of polishing is to be observed on a deer antler and the jaw-bone of a Sika deer.

As a whole, the Upper Cave industry is clearly ranged within an Upper Palaeolithic stage, but on comparison with its European equivalents it shows a mixture of relatively primitive and relatively advanced characters. It is likely that these artefacts represent an isolated culture of their own, indebted in part to a northern 'palaeartic' culture, in part to a Pacific culture sheet extending from Malaya to Manchukuo. It may on palaeontological and archaeological grounds be regarded on the Eastern equivalent of the Western Late Magdalenian.

FOOD PRODUCTION WITHOUT ARTIFICIAL FERTILIZERS

BY YSABEL DALDY

AN ACCOUNT of a valuable experiment in the feeding of schoolboys on vegetables and fruit grown from soil manured exclusively by humus is published by Dr. G. B. Chapman, of the Physical and Mental Welfare Society of New Zealand, Incorporated (Burnock Publications, Auckland, 1939). The locale of the experiment is the Mount Albert Grammar School hostel, the subjects being some sixty boys, teachers and staff. At the time of the inception of the experiment (1936), the dietary at the hostel was liberal, being well above the customary standard for boarding-schools; yet the boys consistently suffered (as was the case in other New Zealand schools and institutions) from colds, catarrh, septic tonsils, epidemics of influenza, dental caries and other preventable complaints. The whole of New Zealand's food supplies are grown from soils manured by the ordinary chemical fertilizers.

Dr. Chapman opened his campaign in 1936 by delivering a few short lectures to the resident teachers and boys, advising the growing of the hostel's fruit and vegetables from soils to be treated by properly prepared humus. He was successful in arousing the interest of the teachers, the boys, the matron and the staff. The reform was put in hand and the change-over made from 'chemically grown' fruit, salads and vegetables to the 'naturally produced' foods now in use at the hostel. At the present time, approximately an acre of land is under cultivation for the benefit of the hostel, to the soil (black volcanic) of which no chemical or artificial fertilizers of any kind have been applied. The area in question is supplying the greater proportion of the green vegetables, salad-greens, pumpkins, kumaras, root-vegetables and fruit required by a household of some

seventy-seven persons. The following general report of progress in health since the time of the change-over has been submitted by the matron of the hostel (pp. 4-6, "Menus and Recipes", Chapman and Lowe, 1939):

"The first thing to be noted, during the twelve months following the change-over to garden produce grown from our humus-treated soil, was the declining catarrhal condition among the boys. Catarrh had previously been general and, in some cases, very bad among the boys. In specific cases the elimination was very marked and in many cases complete. There was also a very marked decline in colds and influenza. Colds are now rare and any cases of influenza very mild. Coming to the 1938 measles epidemic, which was universal in New Zealand, the new boys suffered the more acute form of attack; while the boys who had been at the hostel for a year or more sustained the milder attacks, with a much more rapid convalescence.

"During the past three years there has been a marked physical growth and development during terms of heavy school work and sport [actual heights and weights are quoted]. In some cases boys go through a period of indisposition for several weeks after entering the hostel. This would appear to indicate that the method of feeding causes a certain detoxication period which, when cleared up, does not return. Excellent health gradually ensues in all cases, and is maintained. There are fewer accidents, particularly in the football season, which would possibly indicate that the foods in use contain the optimum amount of minerals and vitamins, thus ensuring a full development of bone and muscle and a greater resiliency to fractures and sprains. The

satisfactory physical condition described is maintained during periods of rapid growth and development of mind and body. Constipation and bilious attacks are rare. Skins are clear and healthy, while the boys are unceasingly active and virile.

"Since the change to naturally grown garden produce, the periodical reports in regard to the boys' dental condition have been more than gratifying." This point needs emphasis, as New Zealanders continue to show a poorer dental condition than is the case in most other countries of the world. In connexion with present-day examinations of young

men volunteering for service in the War, the Hon. W. E. Parry, Minister of Internal Affairs, has published the fact (*New Zealand Herald*, October 2, 1939) that forty per cent of the recruits are found to be temporarily unfit through defective teeth.

