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The Ordnance Survey and National Needs

THE ultimate value of a map or plan is measured by the accuracy with which it records the features of the area covered. It follows, therefore, that when development of an area is rapid, frequent revision of large-scale plans is necessary. For some time past, it has been a source of complaint that the large-scale plans of Great Britain are obsolete, and in July last the International Congress of Surveyors passed a resolution requesting the Chartered Surveyors' Institution to investigate the questions raised by this condition of many Ordnance maps of the British Isles and to take appropriate action. At a meeting of the council of the Institution held on October 8, it was decided that the Institution should proceed with a full inquiry into the present position, with the view of asking the Ministry of Agriculture and Fisheries, to which the Ordnance Survey is responsible, to set up a departmental committee to consider the subject.

The most important of the large-scale plans prepared by the Ordnance Survey are the plans on the scale of 1 : 2,500, that is, about 25 inches to the mile, and the 6-inch plans. There are larger town-scales, but their case is a special one and it would only confuse the issue to discuss it now. We propose, therefore, to deal only with what used to be a great national asset, the plans of Great Britain on the scales of 25 inches and 6 inches to the mile. There was no country in the world which, before the War, had such a remarkable series of large-scale maps on sale to the public. The 25-inch plans covered the whole surface of the country except waste and mountainous areas, and the 6-inch plans covered the whole surface, without exception.

The numbers involved were large ; the area of Great Britain being about 88,000 square miles, and each 25-inch plan covering a square mile and a half, the number of these plans is of the order of 60,000—actually somewhat more. In the same way the number of 6-inch quarter-sheets is of the order of 15,000, since each quarter-sheet covers an area of six square miles. It has been calculated that the human labour put into the surveying of Great Britain on these scales is considerably greater than would be required to map the whole of Canada or Australia on the scale of 1 inch to the mile.

The 6-inch survey of the six northern counties

of England and of part of Scotland was authorised in 1840, but it was not until 1856, after much discussion in and out of Parliament, that the 25-inch scale, with reduction to 6-inch (also to be published), was approved by Parliament. By 1891 the whole of the 25-inch plans of Great Britain, except those of Yorkshire and Lancashire and a few counties of Scotland, were completed by the Survey, and the first revision of the plans was begun.

It was now very wisely laid down that there should be periodical revisions of the large-scale plans, and that these revisions should take place every twenty years; the intention being that, in the future, no plan should be on sale to the public which was more than twenty years old. The revision proceeded systematically; a second revision was begun in 1904, and this continued until the outbreak of the War. So far, the public had no reason to be dissatisfied with the out-turn of the Ordnance Survey. The large-scale plans were kept reasonably up to date, and for certain public purposes, such as land registry and land valuation, special revisions were undertaken.

The War naturally stopped the even course of the revision. The civilians of military age on the Survey joined the Forces, the Royal Engineers were sent to units in France and elsewhere, and the main activities of the Survey were directed to co-operating with the survey battalions on the Western Front and to producing the very large numbers of maps which were used by the troops on the various fronts. Altogether more than thirty-two millions of war maps were printed by the Ordnance Survey during the four years of war.

Arrears of revision naturally accumulated during the War; but with a small increase of staff and a little re-arrangement of duties, arrears would have been overtaken, and the country would have had the plans necessary for its post-War development. But what actually happened was very different.

As the result of the report of the Select Committee on National Expenditure of 1918, a system was approved by which those counties having a population of less than 100 per square mile should be revised only once in forty years, instead of twenty years. Only one county in England was affected, namely, Westmorland, and in Scotland and Wales only the mountainous counties and the islands. This measure would not materially have detracted from the value of the national maps to the State or to the public, and, looking back upon the past, one cannot but feel that it was unfortunate that this decision was not allowed to stand.

Four years later, however, there came the report of the Committee on National Expenditure of 1922, better known as the Geddes Committee. That Committee recommended a further slowing down of the revision, so that revision would be carried out only in boroughs, urban districts and those areas which had undergone considerable change since the last revision. This additional restriction resulted in a diminution of the staff of the Ordnance Survey by 143 men; it effected a saving of about £30,000 a year; and it has been the principal cause of the troubles that were to come.

During the twelve years which have passed since the report of the Geddes Committee was issued, many changes have taken place in the surface of Great Britain. Some of these changes could not have been anticipated by that Committee, or, indeed, by anyone else. We have witnessed a vast extension of that unpleasant feature, 'ribbon development'; we have seen radical alterations in our road system; we have seen an unfortunate increase in our miserable 'conurbations'; and, to quote from an admirable publication recently issued by the Ordnance Survey*, "Judging from our recent plans there has been more change in Great Britain in the period 1922–1934 than in the whole of that period which elapsed between the start of the first revision (1891) and 1922". "When we are able to resume a more active revision we shall be faced with causes such as the following. Scunthorpe, in Lincolnshire, was last revised when a population of 6,750 covered 1,031 acres. It has now a population of 33,761, and covers an area of 7,895 acres". And so the story continues.

Moreover, it is not as if the type of revision remained the same as it was in pre-War days. Partly owing to the longer interval, and partly owing to the changes above indicated, revision of the national plans is a far more laborious matter than it used to be; it takes longer, and, of course, costs more. It appears, from the publication alluded to, that whereas, with approximately the same staff, about 2,050 plans were revised in 1923, it was only found possible to revise about 500 in 1933. Or the matter may be put like this: in 1923 a 25-inch plan took about 12 man-days to

* Ordnance Survey. Professional Papers, New Series, No. 16: The National Plans (The Ten-foot, Five-foot, Twenty-five-inch and Six-inch Scales). By Brigadier H. St. J. L. Winterbotham. Pp. 112+27 plates. (London: H.M. Stationery Office, 1934.) 4*s.* 6*d.* net.

revise, whereas in 1933 it took about 77 man-days. We shall probably be within the mark if we say that a plan costs something like four times as much as it did ten years ago.

It is certain that under the present Director-General and under his predecessor, every possible step was taken to expedite the work of revision; but the task was impossible with the exiguous staff allowed. We are, indeed, being deprived of a great and valuable heritage, the magnificent series of large-scale plans of our country, and if matters are allowed to continue in their present course, the Ordnance Survey plans will lose most of their value to the public. We are not making the best of the large capital expenditure that former generations have contributed to this eminently practical, national institution, and we are not providing in a reasonable manner for the needs of our successors.

The national plans enter intimately into all our social and official activities. They are almost invariably used for the conveyance of property, for land registration, for valuation, for a hundred different engineering purposes, drainage, water and electricity supply, the construction of roads and railways, in the daily work of local government, in town-planning, for the compliance with many recent acts of Parliament, and for innumerable private purposes. At the present time, these plans are so sadly out of date that local authorities and private persons have, perforce, to make maps of their own, maps of much less reliability. The secretary of the Chartered Surveyors' Institution has rightly said that we are not making proper use of the accumulated and co-ordinated knowledge of the Ordnance Survey, that expenditure is often transferred "from taxes to rates, maps less technically excellent are likely to be produced, while even these cannot be reproduced in quantity" and, "What our institution wants to see is a return to centralised map-making by the highly competent Ordnance Survey".

It is not too late to profit by this advice, but the situation is becoming serious. If the Government will examine the question, and will take evidence as to the harm which is being done by the failure to bring the plans reasonably up to date, if it will give serious attention to the difficulties which are being caused by allowing the large-scale surveys of Great Britain to fall into such disrepair, then we feel sure that the small additional annual sum required to bring them into a satisfactory state will not be refused.

Rock Engravings in Central South Africa

The Rock-Engravings of Griqualand West and Bechuanaland, South Africa. By M. Wilman. Pp. xii+78+70 plates. (Cambridge: Deighton Bell and Co., Ltd.; Kimberley: Alexander McGregor Memorial Museum, 1933.) 25*s*. net.

THIS substantial volume by Miss Wilman, keeper of the fine Museum at Kimberley, is the result of a quarter of a century's work, made possible by the financial assistance of the Royal Society of South Africa, and published by the Carnegie Trust through their great research branch in South Africa. The volume is far from being a complete survey of the rock engravings of South Africa, but rather the fruit of excursions round Kinderham, made chiefly during week-ends, with the addition of numerous documents by kindly collaborators.

Miss Wilman starts with a historical list of previous publications on the subject. A tale brought back by Moffat from Bechuanaland: animals and men issued from a cave where their footprints can still be seen (1842); A. Dolman (Bechuanaland, 1849); T. J. Andersson ("Traces of Men and Animals near Bloemhof and Taungs", 1866); Hubner ("Animals and Trees"); E. J. Dunn and G. W. Stow also wrote on the subject. Emile Holub, a Czech and doctor at Kimberley, made a big collection of engravings, now assembled in the Museums of Prague and Vienna and recently published by Zelisko—Miss Wilman is apparently unaware that a large selection of these was reproduced in 1905 by E. Cartailhac and H. Breuil in "La Caverne d'Altamira". Christol, Péringuey, Johnson and Rudolf Pöch all contributed to the subject; it was they who suggested the importance of the patina in determining the relative chronology of engravings, and also noted that, from A.D. 1000 onwards, the Hottentots had introduced a dog and a sheep of Syriac origin into South Africa. The author also alludes to the more recent researches of Mlle Weyersberg, Lebzelter and Dart.

In Chap. ii, the distribution of the open air engravings is described, and their relation to the paintings.

Péringuey, Maák and Halls wrote of painted engravings; sometimes these are paintings scored by a sorcerer, but Johnson described one engraving masked by a painting, and Miss Mannsfeld mentions another. A map shows the geographical extension of the engravings.

Chap. iii is devoted to the physical and prehistoric setting of Griqualand West and Bechuanaland. The wide schistous tableland of the Karoo, 4,000 ft. above O.D., is covered with sand and limestone tufa. Masses of boulders of diabase and

dolerite, sometimes scored and polished by the Carboniferous glaciers, form the kopjes at 4,200 ft. o.d. Here there are no rock shelters, but these exist in the dolomites and banded sandstones of the western region of the Kap plateau. As for the Kalahari, the sand covers nearly all of it. In that region, the winter is dry, and water must be dug for; but, in summer, the soil is saturated with it. The temperature varies from −7·5° C. to +40° C.

The Stone Age is well represented, from the old handaxes of Stellenbosch to the small tools of Smithfield. The latter site has also a few microlithic implements, pestles, mortars, perforated stones, either small (beads and pendants), or belonging to digging sticks. Ostrich eggs provided water bottles and beads; there are leather water bottles and some bone or soapstone pipes. In the graves of the same age, there is unbaked pottery, plain cups ornamented with spots and elementary designs. As for the perforated decorated stones of Heilbron and the cylindro-conical objects from the same district, the author considers that neither they nor the stone rings are attributable to Bushmen. On the other hand, she considers a little sculptured human head in kaolinite, found at Kenilworth (Kimberley), as that of a Bushman: this, with some engravings on ostrich eggs, are the only small artistic objects found underground. Until 1875, the Bushmen children amused themselves by cleverly modelling animals in clay.

The stone circles, often very near the open air engravings, are the sites of contemporary huts, but, in the districts with high rocks, stairways leading upwards are cut in the rock, at places suitable for refuge or for the collection of wild honey.

The author then describes the engraved rocks of Griqualand West and Bechuanaland. So far, many are known in the Vryburg region and the upper and middle Vaal valley; they are more rare on the lower reaches of the Vaal, Riet and Orange Rivers. Miss Wilman divides them into four classes:

(I). The classic style of Péringuey: animals, men, plants, star-shaped and geometrical designs.

(II). Imitations of these, or re-engravings of them at a later date, very varied.

(III). Footprints of men and animals, sometimes associated with animals and snakes.

(IV). Recent scribblings.

This enumeration is followed by a digression on the amygdaloid diabases, bluish-black in colour with a quartz and chalcedony heart; with weathering, this rock becomes dark reddish purple. It is found either on river banks or high kopjes, from which a distant view is obtained. It is there that the engravings are found, and not in rock shelters or on isolated blocks; they are either scattered or concentrated, placed irregularly and sometimes in places which compelled the artist to take very trying positions.

Group I. In this class the line is obtained by pecking clusters of spots often arranged in series or loops. The line is rough and the same shade as the rock background. There are some lines from one quarter to three quarters of an inch wide, sketches of wild animals with very few details—their species and type are often doubtful; they are in profile, though not complete silhouette, for the four legs are given, even when they are joined two and two. In other engravings (really belonging to a second group) the pecked spots blend, thus becoming a continuous line, and sometimes the pecking covers the whole or part of the figure, giving details of the curves, coat, etc. The eye is often omitted (80 per cent are without eyes), and so is the ear, if it is not seen in silhouette. They are nearly always in profile, but some are foreshortened; their attitudes are living, and occasionally there are groups of animals, such as a lion and lioness, buffalo and wild dogs, etc.

Incised lines show the coat, the surface sometimes being polished afterwards with sand. There is also a mixture of pecking and grooving. Human figures are the most rare; some are armed with bows and arrows, but many are employed in peaceful, social occupations. It is seldom that their eyes are engraved. There are imaginary beings as well; semi-anthropomorphic or legendary animals; indeterminate plants (?), star signs, vague though careful drawings, and some compositions which might be meant for landscapes (?).

Group II (*really a third group*). In these, the outline was first drawn with a graver; then the surface was covered more or less completely with either coarse or extremely fine pecking. Some are very old and weathered, others very recent and light in colour. The naked human figures with exaggerated sex seem to be Bushmen; not many are steatopygous—only two men and three women amongst twenty-eight figures. There are very complicated scenes. Plants are rare; the author thinks the star-shaped patterns are flowers. There are fifty-two kinds of animals, including some reptiles, their size varying from an inch or two to 43 inches (elephant). A python seven metres long stretches across two neighbouring boulders. Animals which abound nowadays, such as hippopotamus, hartebeest and springbok are seldom given, other kinds of existing antelopes are absent. The most numerous are types which have left the district, or ceased to exist, such as the quagga. As small mammals, there are only the genette and the meerkat (*Cynictis*). Birds are rare, except the ostrich. There are none of the insects noted by

Holub and Zelisko, no mastodons, or big Equidæ, or pigs such as those the bones of which lie in the old gravels of the Vaal, no *Bubalus Baïni*, or the big hippopotamus of Windsorton. There are no domestic animals ; it is doubtful if there are dogs, and the Cape sheep, copied by Stow, is much later in style.

Certain engravings have been re-interpreted a second time, either at the same date or very much later (in the case of a rhinoceros, remade as an elephant), or they have been revived ; but the majority have remained untouched.

Another group are imitations of the classic designs or inspired by them. These are sometimes excellent, but mostly purely geometrical. They are often on old surfaces scored by carboniferous glaciers ; such as the symbols associated with various animals at Katlani and Driekops Eiland, the patina on which is the same as that of the background (and therefore very old.—H.B.). There are very numerous and excellently made geometric designs (I do not see why the author considers that these were suggested by or imitations of the engravings ; it is not proved by her description, and so this Group II may be perhaps as old or older than Group I ; as its geographical localisation is different, they cannot be due to suggestion or imitation ; so it had better be considered as the work of a different ethnical group).

Group III. Footprints of men and animals. These are direction signs pointing towards the places where there is water, or, according to another tradition, 'creation-sites', the footprints being those of the creatures, men and animals, who emerged for the first time from the mud near a water-hole. The author suggests that there is perhaps something of a rain-making rite here. She adds that the pictures of snakes were to mark the places where there was wild honey.

Group IV. Scribblings. These have no interest ; they were made recently by the mixed races and whites (alas !).

The author, in the following chapter, studies the chronological order of the figures ; she does not trust much to the patina and only studies the few cases of direct super-position, citing the following instances :

1. Disconnected spotted lines of Group I are immediately below the line drawings of Group II and the filled-in ones of Group III.

2. A single line engraving is directly underneath a filled-in one of Group II.

3. A filled-in engraving, Group II, is below one with no contour line, Group III.

4. A partly filled-in engraving of Group II is immediately below another completely filled-in, Group II–III.

5. Many engravings in Group II emerge from beneath engravings of Group III. The "imitations", more or less contemporary with Group III, must have continued until recent times ; as for the footprints, they are partly very old, in some cases not so old, but never recent.

In the basin of the Riet River, the incised line engravings are older than all the "pecked" ones (Afvallingskop).

What is the age of these engravings ? According to Stow (1880), the most recent were only fifty years old, but the oldest (the symbols) had been there for several centuries. Holub said the most recent were a hundred years old, according to some Bushmen who were grandsons of the engravers, and the oldest more than six hundred years old. Péringuey, noting the total absence at Kinderham of oxen and sheep, considers them previous to the arrival of the Hottentots ; less happily, he dated them as contemporary with the Acheulean double-faced tools found at the same spot. An elephant, reproduced by Burkitt, was drawn before the days that Hottentots added on the older figure those of iron-tipped javelins. Lowe considers the engravings of Lower Smithfield and some others, as well as certain paintings, to be of Middle Smithfield date. Lang and I consider part of them much older. At Afvallingskop, which I have visited, there is no Smithfield industry, but much of various dates in the Old Middle Stone Age. Lastly, at Stowland, the industries are very abundant and almost all of Middle Stone Age date ; though it is true that some fairly good figures had been added there only a few days before our passage (1929).

After some remarks about the patina, the author accepts as date "many centuries" for the old ones, without further precision.

How were the engravings made ? Miss Wilman thinks with a diamond : I pointed out that, at Stowland, flakes of quartz and chalcedony had been used. Van Riet Lowe experimented with these and proved their efficacity.