Dr. Chapman has now interested the Government of New Zealand in the results he is obtaining from a dietary inclusive of naturally grown fruit and vegetables; and the Mount Albert Grammar School hostel experiment will in future be continued under the auspices of the New Zealand Health Department.

ORIGIN OF THE VERTEBRATE COELOM

BY H. BARRACLOUGH FELL,

(SHIRTCLIFFE FELLOW, UNIVERSITY OF NEW ZEALAND)

RECENT years have witnessed a series of fundamental changes in our ideas on embryology, these changes being the expression of what had formerly been a growing mistrust of some of the generalizations of the nineteenth century. Thus de Beer¹, in the course of a convincing essay, set forth strong evidence to show that the theory of recapitulation cannot be accepted in its original form. Again, Oppenheimer² has recently reviewed the results of research on the earlier stages of development, and her conclusion is that "... the doctrine of the absolute specificity of the germ-layers as enunciated in the last century must be abandoned". So early as 1894, Garstang³ had presented evidence leading him to believe that the ancestor of the chordates could be found in an animal closely approximating to the present larval forms of echinoderms. One important consequence of Garstang's work in this direction is that it has led to the recognition of the fact that evolution can act on the earlier stages of development; the original recapitulation theory supposed that evolution worked only on adult forms, tacking on, as it were, additional phases at the end of ontogeny. The echinoderm theory has received ever-increasing attention, until now it may be regarded as the most important attempt to solve the problem of the ancestry of the chordates.

The theory in its present form, however, seems to suffer from one serious drawback, in that it supposes that the schizocoel of vertebrates arose from the enterocoel of the echinoderm larva. It has been urged that the formation of the anterior coelomic pouches from the archenteron in *Amphioxus* provides evidence of the enterocoelous nature of the original vertebrate coelom. Against this it must be adduced that all known vertebrates have now a schizocoel, and that it is only *Amphioxus* and its related forms that have an enterocoel. As *Amphioxus* is in so many ways highly specialized, there can be no safe ground for believing that its mode of derivation of the coelom is primitive. Furthermore, there are other groups of invertebrates, notably the annulates, in which there are strong features of resemblance to the vertebrates, and at the same time a schizocoelous development of the coelom.

It is clear that the above objection applies only so long as we regard the coelom of echinoderms as being necessarily an enterocoel—and, up to the present, there appears to have been no suggestion that this

may not be the case. Now, the formation of hollow structures by derivation from pouches does not on the face of it appear to be primitive. Rather it would seem to be a later 'short-circuiting' of some more primitive method which must have involved first the formation of a mass of tissue (in this case mesoderm, derived from endoderm of the archenteron), and secondly the excavation therein of a cavity (in this case the coelom). In the same way it has already been suggested by other workers that the invaginative method of formation of the endoderm and its enclosed cavity the archenteron may be a later short-circuiting of a more primitive scheme in which there first arose a solid mass of endoderm (by migration, delamination, or some other means), and then later the archenteron was excavated in this mass. Invagination in the case of the latter instance, and pouch-formation in the case of the former, are to be regarded as later products of evolution, enabling the final result to be attained in shorter time. One reason for being unable to regard as primitive the pouch method of formation of the coelom is that it is difficult to imagine the incipient stages of such a process, unless we postulate some such previous development as has been outlined.

So far, no practical evidence has been forthcoming to confirm that the enterocoel of the echinoderms is not the only type of coelom found in that group, nor has there been any concrete evidence to show that the echinoderm enterocoel may not be primitive. However, in a paper now in the press⁴ it will be shown that the coelom actually does arise by splitting in the mesoderm in a New Zealand ophiuroid. The fact that this species (as yet unidentified) has an unusual development was first discovered and recorded by Kirk⁵ in 1916, but the schizocoelous origin of its coelom has only recently come to light. This unexpected feature led me to consult a paper by Russo⁶ published as long ago as 1891, in which he claimed to have found that the coelom in the ophiuroid *Amphiura squamata* arose by splitting in mesenchyme. Owing unfortunately to his inaccurate description and figures, Russo's results were ignored by subsequent workers; but actually he was never proved to be incorrect. His statements, of course, accorded ill with the recapitulation theory then holding sway. I am at present engaged upon a re-investigation of the development of *A. squamata*, and the preliminary results seem to confirm that Russo was indeed right

in assuming the schizocoelous origin of the coelom, though in other matters he was mistaken. Thus in one echinoderm at least, and probably in two, there is a schizocoel. In all likelihood the same will be found to be true of other species too.