Who made the engravings ? Not the painters. In Bechuanaland and South Rhodesia, engravings and paintings are near each other, but very different. The author praises the cleverness of the engravings and under-estimates that of the paintings, attributing wrongly (according to my ideas) the 'shading' to disintegration of the rock. The engravings are mostly geometric designs, flowers (?), trees, fewer humans rarely steatopygous, and yet fewer mythical groups and scenes. As a whole, the engravings seem older than the less ancient paintings, as they lack the battle or cattle robbing scenes of these latter.

The geographical distribution differs ; the engravings tend to be in Central South Africa, touching the region where there are paintings in Damaraland, Southern and Northern Rhodesia and

Bechuanaland, where there are few engravings but fine paintings.

The footprints of men and animals have a wider distribution, which, I think, tends to separate them ethnographically from the other engravings. In the actual Bushman country, there are neither engravings nor paintings; there are none in Zululand (Stow and McGregor), or in southern Bechuanaland. Large tracts of country have therefore neither one nor the other.

The author almost follows (except for Damaraland) the geographical divisions given by Stow. She thought the engravers came from the North via the central region, establishing themselves in the upper valley of the Harts and Vaal Rivers, pushing forward into Griqualand as far as Withbergen, and going south as far as Beaufort West and Newbergen.

The painters, however, must have followed the west coast and the midlands of Cape Colony, going upwards as far as the south of the Vaal, where they met the engravers, resulting in a certain combined technique in the Snoewberg: some painters went as far as Griqualand. The habits of the two groups differ; the painters were cave dwellers; the engravers lived in round huts on rocky hills.

What Stow writes about them, he learnt from Bushmen, and the Basutos tell the same story. He exaggerates the density of population in the Pniel and Half Way House (Kimberley) regions, and Miss Wilman corrects this, following Péringuey. She holds (and with reason) that there were fewer engravers at a time, and that the work occupied years and even generations. There must have been settled habitations near permanent water-holes, and at such sites there are many engravings; elsewhere they are only sporadic.

Were the engravers ||N *Bushmen?* Were the primitive engravers of the same race as the last of the engravers mentioned by Stow? The author thinks so, for the different styles of engraving blend one in the other (in the geometrical and footprint series, this can be disputed). She sees here the work of a single tribe, whose descendants spread over Griqualand and Bechuanaland.

According to Miss Bleek, the ||N Bushmen who lived on the Orange River had a different language from that of the Kam Bushmen of the Cape; they wore stone bracelets to give weight to the arm when throwing a javelin.

Should these engravings be considered pre-Bushmen? Without going as far back as the Acheulean industries of Kinderham, there is a Smithfield industry site there, and Van Riet Lowe recognised the association of Old and Middle Smithfield implements with engravings; Upper Smithfield and microlithic Wilton industries are found with the paintings. I have said, and think, that, for the date of some of the engravings, we must go back as far as the Middle Stone Age.

According to Broom, the human type of the Middle Stone Age is the Australoid Korana (though the Springbok man seems to me to contradict this); he attributes to them not only all the engravings, but also the pierced stone rings of the digging sticks, and he thinks, though I do not think this can be upheld, that the engravings have been made with metal. Miss Wilman contents herself with rejecting this attribution to the Koranas, they being too stupid and indolent.

Were not footprints frequently drawn by Australians, as well as a good many symbols and even some fairly well-made figures? Can one argue from the modern Koranas what their ancestors would be? Perhaps they did their share of the engravings and the Bushmen did the best ones. Civilisation, art and race are not synonymous; no doubt, this will be for long an open question.

What did the engravings mean? At Blow Bank, Stow noticed that the old geometrical engravings were not superposed, as were the more recent. He thought that, at the beginning, these drawings were sacred and respected, and remained so for a long time. Then, after a long interval, late copies were frequently made. Certain scenes seemed to him orgies; others hunting scenes, intimate scenes, masquerades and legendary subjects. A hippopotamus at Gams is drawn across dry ground with a rope by Bushmen; no doubt a rain-making scene?

Why are certain boulders covered with drawings (Afvallingskop), whilst others nearby, just as suitable, have nothing on them?

So far, the engravings have been fairly well studied on the Vaal, in Griqualand West at Pniel, Klipfontain, on the upper stretches of the Riet River, at Vereiniging, etc.; but no complete study has ever been made, no corpus published nor even classified, in spite of Miss Wilman's effort.

The technique and the subjects vary from one site to another. At Kinderham humans are associated with animals; elsewhere, the animals are alone. In other places, stars, trees and geometrical designs are side by side with animals and men. The animals vary at the different sites; there are no jackals amongst the engravings on the Vaal. In certain spots, geometrical designs predominate.

How many unsolved problems there are! Miss Wilman has at least made an objective contribution, profusely illustrated, to this entrancing subject; she adds some valuable observations, and we must congratulate her on not having delayed publishing what she knows and thinks, and be ready to discuss the one, and gratefully make use of the other.

H. BREUIL.

Prevention of War

The Intelligent Man's Way to Prevent War. By Sir Norman Angell, Prof. Gilbert Murray, C. M. Lloyd, C. R. Buxton, Viscount Cecil, W. Arnold-Forster, Prof. Harold J. Laski. Edited by Leonard Woolf. Pp. 576. (London : Victor Gollancz, Ltd., 1933.) 5*s.* net.

"THE last word of evolution is this : The race is not to the swift nor to the strong but to the wise." With these words Dr. W. Langdon Brown closed an address on biology and politics in which he indicated certain general biological principles which bear on the political difficulties arising in the present conflict between nationalism and internationalism. Among the gravest needs of to-day is that of more intelligence in our national and international affairs, and anything which directs attention to this need is welcome. Nowhere is this more essential than in international affairs, both in our attitude to, and in thinking about, problems of world peace. Despite the quickening pulse of preparations for war during recent months, all the evidence goes to show that the general will to peace is much more conscious and decided than before the War, and there is no reason to question the sincerity of that desire. The growing danger of war is due mainly to lack of intelligent thinking about the problems involved, to a mental lethargy which refuses to face the full facts and to our tendency to desire two mutually inconsistent things.

The first step to world order is taken with the realisation that competition in national armaments, in place of giving security, leaves the relative position unchanged, and in fact tends to decrease security through the distrust and suspicion it breeds between the nations. The most serious feature of 1933 was the marked tendency in some quarters to forget the lesson impressed on men's minds in 1918–20 and to slip back into the pre-War mentality just when the Disarmament Conference was in session.

The second step towards world order is taken when it is generally realised that national defence rests fundamentally on pooled security and is a collective and not an individual matter. This view is, of course, implied alike in the Covenant of the League of Nations and in the Pact of Paris ; but even now not only are the full implications of such a system imperfectly understood by public opinion but also there is a gnawing anxiety as to whether the pledges given in such treaties will be observed.

These are not matters to which the scientific worker can be indifferent. Without urging that this is a matter which is peculiarly his responsibility, it is undoubtedly one in which he bears special responsibilities, and the lucid and impartial exposition of the various factors contained in "The Intelligent Man's Way to Prevent War" merits indeed the thoughtful attention of all scientific workers. Fundamentally, the problem is one of education, and the uncertainty whether the educational work can be completed in time to avoid disaster only emphasises the need for whole-hearted support from the scientific worker.

As Dr. W. Langdon Brown pointed out in the address referred to above, while we are developing the need for larger and larger units in our social and industrial life, we are slow to restrict the impulses which tend to destroy such units. If we fail to adapt ourselves to the demands of evolution our civilisation will undoubtedly perish, and political events in 1933 do not encourage undue optimism. If, however, from an intellectual point of view there is reason for concern, biological considerations encourage optimism. The ease with which the body can throw off disease and return to health should safeguard us against the hasty belief that events in Japan or Germany, for example, inevitably presage a relapse into barbarism.

Moreover, the problem of security and disarmament, of world peace, is less technical than is commonly supposed. There are important technical factors, it is true, and there are problems to which the man of science can and should make an important specific contribution. What is even more important, however, is to destroy the feeling of mystery with which science is commonly surrounded, and by aiding ordinary intelligent people to appreciate the principles of science, to encourage the application of them to the everyday problems of a modern community. The enthronement of reason in place of prejudice thus secured would not mean the tyranny of experts, but would ensure that rational conduct of international affairs which would at once eliminate war. This point is well brought out by Sir Norman Angell in two chapters on "The International Anarchy" and on "Educational and Psychological Factors" which are among the most valuable in the book. They are to be commended to the scientific worker more than even Prof. Gilbert Murray's expert analysis of the possibilities and problems involved in revision of the peace treaties, Viscount Cecil's study of the League as a road to peace or W. Arnold-Forster's admirable discussion of the interlocked problems of arbitration, security and disarmament. Understanding of the issues there must be, but, above all, there must be action along the lines upon which the experts have already agreed that security and progress are possible.

R. BRIGHTMAN.

Short Notices

Dip and Strike Problems Mathematically Surveyed. By Dr. Kenneth W. Earle. Pp. x+126. (London: Thomas Murby and Co., 1934.) 12*s*. 6*d*. net.

It is not stated whether this book is intended for use as a textbook, although on perusal this seems to be the case. It would perhaps have been preferable to mention the degree of mathematical knowledge desirable in the reader; some of the workings given in the earlier portions are detailed, while later portions omit stages in the calculations, and in this way difficulty might be caused to students who seldom use plane and spherical trigonometry. The working on page 9, from which formulæ for finding the true dip of a bed from three points of outcrop are derived, would be easier to follow had a figure been appended.

The worked examples are extremely useful and clear, and are essential to an understanding of the use of the formulæ. The term "secondary tilt" might perhaps have received more detailed definition, and here also a figure would be useful. Some of the formulæ deduced for use in problems connected with borings are somewhat cumbrous, notably No. 64, and would take some little time to work out even by slide rule. It may also be doubted whether it is worth while calculating dips to minutes of arc, having regard to the manner in which dips change in the field in quite short distances, even in districts which have not been materially affected by major earth-movements.

One of the best chapters is that dealing with faulting. The figures here are well set out and informative, and the treatment is exceptionally clear in style. The glossary of structural terms which concludes the volume is also very useful, though it would be difficult to follow some of the definitions given without a fair knowledge of structural geology.

B. H. K.

Differential Equations. By Prof. H. B. Phillips. Third edition. Pp. vi+125. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 10*s*. 6*d*. net.

To conform with modern teaching practice, the text of this book has been carefully revised and a few new sections added. The treatment is essentially practical and designed to provide a working basis for the scientific student. There are four chapters; two devoted to equations of the first order, one to the special types of second order equations most frequently occurring in practice, and one to linear equations having constant coefficients. The theoretical aspect has not been wholly ignored, and, though inadequate for the needs of purely mathematical students, sufficient is discussed to give an intelligent grasp of the principles underlying the solution of differential equations. The text is well illustrated by worked examples drawn mainly from mechanics, chemistry, engineering and physics. Plenty of exercises are also provided for the student to solve. The notation 'ln' for '$\log_e$' will probably be somewhat strange to British readers.

Analytic Geometry. By Prof. F. S. Nowlan. Second edition. Pp. xii+352. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 13*s*. 6*d*. net.

This volume is the second edition of the original book, published last year. It is designed for first and second year students in American and Canadian universities. Eleven chapters are devoted to a study of the conics, based upon a definition of the general conic, and in which extensive use is made of the principle of orthogonal projection. Parametric representation is freely employed, but the proof that the general equation of the first degree always represents a straight line is not thoroughly satisfactory.

There is a good chapter on higher plane curves, followed by quite an exhaustive treatment of determinants, which seems to come rather late in the course. Indeed, as a study of determinants belongs properly to algebra, a brief revision section at the beginning should have been sufficient.

The remainder of the book is concerned with the usual course in three-dimensional co-ordinate geometry, and is quite well written and developed.

Budgerigars in Bush and Aviary. By Neville W. Cayley. Pp. xv+148+14 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1933.) 7*s*. 6*d*. net.

About one hundred years ago budgerigars or love-birds were first bred in captivity in Australia; in 1840 Gould brought the first living examples to Britain, and by 1880 their breeding had become a considerable industry at Toulouse. But it was not until the present century that the burst of colour-varieties appeared, which made the budgerigar perhaps the most striking example of selection under domestication, and brought for a time the value of birds (in the sky-blue and cobalt series) to from £100 to £500 a pair. This book, with its six beautiful coloured plates, will probably long remain the standard guide to the habits and particularly to the keeping and breeding of these attractive birds.

The Nidification of Birds of the Indian Empire. By E. C. Stuart Baker. Vol. 3: *Ploceidæ—Asionidæ*. Pp. vi+568+8 plates. (London: Taylor and Francis, 1934.) 30*s*.

With commendable speed Mr. Stuart Baker's third volume follows the second (see Nature, April 21, 1934, p. 591). Beginning with the weaver-birds, it completes the Passeres and the Coraciiformes, and some idea of the thoroughness with which the nesting of Indian birds has been investigated (as well as of blanks still remaining) may be gathered from the fact that of 704 species and subspecies included in these series, the nidification of 545 is here recorded. Like the earlier volumes, this also includes descriptions of some extremely interesting nests and their construction, of which we need mention only those of the weaver-birds, the bee-eaters, and the edible-nest swiftlets. The work is as thorough and comprehensive as its predecessors.

The John Murray Expedition to the Arabian Sea

By Lieut.-Col. R. B. SEYMOUR SEWELL, C.I.E., F.R.S.

IN my previous accounts of the John Murray Expedition (NATURE, 133, 86, 669, Jan. 20 and May 5, 1934), I dealt with the work done up to the time of our arrival in Colombo on February 22, and in the present paper I give an account of the concluding part of our voyage. While in Colombo, we were joined by Major E. A. Glennie, R.E., of the Survey of India, and his staff, who had been detailed to accompany us through the Maldive Archipelago and carry out observations on the variation of gravity by means of pendulum experiments. Leaving Colombo on March 17, we steamed south-west to a point just north of the Chagos Archipelago, and then turned northward to investigate the depth and hydrographic conditions existing in the channel between the Chagos and Maldive groups of islands. On the completion of this work we visited Addu atoll, and Major Glennie and his apparatus were landed on Putali Island at the north-east corner of the atoll. After leaving Addu atoll we steamed northwards to South Malé atoll, landing Major Glennie on the way at Kolumadulu and Mulaku atolls.

At South Malé atoll a formal visit was paid to H.H. the Sultan, who very kindly placed a boat at the disposal of the Expedition and thus enabled me to detach a party, consisting of Major Glennie and Lieut.-Commander Farquharson, R.N., to carry out pendulum and magnetic observations in a line across Fadiffolu and South Malosmadulu atolls, while the *Mabahiss* was engaged in hydrographic and biological work in Kardiva Channel and on the western slopes near Horsburgh atoll. During the course of this work, we discovered the existence of a submerged bank, to which we have given the name "King Fuad Bank", lying at a depth of 130 fathoms, and occupying the greater part of the western end of Kardiva channel between Horsburgh atoll and Toddu Island. After ten days we picked up our detached party and proceeded northwards to Minikoi, where Major Glennie was again landed for pendulum observations. On the conclusion of this work we returned to Colombo for coaling and left again, on our return voyage to Aden, on April 19. After passing through Kardiva Channel and running a further line of soundings across King Fuad Bank, we set our course westward, approximately along lat. 7° N., until we were in about long. 58° E., when we altered course and, passing between Cape Guardafui and Socotra, again entered the Gulf of Aden. Having repeated the hydrographic observations across the mouth of the Gulf at a series of stations as near as possible to those that we made in September and October, 1933, and having made several hauls with the trawl or dredge on both sides of the Gulf, we called in at Aden and on May 13 left for Alexandria, repeating a number of observations that we had made at the head of the Gulf and at the southern end of the Red Sea on our outward journey eight months previously. We reached Alexandria on May 25, and the ship was paid off on the following day.

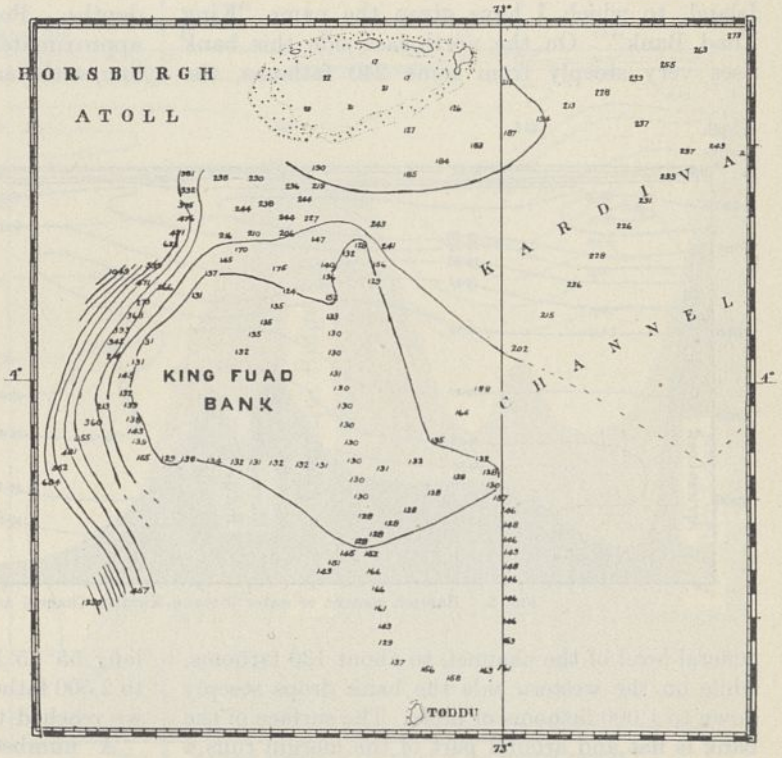

FIG. 1. King Fuad Bank at the western end of Kardiva Channel, Maldive Archipelago.

TOPOGRAPHICAL RESULTS

On leaving Colombo on our voyage to Addu atoll, we first crossed a deep gully, of about 2,200 fathoms depth, that runs north-west near the south-west corner of Ceylon, and then the depth shoaled again. The greatest depth encountered between

Ceylon and the channel between the Maldive and Chagos Archipelagoes was about 2,500 fathoms, but as we approached the Archipelagoes the depth shoaled rapidly until we were in about 1,500–1,600 fathoms, at which depth the bottom remained fairly constant for some distance. In the channel itself the depth of water appears to be in the neighbourhood of 2,000 fathoms with, apparently, a hard bottom, since two attempts to obtain a bottom sample yielded no trace of any deposit.

I have already referred to the discovery of a submerged bank (Fig. 1), situated at the western end of Kardiva channel, and occupying most of the gap between Horsburgh atoll and Toddu Island, to which I have given the name "King Fuad Bank". On the north-east side this bank rises very steeply from some 240 fathoms, the general level of the channel, to about 130 fathoms, while on the western side the bank drops steeply down to 1,000 fathoms or more. The surface of the bank is flat and around part of the margin runs a raised rim on which the depth of water is about 125 fathoms. There can be little doubt that this is a submerged atoll, that still shows clearly the flat lagoon floor and, in places, the raised marginal reef.

As we steamed westward in our voyage from Colombo to Aden, the soundings to the westward of the Maldives showed a series of folds, succeeding each other regularly, the depth varying from 2,800 to 2,000 fathoms. These soundings agree with those taken by us between the Seychelles and the Maldives, but in this more northerly section the range is considerably greater. The eastern edge of the great ridge that runs towards the south-east from Socotra, and to which Schmidt has given the name Carlsberg Ridge, was encountered in lat. 7° N., long. 61° 30′ E. Here again there seemed to be indications of a double ridge, for we obtained a sounding of 1,361 fathoms which seemed to correspond with the 958 fathoms sounding obtained between the Seychelles and the Maldives; the soundings then dropped to 1,840 fathoms and in lat. 7° N., long. 60° E. a second ridge of only 1,209 fathoms depth was crossed. Shortly after this the ship's course was altered to north-west-by-west. This course was considered to be only a few degrees divergent from the general direction of the ridge, and the soundings for the next fifty minutes fluctuated between 1,230 and 1,340 fathoms with occasional deeper depths. For the next 230 miles the ship was approximately steaming along the 2,000 fathom line, with variations on either side, to lat. 9° 20′ N., long. 55° 15′ E., when the soundings dropped steeply to 2,500 fathoms and remained fairly constant until we reached the Guardafui–Socotra channel.

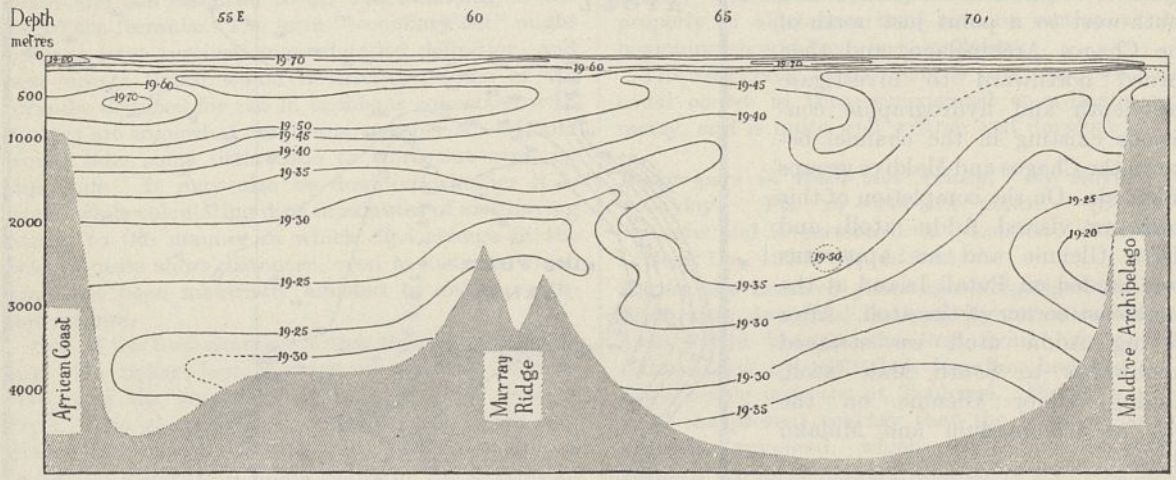

FIG. 2. Halogen content of water between Kardiva Channel and Cape Guardafui.*

A number of samples of the bottom were obtained. In the north-eastern basin, we obtained a long core, 52 inches, of soft reddish-cream ooze, and from a deep trawl in lat. 6° 55′ 18″ N., long. 67° 11′ 18″ E., depth 4,718–4,793 metres (Station 166) we obtained 125 kilograms of rounded or angular nodules, containing manganese, of varying sizes, but there were no signs of any living organisms, though the net was on the bottom for two hours. Sir John Murray himself many years ago directed attention to the character of the bottom deposit in this region, lying between lat. 5°–12° N. and long. 62°–72° E., which must be classed as a "Red-Clay".

On the Carlsberg Ridge itself, in lat. 7° 14′ N., long. 60° 38′ 42″ E., depth 3,182 metres (Station 168), the bottom was rocky; the trawl frame was bent and broken and the net torn, but we obtained a few fragments of foraminiferal limestone.

* It was originally intended to call the ridge between the island of Socotra and the Chagos Archipelago the "Murray Ridge"; but it has since been discovered that Dr. J. Schmidt, who crossed it in the *Dana*, had already named it the "Carlsberg Ridge".

While passing through the Straits of Bab el Mandeb and the area to the immediate north in the region of Great Hanish Island, we again obtained clear evidence of the formation of a calcareous rock on the bottom, and in lat. 15° 54′ 36″ N., long. 41° 13′ E., we brought up large quantities in the four-foot triangular dredge, mixed with a greenish-brown mud that contained large numbers of pteropod shells.

Hydrographic Results

During the run across the Arabian Sea a number of hydrographic observations were taken, and a preliminary survey of these observations indicates a complicated circulation of the deeper water masses. The results of the analysis of the halogen content of the water are shown in Fig. 2, and it is interesting to compare this with the figures that I have given in my previous report of the results obtained in our earlier crossing of this region between Bombay and Mombasa (NATURE, 133, 700, Figs. 2 and 3).

The surface water, having a halogen content of 19·60 and above in the western and central area, is moving in an easterly or south-easterly direction sinking somewhat as it goes, until in long. 61° E. it disappears below the surface and is continued at a depth of some 50 metres. Below this, at 300–400 metres, there seems to be a westerly movement of water of a somewhat lower halogen content, 19·5 and less, that can be traced as far as long. 55° E. The main mass of water of halogen content of 19·6 and above, coming out of the Gulf of Aden between the depths of 400 and 800 metres, appears to swing towards the south and passes partly between Cape Guardafui and Socotra but in the main to the east of the island, while farther east between long. 55° and 62° E. a tongue of water, having a halogen content of 19·52–19·53, is moving in a south-east or easterly direction. In the south-west basin a mass of water of a halogen content of only 19·21 occupies the greater part of the deep area, and appears to be moving east and north-eastward until, meeting with the Carlsberg Ridge, it is deflected, part passing over the ridge into the north-east basin and part being deflected upwards towards the surface. There can be little doubt that this water of low halogen content is derived ultimately from the Atlantic bottom-drift that probably enters the south-west basin between the Seychelles and Madagascar.

In the north-east basin the surface water appears to be forced downwards, and at a depth of some 700 metres is split into two streams, one passing towards the west, where we have already seen it forming a stratum at a depth of 300–400 metres, the other sinking downwards until it meets the eastern slope of the Carlsberg Ridge and is then deflected first eastwards, and then upwards towards the surface. The south-east part of the basin in long. 72° E., between the depths of 2,000 and 3,000 metres, is occupied by a mass of water of low halogen content, 19·25 or less, that must, again, be derived from the antarctic bottom drift, and probably enters the basin between the Maldives and the Chagos Archipelagoes, where there is a deep channel of some 2,000 fathoms (3,600 metres) depth. Below this depth the bottom of the basin appears to be occupied by water of a somewhat higher halogen content, 19·30 and above, the sample from extreme 4,000 metres depth having a content of 19·34 and at 4,500 metres of 19·83, though this last figure is open to suspicion. In long. 67° 11′ E., at a depth of 2,500 metres a mass of water was encountered having a halogen content of 19·50, while the reading at 2,000 metres was 19·36 and at 3,000 metres 19·28. It is possible that this is the continuation of the outflowing water of high

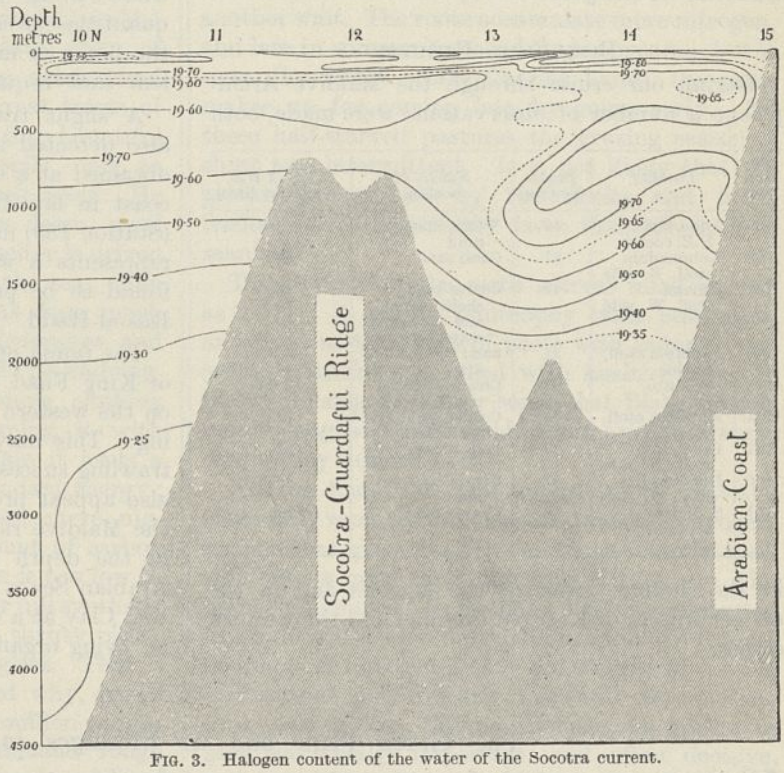

FIG. 3. Halogen content of the water of the Socotra current.

halogen content from the Gulf of Oman, that has gradually sunk downwards off the west coast of India and the western slopes of the Laccadive and Maldive Archipelagoes.

The results obtained by repeating our observations in the Socotra current across the entrance to the Gulf of Aden show a considerable degree of similarity with those obtained during our earlier work in September (cf. NATURE, 133, 67, Fig. 3 and 87, Fig. 2). In the Straits of Bab el Mandeb, however, conditions were very different and now (April–May) agree closely with the results previously obtained by the *Magnaghi* and *Ormonde* at this time of the year.

BIOLOGICAL RESULTS

During our cruise through the Maldive Archipelago a number of observations were made, both in the shallow water of the lagoons and in the deeper waters of Kardiva Channel and the western slopes.

Station No.	Locality	Depth (metres)	Nature of bottom	Amt. of H_2S (mgm. per litre)
137	Addu atoll, N.E. corner	46	White, chalky mud	4·90
139	Kolumadulu atoll, E. side	57	Coral sand	nil.
141	Mulaku atoll, W. side	44	Coarse sand, shells, coral and conglomerate rock	nil.
142 (*a*)	Fadiffolu atoll, E. side	31	Sand and white mud	3·29
142 (*b*)	ditto.	37	Cream-coloured mud	2·26
144	Fadiffolu atoll, W. side	31	Coarse coral and shell sand	nil.
147	Horsburgh atoll, N. side	27	Soft cream-coloured mud	nil.
160	Horsburgh atoll, N. side	37	Cream-coloured mud	7·73
161	S. Malosmadulu, W. side	46	Coarse sand	nil.

One interesting and important discovery that we made was the presence of sulphuretted hydrogen gas in the bottom-deposit of several of the lagoons. The details are given in the accompanying Table.

It will be noted that in every case the presence of the sulphuretted hydrogen is associated with a fine white or cream-coloured mud, and in most cases where the gas was found there were thickly wooded and fertile islands in the near vicinity, so that it seems probable that this gas is caused by the decomposition in the mud of organic material derived from the vegetation of the islands. To what extent the presence of this gas, in such quantities as are indicated above, may influence the fauna or inhibit the growth of coral is a problem that requires investigation.

A slight trace of sulphuretted hydrogen was also detected in a bottom deposit of green mud, obtained at a depth of 95 metres, on the Arabian coast in lat. 13° 51′ 30″ N., long. 47° 49′ 12″ E. (Station 189) in the Gulf of Aden, and this possibly represents a western extension of the conditions found to be present farther to the east off Cape Ras-al-Hadd.

The fauna of Kardiva Channel and the flat level of King Fuad Bank proved to be a rich one, but on the western slopes the catches were disappointing. This may be due partly to the difficulty of trawling successfully on a steep slope, but it would also appear probable that on this western side of the Maldive ridge the fauna is impoverished, and in the depth of the north-eastern basin of the Arabian Sea a trawl of two hours' duration on the Red Clay at a depth of 4,718–4,793 metres yielded no living organisms at all.

The Green Plant and its Messages to Mankind*

IN this clanging world of constant change, one thing stands fast: the green plant, the greatest wonder of the world, the engineer of life. Some of its messages it sends direct to us by its own special messengers, for example, the vitamins; others it leaves scientific interpreters to convey. The green plant is the source of the paper upon which the latter messages are written, and when the paper perishes, the plant gathers up the fragments and welds them again into leaf and flower and fibre. It is also the source of coal, of wood, of dyes, spices, fabrics and wine.

The life of the simplest of green plants, *Chlamydomonas*, tells us of feats of structural engineering beyond human power, and suggests hydraulic systems so perfect that, in spite of its fragility, the green plant can sustain pressures comparable with those of the steam-engine, and that too without shriek or moan. The individual *Chlamydomonas* is invisible to the naked eye, yet so numerous that at certain times they form a green scum on the edge of the sea and on inland waters. *Chlamydomonas* is a plant-animal. In its green youth it is active and self-contained; the only materials for its sustenance are solutions of carbon dioxide, simple nitrogen compounds and mineral salts. From these it builds up sugar and starch by photosynthesis, and amino-compounds and proteins with the help of oxygen derived from nitrates in the sea-water. A powerful swimmer for its size, it propels itself by means of long, slender protoplasmic threads towards the light. But these 'salad' days come to an end. The solitary swimmers unite by fusion, protoplasm with

* Summary of the Thomas Hawksley lecture, "The Green Plant as Agricultural Engineer", given by Sir Frederick Keeble before the Institution of Mechanical Engineers on October 26, 1934.

protoplasm, nucleus with nucleus, and the spherical product settles down on some debris in shallow water. The chlorophyll steals away, and what was before a plant is now an animal, depending, like all animals, on external supplies of food. Its body grows, subdivides, and the parts subdivide again, flagella appear, and the plant-form of *Chlamydomonas* is born anew. The message to mankind is patent to all: "The green plant makes the best of both worlds; go thou and do likewise!"

Whatever man may have done with his own world, he certainly has not made the best of the other world—the world of the green plant; if he had, his own would be far brighter and happier. What has he done for the green plants' world? By incessant labour he has made little plots of earth more fruitful; but invading armies and marauding bands have laid waste great tracts of fertile land. He has changed weeds into bountiful cereal crops, has ravished virgin soils, only to move on and let the weeds come back again. He has felled forests and burned them down, until the earth which the forest used to shelter is driven by storms of rain to seek refuge in the sea. Man by his intelligence and industry has done much for the green plant, but by his ignorance and improvidence he has done far more for its undoing.

The green plant makes a brave show, clothing the earth with verdure and adorning it with garlands of flowers; but in the main it leads a life of poverty. The sun gives it abundant energy; earth and atmosphere are, however, more niggardly. In spite of the ample amount of carbon dioxide in the air, its concentration is too low to allow the green leaves to keep up their full synthetic powers. Wheat is pre-eminent as a thrifty plant, and will stand a fair amount of neglect. That is why it is grown so universally, and why, grown even as it is, the crop feeds some 300 million people. The kinds mostly grown can withstand rough weather and get along with scanty supplies of food. Inured to hardship like the farmer himself, they respond but grudgingly to more generous treatment; but some kinds respond to nitrogen more readily than others. The wheatlands of the world could feed thrice 300 million people if they were relieved of chronic hunger for nitrogen and phosphates. The grasslands of the world are even more hungry, and the landscape often reveals their poverty. Grass makes a brave showing, which adversity cannot mar; but the brave show is brief. The short life of the grass growing on the thin soils of the Cotswold hills was observed by Shakespeare, as we observe it to-day, and he must have had this fact in mind when he wrote: "Everything that grows holds in perfection but a little moment."

The green plant, schooled by age-long privation, has grown adept in the arts of economy. It builds up nitrogen into organic form, breaks it down again, and sends it off to other tissues that need it. These tissues build it up again into protein, only to unbuild it and pass it on once more, like some old garment that is renovated and handed on in thrifty families from the eldest to the youngest child. In spring the grass has but little nitrogen left to pass on; so the roots get to work early to obtain fresh supplies from the soil; but nitrogen is not readily forthcoming from the soil; warmth alone can release it. In time, a belated flush of grass appears, but the nitrogen stored by the root is soon used up, and the grass dies down; another wait. The roots accumulate more nitrogen, and late in summer a second flush appears; but it soon dies away. Like Charles Lamb, the grass makes up for coming late by going early. On these half-starved pastures the grazing season is short and intermittent. Is it not likely that the privations endured by the flocks and herds feeding on such pastures have their effect upon mankind?