There are some relevant facts which must be mentioned here. Both *Amphiura* and Kirk's ophiuroid are species with yolky eggs. In both species the development is shortened. Thus *Amphiura* has only a vestigial larva within the bursa of the parent, while in Kirk's species there is no larval stage whatever, the development being direct. The latter species, unlike *Amphiura*, is not viviparous.

It may be argued that the presence of yolk material in the eggs of these two species, and the viviparous habit of the former, render them too specialized to be regarded as being capable of giving rise to anything else in evolution. Against this the following facts must be considered:

(1) Yolky eggs are very common in echinoderms. The fact that the development of so few yolky species is known may well have given us an incorrect idea of echinoderm embryology in general.

(2) Kirk's ophiuroid is not viviparous, and yet has a more direct development than *Amphiura*, which is viviparous. Therefore viviparity cannot be regarded as a cardinal factor in producing direct development, unless we suppose that Kirk's species was formerly viviparous and then lost the habit.

(3) Most of the lower vertebrates have more or less yolky eggs, together with (invariably) a schizocoelous coelom. This fact is to be considered in relation to the same conditions prevailing in the two echinoderms cited.

(4) *Amphioxus*, on the other hand, has a non-yolky egg, and, as might be expected from the foregoing, has an enterocoelous coelom.

(5) The widespread occurrence of yolky eggs in so many different classes renders it doubtful whether yolk really is a specialization after all. In any event,

the heavily yolky reptilian egg is held to have given rise to the mammals (in whose eggs the yolk is so reduced). Therefore it should not be difficult to imagine an echinoderm larval form, with yolk-material in its tissues, giving rise to other forms.

There is a difficulty in that it appears, from the limited evidence at present available, that suppression of the larval stage tends to accompany the presence of yolk. It is not clear as yet, therefore, whether an echinoderm larva can itself possess a schizocoel, but it has been shown that a schizocoel can occur in the life history. In my view, the significance of the association of yolk in echinoderms and chordates with a schizocoelous development of the coelomic cavities is this: the presence of inert food-material in the endoderm tends to retard the changes of organization of the latter. The yolk for physical reasons makes the cutting off of enterocoelous pouches an excessively slow process. Hence the more primitive method is reverted to, by which the coelom arises as a schizocoel in a mass of mesoderm.

Since writing the above, it has been found that in the embryo of *Ophiomyxa brevissima* the region of the future coelom is first occupied by an extensive zone of solid mesenchyme. The obvious similarity to the condition in *Amphiura squamata* and in Kirk's ophiuroid leaves little doubt that the coelom in this form must also arise as splits in the mesenchyme mass. Here, too, the embryonic tissues are laden with yolk. A fuller account will be published elsewhere.

¹ de Beer, G. R., "Embryology and Evolution", Oxford (1930).

² Oppenheimer, J. M., "The Non-Specificity of the Germ-Layers", *Quart. Rev. Biol. Sci.*, **15**, 1 (1940).

³ Garstang, W., "Preliminary Note on a New Theory of the Phylogeny of the Chordata", *Zool. Anz.*, **17** (1894).

⁴ Fell, H. B., "The Direct Development of a New Zealand Ophiuroid", *Quart. J. Micro. Sci.* (in the press).

⁵ Kirk, H. B., "On the much-abbreviated Development of a Sand-star (*Ophionereis schayeri*?)", *Trans. N.Z. Inst.*, **48** (1916).

⁶ Russo, A., "Embriologia dell' *Amphiura squamata*", *Atti. R. Acad. Nap.*, Ser. 2, **5** (1891).