The poverty of the earth starves mind as well as body; it infects philosophy with pessimism, and burdens the songs of poets with sadness. An earth bountifully supplied with healthy vigorous life would sing the happy songs that Blake wanted men to sing, and hope would again arise in a world desperately in need of it.

Newton found out that apples fall by gravity: it has only recently been learned that it is nitrogen-hunger that gives gravity its chance. Apple-trees will bear a good crop annually if they are adequately manured. Sometimes apple-trees planted in a light soil remain unfruitful in spite of adequate dressings of nitrogen; they are starved of potash, and annual or half-yearly doses will restore them in a year or two. Mineral deficiencies appear to play an equally important, and often decisive, part in inducing disease in both plants and animals. All plants need iron: beans and their like will not grow without boron; tea in Nyasaland has suffered from lack of sulphur; tomatoes in the Philippines have to be given homœopathic doses of copper; some plants cannot thrive without zinc; buckwheat cuts off the heads of its flowers if there is no chlorine in the soil. Potash serves the green plant as a partial substitute for sunshine; magnesium is essential for the formation of chlorophyll; and manganese acts as a stimulant to some plants. Among animals, calcium, iodine, fluorine, iron, and almost certainly manganese, copper and silicon, and possibly magnesium, are needed either for building purposes, or for promoting healthy growth and helping the body to resist disease.

The scarcity of essential plant-foods is all but

universal, and those who are obsessed with the idea of over-production may rejoice in this fact. But the abundance is largely one of half-starved plants and of periodically ill-nourished animals. If food is lacking in quality, its consumer will remain ill-nourished however much he eats. In the days when men lived by calories alone, or thought they did, energy-intake alone mattered; if a man got ill, the cause was ascribed to bad heredity or maleficent microbes. Now we know that starch, sugar, fats and proteins alone will not make us grow or thrive. How this comes about is well shown by the oat shoot. When the extreme tip—not more than 1 mm.—is cut off from the young green shoot, it ceases to grow. If the tip is replaced, the shoot grows again, and the same happens if, instead of the tip being replaced, a cube of agar or gelatin on which the tip has been kept takes its place. The explanation lies in the activity of a chemical messenger (growth-substance) present in the tip of the shoot. Such messengers control the growth of the green plant, and also that of animals. In the human body there are the special chemical messengers known as vitamins, which encourage growth, charm away disease and promote fertility. The green plant is the metropolis from which many of these vitamins set out on their journey to our world, and they reach us either directly in fruit or other fresh green foods, or indirectly in dairy produce and in meat.

To make the best of the world of the green plant, we must utilise to the full our knowledge of the vitamins and their mineral allies on one hand, and of the fertilising power of nitrogen on the other. In carotene, the precursor of vitamin A, summer grass is rich, and winter grass is poor. Summer grass, grown with nitrogen, dried quickly and kept out of contact with air, forms an ideal food, rich in carotene, for cows in winter, and the milk and butter they yield is a perfect food for children. Other and possibly greater benefits will follow from the use, as winter fodder, of lucerne, clover and other crops with all their summer vigour in them.

Through vast periods of time, a long winter of scarcity has alternated with a brief summer of abundance; hence primitive man made the waxing and waning of the sun, and of the earth's fertility, the basis of his mythology; even to-day we celebrate the awakening of life in spring with the Maypole dance.

The nitrogen and mineral scarcities of the earth have directed the evolution of the green plant; may they not also have helped to direct the evolution of mankind? Must not the recurrent malnutrition from which man perforce suffers leave scars upon his body and his mind?

Heredity teaches that our bodily and mental characters are determined irrevocably at birth; the masters of our fate are the genes that reside in the chromosomes of the cell-nucleus. Is it not possible that malnutrition may have undermined the resistance of the chromosomes themselves and weakened the power of the genes? In a world of nitrogen-plenty, the chromosomes might be well nourished, and infertile genes might get the tonic they need to make them fruitful. If that is so, the determinacy in our present view of heredity will disappear, and the age of the creative evolution of mankind will be at hand.

Obituary

Prof. Georges Dreyer, C.B.E., F.R.S.

GEORGES DREYER was born on July 4, 1873, at Shanghai, where his father, Capt. G. H. N. Dreyer of the Danish Royal Navy, was stationed at the time. He was educated in Copenhagen, where he qualified in medicine in 1898 after a very brilliant career as a student. While serving as a medical officer in the Navy, he found time to do some work with Salomonsen in the Pathological Department of the University, and continued this later when he was house physician at the fever hospital. For a time he was responsible for the production of diphtheria antitoxin at the newly established Serum Institute, and he received his M.D. degree in 1900 for a thesis on diphtheria toxin and antitoxin. Dreyer became a *Privatdocent* in the University of Copenhagen, and carried on an astounding amount of research on a wide variety of subjects—typhoid agglutination, the effect of light on bacteria and protozoa, the action of enzymes, and other subjects. An interest in mathematics had been early stimulated by his father, and in all his varied research he attempted to obtain accurate quantitative results. He found existing methods unsatisfactory for exact quantitative work, and developed new technique in many branches of biological research. He travelled extensively in Scandinavia, Germany, France and England, and came into contact with the leading workers in many fields. An excellent linguist, he spoke Danish, French, German and English fluently.

In 1907, at the early age of thirty-four years, Dreyer was appointed to the professorship of pathology at Oxford. He was the first holder of the chair, although pathology had been taught at Oxford for some years and a new laboratory had been recently built. From 1907 until 1914 he organised and built up the department, and together with his colleagues carried out a considerable amount of research, particularly on the blood volume of mammals—probably one of his most important contributions to science. In 1914 he volunteered for service, and spent much time in France. His great experience of the

laboratory diagnosis of enteric fever proved to be very valuable, and the agglutination technique which he had developed several years previously in Copenhagen was very extensively used. With his colleagues he was able to show that the vast majority of cases of enteric fever in inoculated troops was not typhoid, but paratyphoid fever. He promptly pressed for the 'triple inoculation' instead of the single antityphoid inoculation of all troops. When, in spite of vigorous opposition, he was able to bring about this reform, he felt that his most important work with the R.A.M.C. was accomplished. He had become interested in the medical problems of flying, and he transferred to the Air Force. He designed an ingenious apparatus for automatically controlling the supply of oxygen to pilots, according to the altitude.

Dreyer returned to Oxford after the War, and carried out research on the assessment of physical fitness by vital capacity measurement correlated with certain body measurements ; the serum diagnosis of syphilis ; immunity to tuberculosis ; effect of light on bacteria ; bacteriophage, and other subjects. A generous grant from the trustees of the late Sir William Dunn enabled him to build a new laboratory which was completed in 1926. His capacity for administration, and his genius for taking a wide view of science was recognised by his election to the Hebdomadal Council and to the University Chest. He was for some years a member of the Medical Research Council, and served on several of its sub-committees.

Dreyer had been elected a fellow of the Royal Danish Academy of Science and Letters before he came to Oxford. He was also Officier de l'Instruction Publique, and for his military service he was created C.B.E. He was elected a fellow of the Royal Society in 1921.

Dreyer was a man of sound common sense, and his views on administration and on business matters were highly valued in the University, and in his own college, Lincoln, of which he had been a fellow since 1907. His great personal charm and his genial nature endeared him to his colleagues and he was a very welcome guest in common rooms and dining clubs in Oxford. He never suffered fools gladly, but he never bore malice against anyone. His lovable nature, great generosity and the power of inspiring his younger colleagues make the loss occasioned by his death on August 17 last the more deeply felt. He married in 1900 Margrethe Jörgensen, and had an ideally happy married life.

WE regret to announce the following deaths :

Mr. G. H. Bosch, who provided endowments for chairs of embryology and histology, medicine, surgery and bacteriology in the University of Sydney, aged seventy-three years.

Dr. Willard J. Fisher, research associate and lecturer in astronomy at the Harvard College Observatory, known for his studies of meteors, on September 2, aged sixty-six years.

Prof. D. A. Murray, emeritus professor of mathematics in McGill University, an authority on differential equations, aged seventy-three years.

Prof. F. L. Stevens, professor of plant pathology in the University of Illinois, author of works on fungal diseases of plants, who studied especially tropical parasitic fungi, on August 18, aged sixty-three years.

News and Views

Nobel Prize for Medicine and Physiology for 1934

IT is announced that the 1934 Nobel Prize for Medicine and Physiology has been awarded jointly to Dr. George F. Minot and Dr. William T. Murphy, of Boston, Massachusetts, and Dr. George H. Whipple, of Rochester, New York State, for their research into liver therapeutics in connexion with anæmia (*Times*, Oct. 26). Dr. Minot is professor of medicine at Harvard University and Dr. Whipple is dean and professor of pathology of the University of Rochester, New York. The liver treatment of pernicious or Addisonian anæmia, which is now the standard treatment for the disease, was developed by Minot and Murphy about eight years ago from the experimental work of Whipple and his associates on secondary anæmia in dogs. Whipple maintained his animals in an anæmic condition by frequent withdrawals of blood, and tested the power of different foodstuffs to cause blood regeneration by adding definite amounts to a standard diet on which regeneration did not occur. Among the substances so tested was liver. Minot and Murphy tried it in pernicious anæmia and found that adequate amounts produced a remission which is maintained provided the treatment is continued. Liver has little or no action in human secondary anæmias, but is effective in certain other anæmias which, like pernicious anæmia, are characterised by an increase in the amount of hæmoglobin in each red blood cell although the total amount per unit volume of blood is diminished.

LATER work has shown that the factor in liver which has proved so valuable in the treatment of pernicious anæmia can be obtained in extracts of much less bulk ; it also appears to be produced by the action of normal gastric juice upon flesh foods. The deficiency in pernicious anæmia is a deficiency in the secretion of the stomach. The immediate and characteristic response to liver is an increase in the number of young red cells, or reticulocytes, in the blood ; this is followed by an increase in the number of mature cells and in the percentage of hæmoglobin. Pernicious anæmia is a disease which was invariably fatal before liver treatment was adopted, although its course might show a series of remissions and relapses. With adequate liver treatment, patients may live indefinitely in normal health ; and the

onset of the nervous disease which frequently complicates the later stages of pernicious anæmia is prevented. Liver, in fact, has played in the treatment of this disease a similar part to that of insulin in the treatment of diabetes.

Johann Carl Friedrich Zöllner (1834–82)

ON November 8, the centenary occurs of the birth of Johann Carl Friedrich Zöllner, who in the course of a comparatively short career raised himself to a distinguished position among German astronomers as a pioneer in astrophysics. He was born at Berlin, and passed through the Universities of Leipzig and Berlin with distinction; after holding office as an extraordinary professor, he was appointed in 1872 to the chair of physical astronomy at Leipzig. That same year he was elected an associate of the Royal Astronomical Society. In 1865 he had turned his attention to the larger planets, and he afterwards advanced a theory of their constitution which met with wide acceptance, directed attention to the rapid changes in the cloud-belts of Jupiter and Saturn, and made observations of the rotation of the planet. On February 6, 1869, before Janssen and Lockyer devised their method of observing solar prominences in broad daylight, Zöllner read a paper before the Saxon Society of Sciences on a method of doing this, but did not obtain a suitable instrument until some months later. In some of his work, Zöllner was assisted by his pupil Hermann Carl Vogel (1842–1907), afterwards director of the astrophysical observatory at Potsdam. Zöllner died on April 25, 1882, at the age of forty-seven years.

Legislative Control of British Fisheries

IN its report on the herring industry, the Sea-Fish Commission made far-reaching and drastic proposals for the re-organisation of the industry to meet the altered conditions of marketing, and thus to prevent a ruinous decline. The main recommendation was that a Herring Board should be appointed with very wide powers of control over the whole industry. The members of this Board should be nominated by the appropriate Ministers, and should number not more than eight, of which three, including the chairman, should be independent of the trade. Before asking the Government or the Treasury to consider any of the Commission's proposals, however, the Secretary of State for Scotland and the Minister of Agriculture and Fisheries desired to ascertain the views of the fishermen and of the other interests concerned. Accordingly, they arranged to meet a representative conference of all branches of the industry, and this meeting took place at the Scottish Office on October 25. It is learned that, subject to certain reservations made on behalf of Clyde fishermen and exporting interests, the recommendations of the Commission met with the unanimous approval of the industry. If (as now seems likely) the Government decides to go forward with the Commission's proposals, the subjection of the British fisheries to legislative control will be complete. With local by-laws controlling fishing within territorial waters, orders-in-council governing the trawl fisheries of the high seas and the Herring Board directing the herring fisheries, administrative machinery will have superseded individual freedom in fishing and marketing. This greatest of all experiments in the modern history of British fishing is all the more remarkable because it has the general approval of the industry itself. It will surely command the closest attention and interest of economists and biologists alike.

Electrical Properties of Insulating Materials

PROF. W. M. THORNTON, of Armstrong College, Newcastle-on-Tyne, took as the subject of his inaugural address, given to the Institution of Electrical Engineers on October 25, the electrical properties of insulating materials. He said that there is much in the advanced electrical science of to-day that can never come into practice, yet in the maze of experimental research and wave mechanics which constitute modern physics, there is hidden the explanation of some of the outstanding problems of electrical engineering. Industry is impatient and has to advance without waiting for the slow formulation of fundamental theory. As a result, the insulation engineer in the past found himself responsible for vast expenditures, with little but empirically gained experience for his guidance. In these circumstances, it is not surprising to find that in many respects it is the problem of electrical insulation that is holding back the fullest development of high-voltage engineering for the transmission of large blocks of electrical power. There is at the present time no theory of dielectric behaviour that covers all the facts. Yet there seems to be behind the phenomena a hidden simplicity at least as simple as the free-electron theory of conductors. For example, it has been shown experimentally that the electric strength of air is in fact a physical constant comparable in accuracy of determination with most of the constants of Nature. We know also that all insulators break down at a lower voltage when the frequency of the field is raised. Prof. Thornton showed some beautiful experiments to illustrate that dielectrics obey simple laws. The nineteenth century was the age of the machine. Perhaps the twentieth century will be regarded as the age when insulation was made perfect.

Australian Wool and Capt. John Macarthur

IN the course of his Australian tour, the Duke of Gloucester visited the Ercildoune shearing sheds, where he sheared a sheep which is reported to be a direct descendant of the original merinos introduced into New South Wales by Capt. John Macarthur (*Times*, Oct. 30). Capt. Macarthur was born at Plymouth in 1767, and was educated at a local school. Becoming a lieutenant in the 102nd Foot, or New South Wales corps, raised for service in the colony, he retired with a captaincy in 1804. Macarthur possessed an extensive grant of land at Paramatta, and as one aspect of his agricultural pursuits, engaged in improving the breed of sheep in the colony; the "Dictionary of National Biography" says of him that he "practically created the trade in

Australian wool". Sir Joseph Banks, then president of the Royal Society, was also interested in the introduction of breeds of sheep into Australia, and received fleeces from Macarthur which were reported upon by H. Laycock. Banks, in fact, had many dealings with Capt. Macarthur concerning sheep and wool and also grants of land, some leading to acrimonious letters and mutual distrust. These may well be viewed by posterity with lenient tolerance, as being perhaps inevitable on both sides with the masterful types of men who were then involved in discussions affecting methods of colonisation. Macarthur died in 1834.

Photochemical Reactions

AN admirable account of the history and present position of photochemistry was given by Prof. A. J. Allmand, of King's College, London, in delivering the twenty-seventh Bedson Lecture at Armstrong College, Newcastle-upon-Tyne, on October 27. Tracing it from the work of Cruikshank and Scheele to that of Planck, Einstein and Warburg, he gave a concise account of the interpretation of absorption spectra, and the conception of activation, along with the application of kinetics to photochemical reactions, with consideration also of sensitised reactions. He related that the German chemical warfare records mentioned the difficulty experienced in the complete chlorination of methyl formate, in which the yield obtained varies apparently capriciously from eighty to about two per cent. This was actually due, as Luther had shown for the homologues of benzene, to the absence or presence of air, oxygen being a powerful inhibitor. Further, it has been shown that under various conditions reaction tends to vary as the square root of light intensity, instead of being directly proportional to it, and in the case of the decomposition of hydrogen peroxide a maximum is reached in the plot of concentration against rate. In the combination of hydrogen with chlorine, intensive drying does not in fact inhibit the reaction. In the sensitisation of the decomposition of ozone by chlorine, there is formation of the oxide Cl_2O_6. In the bromination of benzene in the light, the red or brown liquid residues were found to contain $C_6H_6Br_2$, and possibly $C_6H_6Br_4$. Summarising, Prof. Allmand said that photochemical reactions tend to be complex, consisting of consecutive interactions of the free groups or atoms which are the primary products.

A Fast American Stream-line Train

IN France, the United States, Germany, Italy and Great Britain, experiments are being made with train units driven at high speed by internal combustion engines. The carriages are constructed of either stainless steel or aluminium, all weights are reduced to a minimum and the trains are stream-lined to lessen so far as possible the resistance due to the air. Oil or petrol engines are used, generally with electric transmission. Several of these train units have been described in our contemporaries, the *Engineer* and *Engineering*, and the *Times* of October 26 recorded a very fast passage made across the United States by a stream-line train belonging to the Union Pacific Railroad. This train, named *M 10001*, which it is stated is driven by a 900 h.p. Diesel engine, arrived at the Grand Central Terminal, New York, at 9.55 o'clock on October 25, after crossing from Los Angeles in 56 hours 55 minutes, beating every existing record in America. During the passage of the 508 miles between Cheyenne and Omaha, the train had an average speed of 84 miles an hour, while over short distances it ran at 120 miles an hour. The train with two others, larger and more powerful, which are being built, will be put in regular service between Chicago and California.

Centenary of Lloyd's Register

THE world-famous society, Lloyd's Register of Shipping, celebrated on October 25 the centenary of its reconstitution by a dinner at the Savoy Hotel, which was attended by about four hundred distinguished guests, members of the staff and representatives of various shipping and commercial interests. The society has been described as a voluntary association of underwriters, shipowners, shipbuilders and others existing for the purpose of surveying and classifying the shipping of the world. It provides a means of self-government for shipping, and is neither State-aided nor a profit-making concern. Of British shipping, more than three quarters is at present classed with Lloyd's Register, and of the ships being built throughout the world, 74 per cent are being constructed under the society's supervision. Its surveyors are found in every important seaport in the world, and in paying a tribute to its work, Mr. Runciman, the president of the Board of Trade, said that for many years Lloyd's Register has classified more ships than all the other classification societies in the world, and it has done so on an international basis which has given uniformity to the trade it has served so well. It has standardised the basis of material and design, and has made a contribution to the safety of travel which could not have been made by any other means. The society is shortly publishing a centenary edition of the "Annals of Lloyd's Register", which will contain a wealth of information anent the development of merchant shipbuilding from the days of the wooden ship to the launch of the *Queen Mary*.

Texture and Chemical Resistance of Materials

DR. C. H. DESCH delivered a public lecture on October 26 before the Institution of Chemical Engineers on "Texture and Chemical Resistance". Dr. Desch pointed out that the resistance of materials of construction to attack by chemical agents depends not only on their composition, both ultimate and proximate, but also on their texture. This is illustrated by the differences between the behaviour of wrought iron and mild steel, the attack of sulphates on limestone, and the action of hard and soft waters on concrete dams. On a finer scale, the resistance of metals and alloys to chemical attack is affected by the grain size, the presence of cold-worked regions, the smoothness of the surface, and the directional effects of rolling and drawing. In steels, the distribu-

tion of the carbides and the size of their particles influence the rate of attack by acids. The texture of the resisting or 'stainless' steels to steam at high temperatures depends on the distribution of the compounds precipitated from the solid during heating. Oxidising agents produce a thin skin on the surface of many metals, and this protects against further action, or fails to protect, according to the texture of the oxide so formed. On a yet finer scale, certain classes of solids containing 'giant molecules' have their chemical properties determined by the shape of those molecules, whether forming thin sheets, fibres, or a loose network. Examples are graphite and other forms of carbon, textile fibres and the zeolites. The study of texture, usually by means of the microscope but also making use of many physical methods, is therefore an essential part of the study of chemically resistant materials.

The Future of Governments

AN address delivered by N. M. Butler at the Parrish Art Museum, Southampton, Long Island, on September 2, attributes the attack on 'liberalism' in the world generally to the very limited extent to which knowledge and power have been linked in official public life, compared with industrial and commercial life. The wide gap between instructed public opinion and Government, and the control of Government by legal formulæ, by passion and by highly organised and effective self-seeking minorities, are largely responsible for the deadlock which threatens many fields of public action. Mr. Butler does not believe that compulsion, whether by a dictator or by a majority, offers any permanent solution of our difficulties. What is required is intellectual and moral discipline to fit mankind for the use of liberty. Dictatorships, no less than democracies, have failed to readjust their policies or the economic life of the peoples concerned to the revolutionary changes in production and intercourse brought about by the application of science. The highest task of liberalism to-day, he claims, is to meet this situation, to show how to end this international anarchy and confusion and to solve these new problems constructively without resort to any form of compulsion. Mr. Butler outlined very broadly the principles of a programme ensuring not only freedom of thought, speech, worship and assembly but also of opportunity to earn a livelihood, and insisted on the importance of preserving individuality in the economic as in other spheres. The whole area of civilisation requires widening and integrating to relieve the economic conditions from which the attack on liberalism largely arose, and Government, agriculture, industry, transport, commerce and finance require adjusting to the conditions of human life and action existing to-day.

Industry in New Zealand

DISCUSSING the prospects of industry in New Zealand in an address to the Dunedin Chamber of Commerce on August 21, Lord Bledisloe said that the decline in international commodity exchange and the growing tendency towards economic self-sufficiency must inevitably cause anxiety in countries like New Zealand, Denmark or Argentina, the economic existence of which is conditional upon the export of agricultural produce. New Zealand will have to search for new directions in which her industrial activities may expand, though this as yet can scarcely be in the direction of large-scale industrial production owing to her small population and limited consumptive capacity. First and foremost, efforts should be made to develop the 'tourist industry', which presents great possibilities provided the travel, hotel and similar interests organise and co-ordinate their efforts. Timber plantations, especially of the native beech, should prove a valuable asset, since conditions elsewhere foreshadow a world-wide timber famine within the next half-century. If properly managed and protected from insect and fungoid pests, the forests should afford remunerative employment to a large section of the rural population. Of New Zealand's mineral resources, gold is the most important and indeed seems likely to open up the most promising avenue for providing fresh employment. Yet another development of importance would be the revival of the once profitable kauri-gum industry now made possible by new methods of refining low-grade gum. The extraction of oil from the local 'groper' presents distinct possibilities since it is 100 times richer in vitamin A than the average cod liver oil. Important new industries might be inaugurated for canning meat and for manufacturing casein from surplus milk; the former could readily be marketed in Britain since there is no quota for canned meat as there is for chilled meat.

Preservation of Natural Woodland

MR. W. DALLIMORE read a paper on amenity planting and the preservation of natural woodlands before Section K at the recent meeting of the British Association at Aberdeen. "Amenity planting," Mr. Dallimore said, "and the preservation of natural woodland may be regarded as common ground whereon arboriculture and sylviculture meet." This somewhat dangerous statement is qualified by the subsequent remark that "In many respects sylviculturists are better placed for general amenity supervision than men who are engaged upon arboriculture". Until comparatively recently, the true work of the sylviculturist was but little understood in Great Britain. In fact, by many it was considered to cover all aspects of the forester's work save that of exploitation and extraction. A truer understanding now exists, and Mr. Dallimore is correct in saying that the sylviculturist generally is in a better position to undertake or supervise general amenity work in woodlands and so forth: though this does not mean that he is always as capable as the arboriculturist specialist. The day has arrived, however, in Great Britain when a sharp division should be made in estates budgets, both Government and privately owned, between all planting done for purely amenity purposes, and plantings undertaken for commercial forestry production. Forestry is a definite business

concern, and if a profit is to be made, it should not have to carry expenditure incurred for work undertaken to beautify a locality; an object quite apart from the utilisation of the soil as a commercial asset. Mr. Dallimore dealt with the various types of planting for amenity purposes, such as garden and park trees, field and hedgerow trees, road-side trees, small shelter plantations and woods of varying type open to the public as pleasure resorts.

Weather in Great Britain and Ireland in 1933

THE most recently published annual volume of the *Weekly Weather Report* (The Weekly Weather Report for the Period February 26, 1933 to March 3, 1934. M.O. 374. London: H.M. Stationery Office. 7*s*. 6*d*., postage extra) is the fifty-sixth that has appeared since the publication of meteorological data in weeks by the Meteorological Office was first begun, and is the fifth in which the data are largely presented in the form of deviations from normal values of the different elements. The deviations of temperature are given in whole degrees, of accumulated temperature (reckoned from 42° F., the zero of temperature from the point of view of plant growth) in day degrees, while for rainfall and sunshine the percentage of the normal for the appropriate week or season is quoted. This report is designed to be used for correlation with agricultural data, for which as a time unit the day is regarded as being too short, and the month too long. The year begins and ends, as in former volumes, with early spring, the whole period under review in this case beginning on February 26, 1933, and ending on March 3, 1934, and the tables are based on the records of fifty-seven stations well distributed throughout Great Britain and Ireland. The time of commencement was for England within a wet period following a remarkably dry winter, which came at a favourable time for agriculture in so far as it supplied the land with some reserves of water, and enabled many crops to withstand the drought, heat and abnormal sunshine of the summer and autumn of 1933 far better than they would have done had the winter drought not had this pronounced check. The period as a whole was with few exceptions one with excess of sunshine over England, especially in the south-east and the Midlands. There was general dryness and warmth throughout the British Isles, the warmth being especially pronounced in spring and summer; July and August provided more than one spell of tropical heat, without however quite repeating the very exceptional extremes of the August of the preceding year.

Recent Acquisitions at the Natural History Museum

AMONG the recent acquisitions of the Department of Zoology is a collection of 300 birds obtained by Mr. A. W. Vincent in the south-eastern district of the Belgian Congo. This is an area which has been very little investigated from the ornithological point of view. A valuable recent addition to the collection of Hemiptera (bugs) in the Department of Entomology consists of a collection of 17 specimens of Termitaphidæ presented by Dr. J. G. Myers of the Imperial College of Tropical Agriculture, Trinidad. These rare and little-known insects are found only in the nests of white ants in America and in the Old World, but the nature of this association is not known. A purchase of particular interest is a collection of 500 beetles from Tibet, Central Asia, western China and the Altai Mountains; the majority of the specimens were described by Continental authors and are paratypes of species hitherto unrepresented in the Department. The Public Schools Exploration Society has presented the whole of the entomological collections made during its recent expedition in Newfoundland. The Department of Geology has acquired a collection of primitive fish-like Ostracoderms comprising a hundred specimens obtained by Mr. Wickham King, chiefly from the Old Red Sandstone of Worcestershire; and a fine series collected by Dr. E. I. White and Mr. H. A. Toombs from Herefordshire, comprising many forms new to science, of which the most interesting are specimens of *Pteraspis*, which show for the first time the unusual form of the tail. A valuable collection of gemstones has been bequeathed to the Department of Minerals by the late Mr. T. B. Clarke-Thornhill, including ninety cut stones, many of them of large size, of various minerals—a fine series of sixteen coloured diamonds, parti-coloured corundum, tourmaline, opal, alexandrite, phenakite, etc.; also uncut specimens of opal, moonstone, and large masses of Kauri-gum from New Zealand. The first meteorite to be recorded from Rhodesia, a stone weighing 48 lb. 11 oz. which fell on March 7, 1934, in the Mangwendi native reserve, 40 miles east of Salisbury, has been presented by the Government of Southern Rhodesia.

Proposed Museum at Verulamium

THE City Council of St. Albans is preparing plans and proposes to seek powers for raising £15,000 for the erection of a museum on the site of the Romano-British city of Verulamium. The museum will be devoted to housing the valuable collection of antiquities found on the site during its recent excavation by Dr. and Mrs. Mortimer Wheeler. The proposal of the Council is a fitting sequel to its enlightened action whereby the excavation, which has proved so fruitful in results, was made possible. Not only has the importance of Verulamium as a centre of Romano-British life and culture been fully confirmed by increased knowledge, but also it is now possible to appreciate more justly the significance and influence of this centre in relation to the rest of the peoples of pre-Roman Britain. The value of the collections to the student will be vastly enhanced by the opportunity the building will afford for the proper display of these antiquities without the distraction of other exhibits by their side; while the effect of such a display as a unitary collection in the midst of its native setting will be to enhance both its historical and its cultural value. The Council is wisely consulting Dr. Mortimer Wheeler before deciding on the exact site of the museum in order to avoid the possibility of interference with any future exploration.

Sanitation of Rural Areas in the Tropics

In a Chadwick public lecture, delivered on October 25, on the sanitation of rural areas in the tropics and sub-tropics with special reference to housing, Prof. D. B. Blacklock expressed the view that rural sanitation in tropical and sub-tropical dependencies and possessions is gravely neglected. He touched on the subject of hygienic conditions in rural West Africa, but attention was directed chiefly to the present state of rural India. The chief part of the lecture dealt with housing in the rural areas, and Prof. Blacklock emphasised by suitable illustrations how diseases of various kinds come to be associated with types of houses showing special defects. These defects are either of site, of structure and material, or dueto the habits of the inmates. A house-relation of many diseases in tropical and sub-tropical countries is directly traceable to an origin in such defects; the removal of the known defects would largely eliminate those house-diseases, which seriously affect millions of people. To-day we have at our disposal in the shape of broadcasting a valuable method of imparting the principles of village hygiene even to those who can neither read nor write. In addition to such educative methods, it is the duty of any Government which wishes to attain success in raising the standard of rural sanitation to undertake a further measure. This is the building, using local materials so far as is possible, of standard houses and villages at many accessible places in each province or even district as examples of hygienic construction. Demonstration villages kept up to the standard would exemplify to the villagers more vividly than other methods the dangerous defects of their own homes.

Pathology at Leeds

The Department of Pathology and Bacteriology, University of Leeds, has issued its annual report for 1933 by Profs. Stewart and McLeod, with some details of the research work in progress. This includes investigations on industrial lung diseases, namely, pulmonary fibrosis of hæmatite miners and asbestos workers, correlation of types of diphtheria bacilli with clinical severity of the cases, phenomena of bacterial respiration, bacterial hæmolysins, and industrial problems such as the bacterial purification of gas-works' effluents. A brief report by Prof. Passey on cancer research is also included.

New British Birds

The note under this heading in our "News and Views", October 27, p. 658, was prepared before the error in the original announcement by the British Ornithologists' Union became known. The Continental song thrush, renamed *Turdus ericetorum planiceps* in the July issue of *Ibis*, should now read *Turdus ericetorum philomelus* (*Ibis*, October).

Marmite: Vitamin B_1 Content

With reference to the recent statement in our columns (Nature, Oct. 20, p. 623) that the yeast extract "Marmite" contains 840 international vitamin B_1 units per oz., Mr. A. R. Keast, 4 Anne Boleyn's Walk, Cheam, Surrey, writes that in answer to inquiries made some months ago, he was informed that this result had been obtained from an isolated sample furnished by the Marmite Food Extract Co. Ltd. Biological assays of ordinary Marmite carried out in Mr. Keast's own laboratories and elsewhere have never, apparently, yielded a result higher than 280 international units per oz. This figure, although high, is lower than the assayed content of certain other products on the market.

Announcements

Dr. Herbert Dingle, assistant professor of astrophysics in the Imperial College of Science and Technology, will deliver the Cantor Lectures of the Royal Society of Arts on November 19, 26 and December 3. His subject will be "Modern Spectroscopy".

The Onyx Oil and Chemical Co., 15 Exchange Place, Jersey City, N. J., has founded an industrial fellowship in the Mellon Institute of Industrial Research, Pittsburgh, Pa., to be held by Dr. Robert N. Wenzel, who is working on problems in textile processing and finishing. Dr. Wenzel is well known for his studies of fatty acids and related compounds.

In connexion with the centenary celebrations at Melbourne, a temporary exhibition of drawings and maps commemorating Admiral Phillip, the first Governor of Australia, has been placed in a case in the Central Hall of the Natural History Museum. The thirteen sketches by Thomas Watling, a convict transported in 1792 for forgery, and other contemporary artists, show Sydney and Port Jackson as they were at the close of the eighteenth century, the arrival of the Governor in H.M.S. *Sirius*, aborigines, and the earliest known illustration of the Echidna. The maps of Norfolk Island and Port Jackson are of considerable interest. It was on Norfolk Island that Capt. James Cook, the discoverer of Australia, landed in 1774.

Applications are invited for the following appointments, on or before the dates mentioned:—A lecturer in electrical engineering at Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham (Nov. 8). An assistant at the London Museum—The Keeper, London Museum, St. James's, S.W.1 (Nov. 17). A dean of the British Postgraduate Medical School—The Chairman of the Governing Body, British Postgraduate Medical School, New Public Office, Whitehall, London, S.W.1 (Nov. 17). An experimental officer for wireless research work in the War Department Establishment at Chatham—The Under-Secretary of State (C.5), The War Office, London, S.W.1 (Nov. 19). A Hackett professor of agriculture in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, London, W.C.2 (Nov. 20). An understudy to the Deputy Director of Research of the British Cotton Industry Research Association—The Director of Research, Shirley Institute, Didsbury, Manchester.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Situation of the A ($^3\Sigma$) Level in the Nitrogen Molecule

IN a recent communication in NATURE, Appleyard, Thompson and Williams[1] have discussed the question as to the height of the A level of the nitrogen molecule, which is the bottom state of the first positive group.

Using the electron collision method, they find for the excitation potential of the first positive group the value 8·34 volts, in good agreement with previous measurements of Sponer. This result they take to indicate that the height of the A level or the level difference (X-A) should be considerably higher than the value derived from the bands recently observed by Kaplan. They express the opinion that the bands observed by Kaplan are too limited in number for a determination of the vibrational terms with such an accuracy as to prove their identity with the vibrational terms of the A and X level.

If the interpretation of the Kaplan bands and the calculation of vibrational terms were merely based on the few bands observed by him, Appleyard, Thompson and Williams would be justified in expressing some doubt as to the validity of his interpretation; but in this connexion I wish to direct attention to the fact that the Kaplan bands—as clearly pointed out by Kaplan himself—are identical with the bands of the so-called ε-system, which I discovered nine years ago in the luminescence from solid nitrogen.

This ε-system appears with great intensity and up to the present no less than 111 vibrational bands belonging to this system have been observed. In the lower level of the ε-system, 22 vibrational states have been measured, and in the upper electronic level 7 vibrational states are concerned in the formation of the observed bands.