POST-GLACIAL VEGETATION OF ENGLISH FENLAND

A STRATIGRAPHICAL sequence of lower peat, fen clay, upper peat and upper silt is characteristic of the whole of the southern part of the Fenland. The corresponding sequence of post-glacial vegetation successions throughout the area and their correlation with archaeological horizons is described by H. Godwin (*Phil. Trans. Roy. Soc.*, **230**, No. 570, Feb. 1940).

Evidence from pollen analysis methods shows that birch, which along with pine originally dominated the area in Pre-boreal times, was replaced in the Boreal period by pine; whilst extensive elm and oak woods developed with an undergrowth of hazel and with alder and lime in favoured places. These forests were occupied by Tardenoisian people, as evidenced by microlithic flints from weapons and tools. Oak, alder and lime predominated during the succeeding wetter Atlantic period, and the post-glacial forests reached their maximum development, affording shelter for late Mesolithic and Neolithic peoples.

Within the Neolithic period the Fenland area became generally water-logged and fen peat began to accumulate, embedding the tree bases and leading to their destruction and to the transition to a sedge fen with wooded tracts of alder, willow and birch. Drier Sub-boreal conditions led to renewed develop-

ment of woodland, to be succeeded by extensive invasion by the sea and the conversion of the whole area into a brackish lagoon. The deposition in this shallow lake of silt and clay gave rise to the thick deposits of fen clay overlying the lower peat.

In the Bronze Age, freshwater fen was re-established and a new mantle of peat formed. Towards the end of the period dry fen woods, across which pre-historic man passed freely, had once more extended across the full width of the fens. At 500 B.C. the colder and wetter conditions made the area uninhabitable for, in contrast with the Bronze Age, no trace of Iron Age man has been found.

The effect of climatic deterioration was heightened during the Roman period by a further phase of marine invasion giving rise to extensive coastal salt marshes of silt and raised river banks which penetrate far into the peat country. Romano-British agriculture spread along the silt banks of the river channels, and the first drainage operations date from this period. Between then and the effective drainage of Fenland in the seventeenth to the nineteenth centuries no trace is available of human occupation. The present change in relative land and sea-levels points to a further marine invasion.

SEVENTY YEARS AGO

NATURE, vol. 2, June 9, 1870

The New Australian Mud-fish

P. L. SCLATER, F.R.S., secretary of the Zoological Society, describes and illustrates the newly discovered Australian mud-fish, basing his account on a paper sent to the Zoological Society by Mr. Gerard Krefft, curator of the Australian Museum, Sydney, who had named the fish *Ceratodus forsteri*. The general resemblance of the fish to *Lepidosiren* is remarked upon, and it is said to be so common that it is known as the "Burnett" or "Dawson salmon", from the two Queensland rivers in which it is principally found.

In conclusion, Mr. Sclater hopes that "this short notice may have the effect of calling the attention of some of the colonists of Queensland to the wonderful nature of this relic of the Devonian epoch that is now swimming about beneath their noses, and that they will cease, for the present at least, to kill it and eat it as 'salmon'. Any specimens that may 'rise to their fly' should be carefully kept out of the way of the cook, preserved in alcohol and transmitted to the British Museum or some other scientific institution".

Fizeau's Experiments on "Newton's Rings"

PROF. G. CAREY FOSTER, F.R.S., compares the wave-lengths of the sodium doublet as determined by Ångström with observations made by Fizeau by the method of Newton's rings.

Fizeau produced Newton's rings by means of a convex lens and a plane glass illuminated "by the yellow flame of spirit of wine containing a little common salt". It was found that, on separating the lens from the glass, the rings contracted, disappeared at the middle, and were replaced by new rings. In this way, nearly 500 rings were counted, after which rings ceased to be visible; then after a period, a further 500 rings became visible again, and so on. The explanation is that the yellow light used consists of two parts of slightly different refrangibility. Each part is capable of producing a set of rings, and when they are put together, they nearly, but not quite, fit each other. The effect can be explained on the "undulatory theory" of light, and gives results in good accord with those derived from Ångström's wave-length measurements.