In a paper published in 1930[2] it was shown that the bottom level of the ε-system was identical with the normal state of the nitrogen molecule, which forms the bottom level of the Lyman and the Birge-Hopfield bands. As a consequence, an electronic level of the N_2-molecule had to be placed about 6 volts above the normal state. In a paper published in January 1932[3], I showed that this upper ε-level was no doubt identical with the bottom level (A) of the first positive group, and this would have the effect of lowering the A level about 2 volts from the height then accepted.

During the past year, Mr. S. Stensholt and I have obtained spectrograms of the ε-bands in the region from red to far in the ultra-violet with a 1-metre grating spectrograph giving dispersion of 17 A./mm. and a corresponding accuracy of the wave-length measurements (probable error about 0·02 A.).

A more complete account of our results relating to the ε-system will be given in a subsequent paper. In this connexion I merely wish to mention that on the basis of the new measurements, we have found the following more accurate and slightly modified formula for the ε-band system:

$$=49617\cdot5+(1444\cdot6v_1-13\cdot7v_1^2)-(2344\cdot2v_2-14\cdot6v_2^2).$$

The vibrational term of the A level derived from the first positive group is:

$$1446\cdot46v-13\cdot93v^2,$$

and the vibrational term of the normal (X) state derived from the Lyman and the Birge-Hopfield bands is:

$$2345\cdot16v-14\cdot445v^2.$$

Within the limit of error, these terms are seen to be identical with those of the upper and lower level of the ε-system respectively.

From the formula of the ε-system, we find that the difference in height between the vibrational zero levels corresponds to 6·12 volts, or the electronic levels corrected for vibrational influence should be situated 6·18 volts apart. In other words, the electric (A) level forming the bottom level of the first positive group is situated 6·18 volts above the normal state (X).

This result is in good agreement with the results of Smyth, Levesly, Rudberg and Brindley, who by electron bombardment found signs of an electronic state between 6 and 7 volts. In view of the results derived from the study of the ε-system, this level is no doubt identical with that of the upper ε-state, which again is identical with the A ($^3\Sigma$) state.

The excitation potential of 8·34 volts found by Appleyard, Thompson and Williams then must mean that for some reason a potential considerably higher than (A-X=6·18 volts) is necessary to excite the first positive group.

L. VEGARD.

Physical Institute,
University, Oslo.
Sept. 25.

[1] NATURE, **134**, 322, Sept. 1, 1934.
[2] *Ann. Phys.*, **6**, 487; 1930.
[3] *Z. Phys.*, **75**, 30; 1932. Compare also *Z. Phys.*, **79**, 471; 1932.

Isotope Effect in the Band Spectrum of Sodium Hydride

As has been pointed out by Holst and Hulthén[1], the elementary theory of isotopy in band spectra cannot account for shifts and the constants of deuterides, determined with the highest precision. They find it necessary, in calculating the reduced mass of the molecule, to add a correction for the electronic masses, which are supposed to partake fully in rotation and vibration. Since this correction is quite general, one would expect it in all deuterides determined with sufficient precision. The only reported cases which fulfil this prescription are:

AlH/AlD [2], calculated ratio of the reduced masses

$$=\frac{\mathrm{Al}\cdot\mathrm{H}}{\mathrm{Al}+\mathrm{H}}:\frac{\mathrm{Al}\cdot\mathrm{D}}{\mathrm{Al}+\mathrm{D}}=\rho^2=0\cdot51848,$$

$$\text{observed, } \rho^2=\frac{B_e\,(\mathrm{AlD})}{B_e\,(\mathrm{AlH})}=0\cdot51889.$$

CaH/CaD [3], calc. $\rho^2=0\cdot51276$, observed $\rho^2=0\cdot51337$, and from an investigation of NaD by the present author,

$$\text{calc. } \rho^2=0\cdot52147,$$

observed in the normal state, $\rho^2=0\cdot5222\pm0\cdot0003$.

In all these cases the agreement between calculated and observed values is complete, if one adds the small correction proposed by Holst and Hulthén.

It must be mentioned, however, that the constants α_e, ω_e, x_e, etc., cannot be calculated with the same accuracy, and therefore further additions to the theory of isotopy are required.

The rotational constants of the excited state in NaH and NaD cannot be used in calculating ρ^2, due to the known strong irregularities[4] in this state. It is hoped instead that the isotope effect may contribute to the explanation of these irregularities. A detailed report will appear later.

Laboratory of Physics, University, Stockholm. Sept. 14.

E. OLSSON.

[1] NATURE, **133**, 796, May 26, 1934.
[2] Holst, W., and Hulthén, E., NATURE, **133**, 496, March 31, 1934.
[3] Watson, W. W., *Phys. Rev.*, **46**, 319; 1934.
[4] Hori, T., *Z. Phys.*, **71**, 478; 1931.

Complexity of the Solid State

THE theory of allotropy assumes that every state of aggregation of a so-called single substance is complex, so that every crystalline state consists of mixed crystals, built up of molecules of different kinds. These different kinds of molecules can change the one into the other. The transformation can lead to a chemical equilibrium, and only when this equilibrium (inner equilibrium) is established does such a pure substance behave as a real single substance.

If this equilibrium is established slowly, or if the transformations are stopped, then a pure substance will behave as a mixture. Ten years ago[1] we studied the behaviour of sulphur trioxide after drying with freshly distilled pure phosphorus pentoxide[1]. Since sulphur trioxide itself possesses strong self-drying properties, after a short drying, it showed its complexity distinctly. Thus we were able to change greatly the vapour pressure of the high-melting asbestos form by partial evaporation, for example, at ± 36° from 200 mm. to 2·5 mm. of mercury.

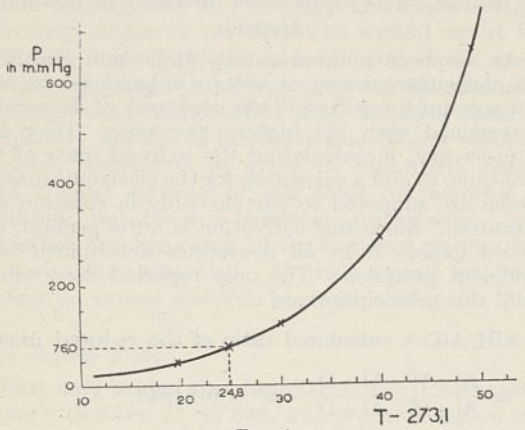

FIG. 1.

In measuring the vapour pressure in a bath at constant temperature, we found that the vapour pressure rose with decreasing velocity, approaching asymptotically after several weeks or months an end value. The curve answers closely to a hyperbola represented at 30° by the following equation:

$$\frac{1}{120 - p} = 0{\cdot}00710t + 0{\cdot}0140 \qquad (1)$$

or

$$p = \frac{680 + 852t}{7{\cdot}10t + 14{\cdot}0} \qquad (2)$$

Our equation shows that when $t = \infty$, $p = 120$, which means that when inner equilibrium is established, the vapour pressure at 30° will be 120 mm. mercury. In this way, the end vapour pressure of the initial disturbed high-melting asbestos form is determined at different temperatures so that the vapour pressure curve of this form in inner equilibrium can be plotted (Fig. 1).

In 1926, one of us discovered that irradiation by X-rays (copper rays) accelerates the establishment

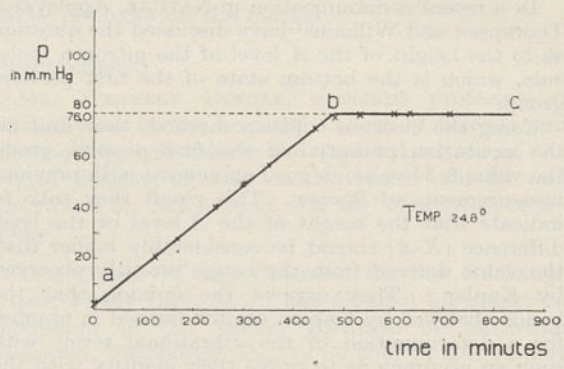

FIG. 2.

of the inner equilibrium in a high degree, so that within 8 hours the inner equilibrium was reached[2]. On continuing these researches, and measuring the increase of the vapour pressure of the irradiated disturbed substance, we obtained the remarkable result illustrated in Fig. 2, in which the pressure is plotted against the time of exposure to the X-rays. From this, it follows that after 598 minutes, increase of the vapour pressure ceases, that this value is 76·0 mm. mercury at 24·8°, which corresponds exactly to the vapour pressure in Fig. 1 at the same temperature. This proves that irradiation by X-rays greatly accelerates the establishment of the inner equilibrium.

Plotting the vapour pressure during irradiation against the time in minutes, we get a straight line, as shown in Fig. 2, *ab* ending at *b*, after which the vapour pressure remains constant, following the straight line *bc*, proving that at *b* inner equilibrium is reached. It may be added that examination of the irradiated substance showed that not the smallest trace of sulphur dioxide was formed.

The course taken by the vapour pressure on irradiation with X-rays is remarkable, since from it the conclusion can be drawn that the thermal reaction taking place in the disturbed substance is quite different from the reaction caused by X-rays. In the latter case, the reaction is of zero order, that is, independent of the pressure. What is the effect of X-rays here? The disturbed substance is probably very rich in a polymer of SO_3 and very poor in single molecules. Therefore it seems that X-rays are able to split up the polymerised molecules in the solid phase with the result that the vapour pressure increases. Density determinations showed that the vapour consisted almost entirely of single molecules. The remarkable thing here is that an X-ray quantum represents too large a quantity of energy per molecule for such a reaction as this. We must imagine therefore that one quantum is taken up either by a number of polymerised molecules, which is not very probable, or that a kind of photoelectric effect occurs.

The photon coming into collision with a polymerised molecule gives up a part of its energy, which is taken

up by the dissociating molecule. The explanation of this very remarkable phenomenon cannot be given with certainty until the results of further experiments are available[3].

A. SMITS.
N. F. MOERMAN.

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[1] NATURE, 113, 855, June 14, 1924.
[2] *J. Chem. Soc.*, 1603; 1926.
[3] E Adinolfi (*Atti R. Accad. Lincei*, 8, 381; 1928) found that the specific heat of bismuth is increased by about 14 per cent and that of tellurium by 8 per cent by exposure to X-rays. D. Coster and A. v. d. Ziel (*Z. physik. Chem.*, B, 20, 283; 1933) found that irradiation with X-rays of the monoalkyl malonic acids accelerates strongly the transformations taking place in these substances.

Magnetron Oscillations of a New Type

IN a recent issue of NATURE[1] Dr. Megaw suggests that the magnetron oscillations dealt with in my letter[2] should be "dynatron oscillations" of the type described in his fundamental paper: "An Investigation of the Magnetron Short-Wave Oscillation"[3].

One condition that oscillations should be of a "dynatron" character is the presence of a static negative resistance. In our case such a negative resistance could not be measured. Also there was a definite lower frequency limit for every adjustment of anode tension and magnetic field as well as an upper frequency limit, both limits being fairly close together. This fact is not in favour of the "dynatron" theory.

In a paper which has not yet appeared, the generation of the oscillations is shown to be possible under the influence of the tangential alternating electric field, which can be resolved into two rotating fields. As one of these components plays the principal part, the oscillations are called "rotating field oscillations" in this paper.

For the upper frequency limit is derived the equation

$$\omega_{max.} = \tfrac{1}{2} H \frac{e}{m}\left[1 - \sqrt{\left(1 - 8\,\frac{V_a^2}{r^2H^2}\,\frac{m}{e}\right)}\right] \text{ or}$$

$$\omega_{max.} = \tfrac{1}{2} H \frac{e}{m}\left[1 - \sqrt{\left(1 - \frac{H_{cr.}^2}{H^2}\right)}\right].$$

$H_{cr.}$ is the critical cut-off field strength, the other symbols are the same as those used in my previous letter. As an approximation, this is transformed to $\omega_{max.} = 2\,V_a/r_a^2H$ in my previous letter, only holding for $H \gg H_{cr.}$, and for a four-plate magnetron the frequency should be twice this value.

Therefore these formulæ yield the upper frequency limit for *every* value of $H > H_{cr.}$, and it would not be clear what proof is to be derived for the identity of these oscillations and the "dynatron" oscillations, when for H is substituted the arbitrary value $H_{cr.}$, apart from the fact that the approximate equation $\omega_{max.} = 2\,V_a/r_a^2H$ is not valid for $H = H_{cr.}$.

The equations are confirmed by experiment. As already stated, there exists also a lower frequency limit, which is found experimentally to be equal to

$$\omega_{min.} = \tfrac{1}{4} \frac{e}{m} H\left[1 - \sqrt{\left(1 - \frac{4}{3}\,\frac{H_{cr.}^2}{H^2}\right)}\right],$$

this expression being obtained by drawing a straight line through a group of experimental points in a certain diagram.

For $H \gg H_{cr.}$ this can again be simplified to

$$\omega_{min.} = 4/3\ V_a/r_a^2H.$$

In the rotating field theory mentioned above, these limits have the following physical significance. When $\omega = \omega_{max.}$, the radial velocity of the electrons arriving on the anodes equals zero. When $\omega = \omega_{min.}$, the total kinetic energy of the electrons reaching the anodes equals one third of the energy corresponding to the D.C. potential. As formerly stated, this latter limit is found experimentally, and at present I see no reason why this figure should be precisely one third.

From the rotating field theory it is obvious that for four-plate magnetrons all frequencies are twice the values for two-plate magnetrons, which is very well confirmed by experiment. Recently we succeeded in obtaining weak oscillations from an eight-plate magnetron, the frequency being equal to four times the frequency obtained from a two-plate type under similar conditions. However, this was only possible for values of H not much greater than $H_{cr.}$; for higher values of H the electrons are confined to an area where the tangential rotating field cannot become appreciable.

As stated in my previous letter, the output obtainable at about 40 cm. is of the order of 30 watts for a four-plate magnetron, whereas Dr. Megaw states in the summary of his paper[3] "It is concluded that for wavelengths below about 50 cm. electronic oscillations give the greater output", electronic oscillations only giving an output of the order of 1 watt.

In practice, we obtained this type of oscillations on a wave-length ranging from 80 cm. to 5 m. for a two-plate magetron and from 35 cm. to 250 cm. for a four-plate magnetron, whereas Dr. Megaw even mentions measurements on a pure dynatron oscillation of only 600 kc./sec.

K. POSTHUMUS.

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Sept. 25.

[1] NATURE, 134, 324, Sept. 1, 1934.
[2] NATURE, 134, 179, Aug. 4, 1934.
[3] *J. Inst. Elec. Eng.*, 72, 1933.

Fluorine in Coal

A CASE of severe disintegration of porcelain tower fillings over which hot ammoniacal liquor was circulated in a gasworks, caused me to investigate the source of this somewhat puzzling corrosion.

It was found that the attack on the porcelain was due to fluorine, which was shown to be present in the liquor in appreciable quantities (80 parts per million), probably in the form of ammonium fluoride. After eliminating the possibility of other sources of fluorine, I was forced to the conclusion that this element had been derived from the coal carbonised in the gas-making process. On examining a sample of the coal, which consisted of a mixture of Midland and West Country coals, the presence of fluorine was definitely established by the etching of glass.

The existence of fluorine in coal has, I believe, hitherto not been known, or has at any rate not been mentioned in the literature. I have examined a limited number of other coals and have established the presence of fluorine in all of them, in amounts not exceeding one part per million.

The available methods for the quantitative estimation of small amounts of fluorine have not been found satisfactory when applied to coal, but work in this direction is proceeding. Pending the elaboration of a reliable method, the etching test under

controlled conditions gives a good indication of the fluorine content of coal and of the distribution of this element over the coal components.

It has been found that the fluorine content of natural coal dust (containing most of the fusain) is much higher than that of the dust-free coal (vitrain, clarain, durain). This observation indicates that the fluorine is derived from the water which, according to accepted theories, has furnished by a process of infiltration the bulk of the mineral constituents of fusain. On putting this theory to the test, it was found that a small portion of fluorine could be extracted by water and a larger portion by a 1 per cent solution of sodium hydroxide. This distinction proves that the fluorine is mainly present in the form of calcium fluoride.

In one of the coals examined, the chloride content in the dust was three to four times higher than in the dust-free clean coal. As a similar ratio appears to exist between the fluorine contents of the two materials, it is fairly certain that the water with which the coal substance was in contact during or after its formation must be regarded as the source of this element in coal. Moreover, the ratio of fluorine to chlorine in one of the coals examined is of the same order as that found in sea-water. The discovery of fluorine in coals will therefore prove of interest in the study of coal formation.

Its practical importance lies in the direction of eliminating coal components, notably dust, from processes in which an accumulation of fluoride might cause difficulties, as in the case which gave rise to this investigation. R. LESSING.

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Conception of 'Synthesis' in Organic Chemistry

IT is perhaps ungrateful to take exception even in part to so appreciative a note as that on "The Male Sex Hormone" which appeared in NATURE of October 13 (p. 563). However, it contains the following sentence: "It is unfortunate that this conversion of cholesterol into androsterone should be described as a 'synthesis'." Now, the elimination of water from ethyl alcohol is designated as a synthesis of ethylene, and the pyrogenetic decomposition of dipentene is a synthesis of isoprene. These 'partial syntheses' become 'complete' when the starting materials, ethyl alcohol, dipentene, and, in the case of the male sex hormone, *epi*dihydrocholesterol, can be built up from the elements. Naturally, the term 'synthesis' should not be too freely used, but we are nevertheless of the opinion that the first artificial preparation of a sex hormone from a compound with a different number of carbon atoms merits this designation, particularly as we clearly stated in the title of our paper: "Synthese . . . durch Abbau. . . ." L. RUZICKA.

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Technical High School,
Zurich.