The Natural History Collections

In 1858, a memorial on the organization of the British Museum Natural History Collections was submitted to the Chancellor of the Exchequer by a group of four zoologists and five botanists. Nothing was done at the time, but the subject having again come before Parliament, the memorial was printed in NATURE in full, and readers, especially botanists, were asked to communicate their views to the Editor.

At a meeting of the German Chemical Society on May 23, A. Baeyer and M. Emmerling reported on the transformation of isatin into indigo. When treated with phosphorus in "chloride of acetylene or of phosphorus", isatin forms indigo-blue and indigo-red.

THE council of the Society of Arts has awarded the Albert Medal to M. F. de Lesseps, "for services rendered to arts, manufacturers, and commerce, by the realization of the Suez Canal".

MR. JOULE has been elected to the Section of General Physics of the Paris Academy of Sciences.

FORTHCOMING EVENTS

Monday, June 10

ROYAL GEOGRAPHICAL SOCIETY, at 5 p.m.—E. J. Wayland "Forest versus Desert in Eastern Africa".

Tuesday, June 11

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5 p.m.—E. J. Wayland: "Some Aspects of Uganda Prehistory".

ZOOLOGICAL SOCIETY OF LONDON, at 5 p.m.—James Fisher: "The Status of the Fulmar in the British Isles". A Symposium on Taxonomy and Palaeontology (J. A. Moy-Thomas: "Problems of Palaeontological Classification"; E. B. Ford: "Palaeontological Classification from the Geneticist's Point of View"; Dr. L. R. Cox: "Problems facing the Invertebrate Palaeontologist").

APPOINTMENTS VACANT

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

INSTRUCTOR IN MECHANICAL ENGINEERING WORKSHOP PROCESSES AND PRACTICE—The Secretary for Education, County Education Offices, Northampton (June 12).

TECHNICAL ASSISTANTS (MECHANICAL ENGINEERING) IN THE DIRECTORATE OF AMMUNITION PRODUCTION—The Secretary, Ministry of Supply (S.E.3.b), Adelphi, W.C.2 (quoting Apts. 034/S.E.3.b) (June 12).

PROFESSOR OF MATHEMATICAL PHYSICS—The Secretary and Bursar, University College, Dublin (June 15).

HEAD OF THE CHEMISTRY DEPARTMENT—The Clerk to the Governors, Technical College, Nottingham Road, Derby (June 15).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING—The Principal, Technical College, Kingston-upon-Thames (June 18).

LECTURER IN EDUCATION—The Acting Secretary, University Court, Glasgow (June 20).

A METALLURGIST OR A METALLURGICAL CHEMIST at the Midway Technical College, Gillingham—The District Education Officer, Fort Pitt House, New Road, Rochester, Kent (June 22).

LECTURER (MAN OR WOMAN) IN THE DEPARTMENT OF PURE AND APPLIED SCIENCE, FOR BIOLOGY, ANATOMY AND PHYSIOLOGY—The Registrar, Loughborough College, Loughborough, Leicestershire (June 22).

GRADUATE ASSISTANT MASTER TO TEACH MATHEMATICS AND SCIENCE—The Principal, Technical Institute, Beckenham Road, Beckenham (June 24).

ASSISTANT ENGINEER TO THE CENTRAL ROAD BOARD, BARBADOS—The Secretary, Central Road Board, Bridgetown, Barbados (July 13).

EDUCATION LECTURER AT THE PORTSMOUTH TRAINING COLLEGE—The Registrar, Municipal College, Portsmouth.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1939-1940. Vol. 60, Part 1, No. 5: The Periodic Lamé Functions. By Dr. E. L. Ince. Pp. 47-63. 1s. 6d. Vol. 60, Part 1, No. 6: The Estimation of Factor Loadings by the Method of Maximum Likelihood. By D. N. Lawley. Pp. 64-82. 1s. 6d. Vol. 60, Part 1, No. 7: Further Investigations into the Periodic Lamé Functions. By Dr. E. L. Ince. Pp. 83-99. 1s. 6d. Vol. 60, Part 1, No. 8: Reciprocity, Part 2: Scalar Wave Functions. By Prof. Max Born. Pp. 100-116. 1s. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [245]