MY opinion is in no way altered by Prof. Ruzicka's comments. When Prof. Ruzicka has succeeded in preparing *epi*dihydrocholesterol from carbon, hydrogen and oxygen (or from some compound which can be shown to be capable of artificial formation from these elements), I shall endeavour to be the first to congratulate him on having synthesised the male sex hormone (androsterone). I am not concerned with the question whether the transformation of the sterol into the hormone involves a 'building up' or a 'breaking down' of the molecule. The main issue, in my view, is that the term 'synthesis' cannot be justified, either by definition (see, for example, Bailey and Bailey: "An Etymological Dictionary of Chemistry and Mineralogy", 1929) or by common usage, as a description of the conversion into another substance of a compound of purely natural origin. I am sure that the great majority of chemists will agree with this point of view.

In saying this, I am not disparaging Prof. Ruzicka's magnificent achievement. I still have very pleasant memories of a few brief hours spent in his company last March, when he was kind enough to tell me something of the early experiments which have been brought to such a successful conclusion.

THE WRITER OF THE NOTE.

The 'Orthogonal' Matrix transforming Spearman's Two-Factor Equations into Thomson's Sampling Equations in the Theory of Ability

IF φ is a column vector of t elements representing scores in t tests, and s a column vector of $t + 1$ elements of which the first, s_0, represents Spearman's g and the rest his specific factors, then $\varphi = Ls$ represents t Spearman equations giving the composition of the φ's, which will in that case be perfectly hierarchical. Here L is an oblong matrix of t rows and $t + 1$ columns. Its first column is $\{l_1\, l_2 \ldots l_t\}$ where l_i is the correlation of φ_i with g. The principal diagonal of the remainder of L is $(m_1\, m_2 \ldots m_t)$ where $m^2_i = 1 - l^2_i$. The remaining elements in L are zero.

The transformation $s = \overline{O}y$, where $\overline{O}$ is a slab of an orthogonal matrix O, will transform these Spearman equations into equivalent equations $\varphi = L\,\overline{O}\,y$ (where the components y may be of any number not less than t) which will give the same correlations as before. Among the infinity of matrices O there is one, T, the proper slab of which transforms the Spearman equations into equations agreeing with the most probable result of the Sampling Theory, on which theory the complete set of tests formed from all possible linear combinations of the components will be strongly though not perfectly hierarchical, so that a perfectly hierarchical sample can easily be selected, as is in fact done in practice.

The matrix T will be described more fully elsewhere. It is of order 2^t (the slab required being the first $t + 1$ rows), is composed of elements like $\pm\, l_1\, l_2\, m_3\, l_4 \ldots m_t$, is axisymmetrical, and has a special kind of reflex symmetry about its vertical and horizontal centre-lines, which can be most readily followed when it is divided into "binomial" compartments by taking the 2^t rows (and columns) in blocks of $1,\ t,\ t\,!/(t-2)\,!2\,! \ldots$ (the binomial coefficients). I arrived at it by other means, but Dr. A. C. Aitken has since pointed out to me that it is a Zehfuss matrix and can be made by multiplicative composition (called in America the direct product) of t matrices each of the form

$$\begin{bmatrix} l_i & m_i \\ m_i & -l_i \end{bmatrix}.$$

University,
Edinburgh.
Oct. 6.

GODFREY H. THOMSON.

Difficulty of Long-Wave Transmission in Summer

THADÉE PECZALSKI has developed a theory of sub-electrons[1] which explains the absorption of electromagnetic waves by charged small particles. The result, it seems to me, can be found intuitively, so to say, by considering Langevin's formula for the energy of radiation of an electromagnetic wave when a particle of mass M carrying a charge e collides with a gas molecule of mass m. The energy ε is given by

$$\varepsilon = \frac{2}{3}\frac{e}{c}\int_{t_1}^{t_2} \Gamma^2 \, dt$$

This function Γ is regular, that is, uniform and continuous in the interval of integration. A function of this type translates into the language of function theory the principle of conservation of momentum and energy. The arguments of the function undergo transformations that maintain a certain invariance of the function due to the quadratic form of the integrand. Here the asymptotic method[2] may be utilised, as we are concerned with a periodical phenomenon. The function expressing the kinetic energy has been shown by Peczalski to be

$$\varepsilon_1 = \frac{2}{3}\frac{e}{c}(eF)\, t \, \Delta t,$$

where F is the external field, Δt the period between two successive impacts of a molecule and a charged particle. An asymptotic series will approach a limit; in this case the limit will be $\bar{\varepsilon} \to RT/N$ with the well-known meanings of R, T and N. The Planck formula of radiation

$$\bar{\varepsilon} = h\nu / (e^{KN.h\nu/RT} - 1)$$

shows that ν should be very small, that is, the radiant waves must be very long. The small particles carrying charges will be absorbing energy like resonators (Peczalski's result).

In summer conditions, when the sun is shining, photoelectric processes will produce electrons and sub-electrons which collide with the molecules of air and act as resonators absorbing the energy of long electromagnetic waves.

S. C. BAGCHI.

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92, Upper Circular Road,
Calcutta.
Sept. 8.

[1] *C.R.*, July 4, 1927.
[2] NATURE, **134**, 216, Aug. 11, 1934. A misprint occurring there may be corrected: for $\psi \sim e^{i\delta} - \left(v_0 + \frac{v_1}{\lambda} + \ldots\right)$ read $\psi \sim e^{i\delta}\left(v_0 + \frac{v_1}{\lambda} + \ldots\right)$.

Physico-Chemical Test for Mitogenetic (Gurwitsch) Rays

UNTIL now, there has been only one physical method for detecting Gurwitsch rays, namely, with the Geiger-Müller electron counter. Using this method, some workers[1] have got positive results, whilst other investigators[2] have not been able to confirm them. The method needs complicated apparatus which is difficult to manage.

Therefore I have tried a simpler method to test for the existence of the so-called mitogenetic rays, without using biological objects. Inorganic colloidal solutions—charged either negatively or positively, and made unstable by the addition of neutral salts—flocculate more rapidly when influenced by mitogenetic rays. The duration of irradiation is very important to get good effects. At first I used colloidal solutions of iron hydroxide, the turbidity of which had been produced by potassium chloride solution of a fixed concentration, and which afterwards were exposed to the influence of Gurwitsch rays. The increase of turbidity after a certain time indicated the presence of the mitogenetic rays; the turbidity was measured with an electrical nephelometer. Afterwards it was found that better and more regular effects can be obtained by using gold sol. The gold sol, which should be clear and red, was prepared with hydrogen peroxide. The change of colour of the irradiated samples in comparison with the non-irradiated ones can be perceived sometimes macroscopically. Measurements of the turbidity in an electrical nephelometer have, however, proved more convenient and more reliable.

As sources of radiation, comparatively slow chemical actions (sodium chloride dissolving in water, urea-urease) and human blood were used. The result of one experiment is given below. The gold sol was in Petri dishes, covered by dishes of quartz, and exposed for two minutes to crystals of sodium chloride in water. Measurements made with the nephelometer:

	Control	Induced
4 min. after the end of irradiation	80	96
7 ,, ,, ,, ,, ,, ,,	82	103

The same without irradiation, both as controls:

3 min. after the end of the experiment	80	80
6 ,, ,, ,, ,, ,, ,, ,,	82	85

Full details will be communicated elsewhere.

M. HEINEMANN.

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University of Utrecht.
Oct. 9.

[1] Rajewski, "10 Jahre Forschung auf physikalisch-medizinisch. Grenzgebiete", 1931. Frank and Rodionow, *Naturwissen.*; 1931. Siebert and Seffert, *Naturwiss.*; 1933. Ruyssen, *Natuurwetenschap. Tijdschrift*, No. 6; 1934, has not yet finished his investigations. Barth, *Arch. Sci. Biol. Lenin.*, **35**, 1934.
[2] Seyfert, Dissertation, Tübingen, 1932. Locher, *Phys. Rev.*, 1932. Lorenz, Public Health Reports, Washington, 1933, and *J. Gen. Physiol.*, **17**, No. VI; 1934. Schreiber and Friedrich, *Biochem. Z.*, 1930. Gray and Ouellet, *Proc. Roy. Soc.*, B, 1933.

Reduction of Traffic Noise

THE report in NATURE of October 20, p. 633, of a discussion on this subject at the recent meeting of the British Association at Aberdeen encourages the hope that the attention of competent minds directed to the reduction of sound in motor traffic may have practical results.

Nevertheless those who, like myself, knew London sixty years ago, may remember that its streets were far noisier then than they are now. At that time they were all either paved with stone or laid with macadam; all vehicles ran upon metal tyres and were drawn by iron-shod horses. The result in rumbling and clatter was far in excess of what we complain about now.

HERBERT MAXWELL.

Monreith.

Research Items

Man or Ape? In view of the difficulty which has been felt in determining the position of the Taungs skull in relation to man and the anthropoids, Dr. Paul Alsberg of Berlin puts forward in *Man* of October a suggested criterion for deciding on biological lines whether in an indeterminate instance, such as the Taungs skull, the specimen is to be assigned to the human or anthropoid branch in the line of descent. Biologically, man and the animal develop on diametrically opposite principles. The animal develops by physical or organismal adaptation, man by extra-physical or non-organismal adaptation, that is, by the liberation of the body from the necessity of adaptation through extra-physical means, for example, tools. The animal possesses a perfect body with manifold structures for offence and defence; while man's body is utterly defenceless and helpless. His technique develops and replaces his adaptation to Nature; and as evolution proceeds, his technique becomes more perfect, while his body becomes more and more deficient. The development of technique is not limited to tools, but is also revealed in the mental province, being responsible for the development of the word, speech and the concept, the basic element of thought. Further, the body, owing to the use of tools and the principle of body liberation, has suffered both regressive and progressive changes, such as the retrogression of the jaws, or the modifications produced by upright walking, the improvement of the hand, the development of the speech organs and the enlargement of the brain. The ape, on the other hand, has taken the line of animal adaptation. Thus the ape's hand, originally better adapted for tool using, developed for climbing. Again, the upright gait is bound up with the fight principle, but while the gorilla developed or retained equipment for fighting, man did not. Judged by these criteria, a border line case such as *Pithecanthropus erectus* is definitely human, while the Taungs skull points in the human direction.

The Later Stone Age in Northern Ireland. The first of a series of projected papers by Mr. C. Blake Whelan, dealing with the place of the stone age of northern Ireland in a provisional synthesis of late mesolithic and later stone age industries, has appeared (*Proc. Roy. Irish Acad.*, 42, Sec. C, No. 7). While a number of closely related mesolithic industries are differentiated as 'pseudo-Campignian', 'pre-Campignian' or 'proto-Campignian', as well as Campignian, the value of the Continental material is affected by the fact that this shadowy sequence has not received clear stratigraphic confirmation. In Northern Ireland, however, such a stratification is to be found in the Northern Irish coastal sites. These sites are now being investigated by the Harvard University Archæological Mission, which will test the provisional conclusions to be advanced here. It would appear that from the earliest stages of the Littorina transgression, a succession of differentiated, but related, littoral cultures, emanating from some eastern focus over a prolonged period, reached the Irish shores. However marked the separation of these industries in facies and time, there is a technical continuity which is unmistakeable. The groups represented comprise analogues of the Orwell Estuary industry called "Magdalenian", the so-called "Azilian" of Campbelltown raised beach, the pseudo- and pre-Campignian of the French sites, certain Portuguese Asturian forms, the shell-mound industry of Denmark and lastly the classical type station of Campigny. The Campignian site of Ballynagard, Rathlin Island, is now described. Here with characteristic implements of pure Campignian facies the author has discovered locally polished axes associated with pottery of veritably Windmill Hill type. Ballynagard is thus brought within the great western culture group of the neolithic, exemplified in the ceramic groups of Windmill Hill, Chassey (France) and Michelsberg (south-west Germany).

Fish Eggs and Larvæ from the Java Sea. Under this title, Dr. H. C. Delsman continues his studies on the eggs and young of fishes (*Treubia*, 14, No. 2, 1933). Eel eggs are fairly common in the surface catches with the egg net and may be recognised by their large size, segmented yolk and spacious egg membrane. The most numerous are those without an oil globule, which probably for the greater part belong to the many species of *Muræna* inhabiting especially the coral reefs. Those eggs which possess an oil globule are very interesting, hatching out into larvæ developing black spots ventrally, similar to those studied by Raffaele, Einigmann and others and shown to belong to larvæ of different species of ophichthyids. One of these in the present material is probably *Ophichthys macrochir*. If this be correct, there must be a forward movement of the anus over a distance of at least ten vertebræ. A similar conclusion was reached by Schmidt and by Grassi for *Ophichthys* (*Ophisures*) *serpens* from the Mediterranean. Other eggs and larvæ possibly belong to *Pisoödonophis*, the commonest ophichthyids along the coast of Java. Here again a forward shifting of the anus over several vertebræ must take place. Amongst the clupeoid eggs is a large one, found in brackish water, probably a species of *Alosa*, two of which (known as *trubuk*) occur in the river mouths of Sumatra and Borneo. These are related to the shads, but unlike them, appear to spawn in brackish instead of fresh water and have several oil globules in the eggs and newly hatched larva, the ovaries of the *trubuk* being rich in oil.

Cyclostomes. A concise systematic survey of the Cyclostomata is given by Dr. M. Holly in "Das Tierreich", 59 Lief., pp. xii+62 (Leipzig and Berlin: Walter de Gruyter und Co., 1933). The class is defined and the chief anatomical characters are briefly described. The classification follows on recognised lines into two orders, two families, eleven genera and forty-one species, the discrimination of which is aided by the usual tabular keys. Two other species are regarded as doubtful. The work is illustrated by 57 figures in the text.

Chromosome Division in Grasshoppers. There is some divergence of opinion regarding the behaviour of the chromosomes of the grasshopper and its interpretation, and an investigation by T. Ramachandra Rao upon the spermatogonial divisions of *Aularches miliaris*, supports the observations of McClung and others (*Proc. Indian Acad. Sciences*, 1, No. 1, 19; 1934). The rod-shaped chromosomes numbered 19, a standard number for the males of all the members

of the sub-family Pyrgomorphinæ. Individual chromosomes are built of fine threads—the chromonemata—and these are double in the telophases, become very thin and reach the limit of visibility during the resting stage, and show a spiral structure in the prophases. Each chromosome is confined to a chromosome vesicle, formed in the interphase owing to the limited centrifugal movement of the chromosome matrices, and it is after the gradual thickening and uncoiling of the chromonemata leading to the late prophase chromosomes that the vesicles break down.

Common Weeds of the Chicago Region. A very attractive booklet on "Common Weeds" by Paul C. Standley, associate curator of the Herbarium, has recently been issued by the Field Museum of Natural History, Chicago. Though it is interesting to note that several of the plants described are found as weeds in Great Britain, most readers will be struck with the high pictorial quality and attractiveness of the illustrations, of which there are twenty-seven. The printed descriptions are short, and describe the most-favoured habitat of the species, the country of origin if introduced, and the manner of seed dispersal. No attempt is made to deal with methods for the eradication of weeds; indeed the author is intent on mentioning any possible use the plants may have. Many people will be interested to know, for example, that the leaves of the yellow dock, which is the same species as our English curled dock (*Rumex crispus*), can be gathered in spring, and cooked and eaten as greens.

Fermentation of Mushroom Hotbeds. The use of fermenting manure as a source of heat for the cultivation of mushrooms and other crops has been a standard horticultural practice for a long time. Successful hotbeds require skilled compounding and attention, but little is known about the bacteriology of the process. An article on the "Distribution of Oxygen and Carbon Dioxide in Mushroom Compost Heaps as affecting Microbial Thermogenesis, Acidity and Moisture therein" by Edmund B. Lambert and A. C. Davis (*J. Agric. Research*, 48, No. 7, 587–601, April 1934) reports a preliminary study of the process of fermentation. It was found that in general, fermentation is anærobic below a foot from the top of the heap and three feet of the sides. The highest temperatures were found 1–3 ft. from the top and 2–4 ft. from the sides of the heap. Compost in the anærobic part of the heap tends to be acid, whilst aerobic conditions produce alkalinity. The introduction of ventilating tiles at ground-level permits air to enter the central parts of the heap, and raises the temperature there. It is not known if this will improve the yield of mushrooms; but it opens up interesting possibilities for the control of insect pests which flourish in the cooler places at the base of the heap.

Cultivation of Animal Fodder. The Imperial Bureau of Plant Genetics has just issued a new booklet in the Herbage Publication Series, "Grassland and Forage Crops in Thuringia, Czechoslovakia and Hungary" (Bull. No. 15, 3*s*. 6*d*.) The area under review is situated in long. 10°–23° E., lat. 46°–51° N., the type of fodder cultivated depending on two chief factors, namely, climate and elevation. The climate may be divided into two main types, the maritime (Atlantic) and the continental (Russian). Two important continental areas at low elevations and with rich soils are the Alföld and Thuringian Basin, and it is here that the most important lucerne strains are to be found. The chief aim in the breeding work in these districts is the maintenance of high yield combined with the ability to withstand excessive cold and drought. At the other extreme as regards altitude are the mountain pastures of Thuringia and eastern Czechoslovakia (Slovakia and Sub-Carpathian Ruthenia), where the economic problem is the substitution of the *Nardus stricta* and related poor quality swards by better quality grasses capable of persisting under these conditions. The articles on each district have been prepared in collaboration with acknowledged authorities in the region concerned. It is hoped to extend these studies to other European countries in which the cultivation of animal fodder represents an important part of the national economy.