Ministry of Health. International Agreement, Brussels, 1924. Venereal Diseases: Centres in the Ports at Home and Abroad where Seamen can obtain Treatment. (List 7a, revised.) Pp. 30. (London: H.M. Stationery Office.) 6d. net. [275]

Other Countries

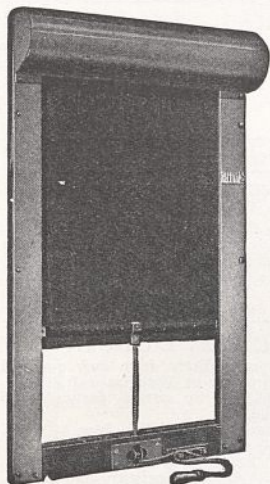
Southern Rhodesia: Geological Survey. Bulletin No. 35: The Geology of the Country around Bulawayo. By F. L. Amm. Pp. viii+307+27 plates. (Salisbury: Government Stationery Office.) 9s. 9d. [275]

Southern Rhodesia. Meteorological Report for the Year ended 30th June 1939. Pp. 48. (Salisbury: Government Stationery Office.) [275]

Common Marine Food-Fishes of Hong Kong. By G. A. C. Herklots and S. Y. Lin. Second enlarged edition. Pp. ii+89. (Hong Kong: G. A. C. Herklots, The University.) 2.50 dollars. [275]

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The entry for which the prize is awarded will become the sole property of the Punjab Government, which reserves the right to postpone or withhold the award of the prize if no entry of sufficient merit is received, or to reduce the prize or divide it if two or more entries of equal merit, in the opinion of the judging committee, are received.

Applications, complete in all respects, must reach the Director of Agriculture, Punjab, Lahore, by September 30, 1940, at latest.

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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,
Secretary to the University of Aberdeen.

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Further particulars of conditions of appointment and forms of application may be had from the undersigned, with whom applications are to be lodged on or before 29th current.

A. J. WILSON,
Secretary.
6 Blythwood Square,
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4th June, 1940.

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UNIVERSITY COLLEGE, DUBLIN

Applications are invited by the Governing Body, from fully qualified persons, for the Statutory Office of Professor of Mathematical Physics.

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May 30, 1940. A. J. O'CONNELL,
K.A.A. Secretary and Bursar.

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CONTENTS OF JUNE ISSUE

A Chatelaine from Coorg, South India (with Plate). Blumenbach's Centenary (Illustrated). Glass-making in Nupe. Man and Elephant in Central America (Illustrated). Obituary: Sir Hubert Murray, K.C.M.G., December 29, 1861—February 29, 1940. Proceedings, Reviews, Correspondence.

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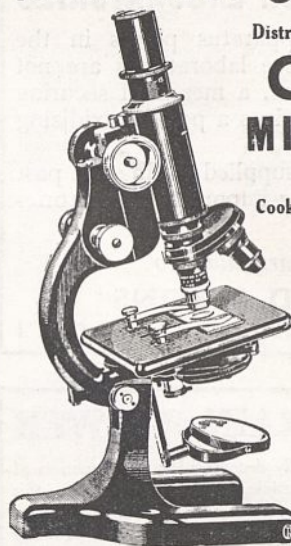
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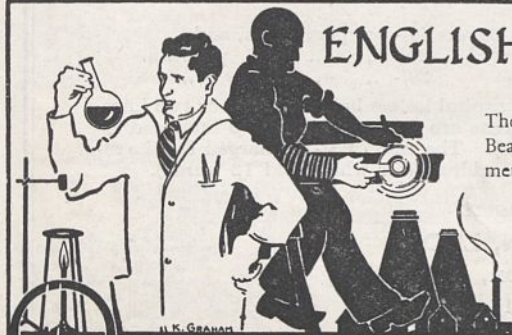
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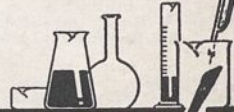


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