The Development of the Rhone Delta. In 1930, Mr. R. D. Oldham showed that the present deltaic character of the Lower Rhone was a very late development in the evolution of the river. He is now able to give an outline of the whole history of the Lower Rhone (*Quart. J. Geol. Soc.*, pp. 445–461; 1934). In the Pleistocene, the river had already established its course through a gap between the Alpine and Beaucaire hills, but the present channel through the delta was not open, as a barrier blocked the way and forced the stream westwards. About 600–700 B.C., changes of level occurred which resulted in the formation of a lake (Accion) and involved the submergence of the lowlands near the sea. Some time after 500 B.C., the river built up its channel across the Accion, and floods rose higher against the banks until the barrier was overtopped a little upstream of Arles. A new channel to the sea was thus formed and by 218 B.C. it had become well established. In the eighth century of our era, a fresh movement brought about a subsidence of 15–20 ft. along the line of this new eastern channel, with consequent changes in its course as the flooded areas were gradually reclaimed by river silt. Along the older western branch a more direct channel to the sea was opened up past Albaron and the older course became blocked up and was abandoned. The delta of the Rhone may be said to have begun at this time, since when its development has been normal except in so far as it has been recently controlled by embankments.

Plessey Coal Seam, Northumberland. The Department of Scientific and Industrial Research has issued Paper No. 34 of the Physical and Chemical Survey of the National Coal Resources, dealing with the Plessey seam in Northumberland (London: H.M. Stationery Office. 2*s*. net). This seam, though only of comparatively limited area and low down in the series, is especially valuable because, as the report states, it yields a good quality of clean hard coal, hard enough to stand transport, and it is, therefore, mainly marketed as a steam and bunker coal. As it is a dull coal, it is not much used for household purposes. The report gives a full account of the seam and its properties, shown by fourteen analyses of samples of the coal together with some four special analyses. The report is of course mainly of interest to the few collieries working this seam, but may attract wider notice through the fact that this seam played an important part in the history of the

Northumberland coalfield and really started coal shipments from the port of Blyth, which has now become a very important coal-shipping centre.

Meteorology of Greenland. Geophysical Memoir No. 61 of the Meteorological Office, Air Ministry, is the fullest account that has yet been given of the meteorological results of the British Arctic Air-Route Expedition, 1930–31. The available material has been worked up by Mr. S. T. A. Mirrlees, of the Meteorological Office. The expedition was not, of course, undertaken with the view of finding out more about the part played by the high land mass of Greenland in the formation and behaviour of the depressions of the North Atlantic, and its significance in connexion with the streams of cold air that spread down from the arctic regions and are responsible for so many of the spells of cold weather in Europe that are initiated by strong winds or gales from between west and north. Nevertheless, to meteorologists this is perhaps the most important problem that the observations might help to solve. The expedition maintained a base station near the head of a fjord not far from Angmagssalik, in East Greenland, from August 1930 until July 1931, and for part of that time on the inland ice-cap at lat. 67° 3′ N., long. 41° 49′ W. Mr. A. Courtauld performed a remarkable feat of endurance by maintaining, alone, all the observations at this inland station from December 5 until March 20, and—after being snowed up—took indoor observations until May. It is difficult in a short space to give a proper idea of the knowledge gained; some of this is of a negative character; for example, the failure to correlate the violent northerly hurricanes experienced at the base station with subsequent gales in the Atlantic. These hurricanes were thought to be only partly katabatic, and, as happens with katabatic winds in some other parts of the world, are usually associated with a pressure gradient having the appropriate direction and yet cannot be relied on to appear when such a gradient is present. The cup anemometer at the base was blown away in one of these, after recording a speed of 129 miles an hour. The main object of the expedition led to particular attention being paid to visibility. On the ice-cap, this was often bad near the ground owing to drifting snow, but on one occasion a cape 220 miles away was identified by an observer in a seaplane, and on another visibility aloft was 180 miles, these observations both being made at 10,000 ft. in late summer.

Accurate Wave-Lengths in Stellar Spectra. Dr. S. Albrecht has published the results of a detailed study of Procyon with a three-prism spectrograph at Yerkes Observatory (*Astrophys. J.*, **80**, 86). The object is to obtain accurate wave-lengths of as many spectral lines as possible for use in determining radial velocities of stars of similar spectral types (*F*5 dwarf). The wave-lengths in stellar spectra cannot be computed from laboratory values, since, owing to the comparatively small dispersion used, a large number of the observed lines are blends of two or more lines in unknown proportions, and must be measured directly in the stellar spectrograms. Wave-lengths are given to 0·001 I.A. for 1,094 lines (about one third of which are due to Fe) in Procyon. The probable errors, intensities, widths and identifications (when possible) are also given, together with all data which would be necessary if a future rediscussion of the wave-lengths and radial velocities should be desirable. The work is a continuation of a series of similar studies of standard stars covering classes *Ao* to *Mb*, the first of which (on γ Geminorum, class *Ao*) was published in 1930.

Dissipation Constants of Solids. If a bar of carefully annealed aluminium is held in the middle and one end is struck, the sound emitted can be heard for a minute afterwards. If the same is done to a bar of lead, no musical note is emitted. There is therefore a great difference in their behaviour towards mechanical vibration. In the case of aluminium, the energy is gradually radiated into the air. In lead the vibrations die out so quickly that within one tenth of a second of being struck the displacement at the end of the lead bar is reduced to about one millionth of its original value. Researches on this subject described in the *Bell Laboratories Record* of August by H. Walther show how to distinguish between the way bodies act in this respect by means of a 'dissipation constant'. The results show that typical solid materials have a wide range of values for this constant. In some cases the results are surprising. For example, of two bars of steel identical in size, shape and composition, one of which is hardened by heating and quenching and the other softened by careful annealing, it is found on tapping their ends that it is the soft one that rings the longer. The constants for most solids lie between the two extremes of lead and aluminium. The figures given indicate orders of magnitude rather than specific values, since for a given material appreciable variation is possible under various conditions of internal strain. It is curious to notice that the order in the list given seems to bear no relation to other physical properties of the body. Carbon and tin have much the same values for the dissipation constant, but their melting points are very different. Zinc and glass differ greatly in hardness and electrical resistivity, but their dissipation constants are nearly the same.

Fatigue Properties of Patented Steel Wire. The importance of the surface condition on the fatigue resistance of steel has been shown conclusively in several recent publications. The importance of this in the production and use of steel wire has led E. T. Gill and R. Goodacre (*J. Iron and Steel Inst.*, **130**, Advance Copy; 1934) to undertake a comprehensive study of the effect of decarburisation with the aid of the new Haigh-Robertson fatigue testing machine. They have shown that the effect of the decarburised surface, especially for higher percentage reductions by drawing, is sufficiently great to obscure completely the effect of the carbon content. The removal of this skin results in the fatigue limit increasing, as would be expected, as the carbon content of the steel is raised, but not to so great an extent as does the tensile strength. Under certain conditions, the fatigue properties have given an indication of the stage at which overdrawing of the wire occurs, but much more work is required before any generalisation is possible. An interesting feature of the work is the suggestion that the endurance properties of wire under high stresses undergo critical changes at certain reductions of area, an effect to which the authors are inclined to ascribe certain unexpected failures in wire ropes. They also make the interesting suggestion that although the fatigue limit of wire free from decarburisation is higher than that of decarburised wire, the endurance at stresses higher than the fatigue limit, at any rate in some cases, may be less.

Physiology and Pathology of Blood

THE active state of research on blood was well shown by the symposium held at Aberdeen on September 6 by Section I (Physiology) of the British Association. The four papers which were presented at the meeting ranged from matters of practical importance to medicine, such as the incidence of anæmia amongst the poor of Aberdeen, to problems of—at the moment—purely scientific interest such as the molecular weight of the blood pigment, hæmoglobin, in different species ; this short account of the discussion may well begin at the medical angle of the discussion, and travel gradually over to the more academic aspects.

Prof. L. S. P. Davidson (Aberdeen) emphasised the importance of nutrition in the etiology of blood diseases. As regards the anæmias which arise from nutritional diseases, these can be sharply divided into two groups : (*a*) A group of diseases, which are severe, though comparatively rare in incidence, and respond to feeding with liver or liver extract but not to iron. (*b*) An extremely common group with low mortality but high loss of economic efficiency. These respond to feeding with iron. A deficiency of iron or of the specific anti-anæmia factor found in liver may occur through (i) actual deficiency of the factors, or of their precursors, in the diet ; (ii) imperfect digestive processes either leading to failure in the manufacture of the factors or rendering them unavailable ; under this heading specific deficiency in gastric secretion has been shown by Castle and others to be of clear importance ; (iii) defective absorption from the intestine ; (iv) demand being excessive, though the supply is normal, as in pregnancy.

Prof. Davidson has found amongst the poor of Aberdeen that roughly 50 per cent of adult women and of infants up to the age of one year are anæmic, though children between the ages of five and fourteen years and adult men are rarely so. The diet was the same in all these cases, but was relatively low in iron : the anæmia in the women and young infants is therefore attributed mainly to the excessive demand for iron in these two cases, due either to rapidity of growth or to loss of blood at child-bearing age or menstrual periods. Prof. Davidson concluded by describing the steps which a practising physician should take when faced with a case of anæmia.

The main theme of the paper by Prof. J. Barcroft (Cambridge) was the oxygen supply to the blood of the developing fœtus. At the beginning of gestation, the placenta is large relative to the size of the fœtus, but the growth of the fœtus soon catches up with the placenta, and by term it may well be that the fœtus has outgrown its commissariat.

The matter has been investigated quantitatively by measurement of the oxygen content of maternal and fœtal blood. Several compensatory mechanisms seem to have been adopted to cope with the relatively poor conditions of oxygen supply to the fœtus. (i) The maternal blood becomes more acid, thus being enabled to part with its oxygen more readily. (ii) The hæmoglobin of the fœtus differs from that of the mother in that it has, under identical conditions, a distinctly greater affinity for oxygen. (iii) In certain animals (for example, rabbit) the maternal and fœtal blood vessels are anatomically arranged in such a way as to ensure maximum diffusion of oxygen from the maternal blood to the fœtal blood. The extraordinary efficiency of these arrangements is shown by observations on the oxygen content of the blood returning from the uterus to the venous system of the mother. As pregnancy advances, the content sinks until at term the blood is almost denuded of oxygen.

Even so, the oxygen in the fœtal blood feeding the fœtal organs does not reach a level as high as would be found in the arteries of a man at the top of Mount Everest ; it is doubtful indeed whether the fœtal oxygen level would be enough to maintain consciousness in the born animal. The fœtus, however, appears to be better off, in that the oxygen consumption of its tissues, per unit weight, may be only about a third of the oxygen consumption per unit weight after birth.

Dr. F. J. W. Roughton (Cambridge) gave a summary of recent work on the transport of carbon dioxide in blood from the tissues to the lungs. The pioneer work of Henriques in 1928 first directed attention to the need for studying the kinetics of the reactions of carbon dioxide in blood. This new orientation has resulted in two new lines of work.

(*a*) The discovery of an enzyme in the red blood corpuscles capable of accelerating both phases of the reversible reaction carbonic acid $\rightleftharpoons$ carbon dioxide + water. The enzyme has been separated in a high state of activity, and has been given the name carbonic anhydrase. Without this enzyme, most of the carbon dioxide to be eliminated from the animal could only escape from the blood at about one fiftieth of the rate at which it is actually excreted in the expired air. The amount of enzyme in the corpuscles is, however, sufficient to accelerate the rate of carbon dioxide elimination about a thousandfold, if the activity of the enzyme in the corpuscle is the same as in solution. The enzyme is not present in appreciable amounts in the normal blood plasma ; its absence therefrom means that, whilst the blood is actually passing through the capillaries, that part of it which is in closest proximity to the tissues, that is, the plasma, suffers even less change in acidity than had been hitherto thought. Nor is the enzyme present in most organs : Dr. Roughton gave reasons why its presence in the actual tissues would *reduce* rather than increase the rate of removal of carbon dioxide by the blood. Organs where its presence would be, however, an advantage, are those in which bicarbonate, as well as carbon dioxide, is excreted, such as the pancreas (via the pancreatic juice). Here the enzyme is found in large quantities.

(*b*) The demonstration of a direct reversible reaction between carbon dioxide and hæmoglobin of a carbamino type, namely, $HbNH_2 + CO_2 \rightleftharpoons HbNHCOOH$. The indirect evidence for the occurrence of this reaction in blood has recently been strengthened by the work of Ferguson and Roughton, who claim to have separated and estimated the compound by taking advantage of the fact that its barium salt is soluble and stable in alkaline solution. Owing to the greater ease with which reduced hæmoglobin forms such compounds than oxyhæmoglobin does, an appreciable fraction, possibly 20 per cent, of the carbon dioxide carried by the blood during the respiratory cycle is believed to be transported via this carbamino-CO_2-hæmoglobin mechanism,

which works quite independently of carbonic anhydrase. Dr. Roughton, in a concluding survey of the present experimental evidence, suggested that there might be at least one more chemical mechanism for carbon dioxide transport in blood besides those already postulated.

Dr. G. A. Millikan (Cambridge) gave a useful résumé of Svedberg's work upon the molecular weight of the respiratory pigments. The values obtained in different animals range from 17,000 in the *Chironomus* larva to 5,000,000 in the edible snail and most gastropods. The physiological significance of the enormous variation was discussed. Dr. Millikan then described in detail the properties of the newly isolated muscle hæmoglobin, with particular emphasis upon the striking respects in which it differs, as regards its reactivity, from blood hæmoglobin. This led him finally to a survey of present theories as to the nature of the equilibrium between oxygen and hæmoglobin.

F. J. W. R.

Distribution of Marine Animals and the History of the Continents

HOW the past history of the great land and water masses of the earth's crust is reflected in the distribution of many marine animals was the subject of an important paper read by Prof. J. Versluys on September 7 before Section D (Zoology) of the British Association meeting in Aberdeen.

Prof. Versluys directed attention to the fact that the presence of a considerable number of closely allied marine animals and even specifically identical ones on both sides of Central America and in the Indian Ocean and European Atlantic points conclusively to the presence of former sea connexions linking up the Atlantic, the Pacific and the Indian Oceans. These connexions lay across Central America and through a bygone sea called Thetys, along the region where Asia and Africa now unite. In elaborating this thesis, he dealt mainly with the curious distribution of a small family of deep-water horny corals, the Primnoids.

In spite of the great land barrier now separating them, the Primnoid fauna of the European Atlantic is very similar to that of the Indo-Malayan seas, every species in the one region being represented by corresponding and, in part, closely allied species in the other. This is due to the fact that these two regions were in communication by way of the Thetys until the middle of the Tertiary period—a date so recent that no great changes in the Primnoid fauna have since then taken place.

The West Indian Primnoids, on the other hand, differ more widely from the European ones than do those of the Indo-Malayan region. Prof. Versluys suggested that this is explained by the intervention of the big Atlantic basin which, for Primnoids with their very ineffective means of dispersal, must act as a considerable barrier to distribution. Nevertheless, the difference between the West Indian and European Primnoids, though considerable, is not so great as might on this account have been expected. The Central Atlantic formerly had a continuous southern coast, Brazil and West Africa being united, so that conditions for dispersal between European seas and the West Indies were more favourable in times past than they are now.

Contrary also to what one would expect, the West Indian fauna of Primnoids bears but little resemblance to that of the American Pacific coast, no closely allied species being known from both regions. This applies not only to the Primnoids of these regions but also to the Gorgonacean corals as well. The old Central American connexion was, for some reason, not favourable to the distribution of corals across it.

Again, the American Pacific fauna of Primnoids shows no close relationship with the Indo-Malayan and Japanese fauna. There are a few species in common—indicating a migration across, or more probably around, the Pacific—but a number of important genera have very different species in the two regions, proving that, on the whole, distribution has been restricted and that these faunas must have been separated by the large Pacific basin for a very long time.

In view of these findings, Prof. Versluys is confident that Central America is, and has been, the most formidable distributional barrier encountered by the circum-tropical fauna of Primnoids. The Pacific Ocean also was, and is, an important barrier, but the present obstacle provided by the Africa-Asia continent was absent in pre-Tertiary times when the Thetys offered favourable conditions for the dispersal of Primnoids—so much so that Indo-Malayan forms seem to have reached the West Indies by way of this ancient sea and the then smaller and circumscribed Atlantic.

In support of these conclusions, comparison was made with the distribution of sea urchins. In spite of the fact that these animals live in shallower water (where stronger currents usually occur) than do the Primnoids, and have specialised pelagic larval stages of some duration which can be transported over long distances by water movement, the sea urchin faunal regions in the tropics and sub-tropics are the same as those of the Primnoids. The Atlantic again has proved but a feeble barrier. Of about eighty West Indian species, 19 are found also in the European Atlantic. On the other hand, there is no species of sea urchin known from both sides of Central America, and the tropical American Pacific coast has no species in common with the Indo-Malayan region.

The Primnoid fauna of the southern oceans also has a curious distribution, the explanation for which must be sought in the geological formations of earlier times. The southern Primnoids, especially those of the genus *Primnoella*, are found at a number of stations widely separated from one another by stretches of sea that must be scarcely passable for these corals with their very limited means of distribution. Moreover, of the entire southern fauna of Primnoids, only two—species of *Parathonarella*—are recorded from South Africa. The simplest explanation of this curiously scattered distribution, according to Prof. Versluys, is offered by Wegener's well-known theory of the splitting up of a southern continental mass known as Gondwanaland, the parts of which drifted away from one another to form South America, Australia, Africa, part of India and the antarctic continent, with some intermediate small islands representing parts that split off from the drifting mainlands and were left behind.

G. A. S.

Experimental Method in Industrial Relations

AN interesting discussion arranged by the Department of Industrial Co-operation of Section F (Economic Science and Statistics) at the Aberdeen meeting of the British Association dealt with the use of the experimental method in the field of industrial relations. It would probably have attracted more attention had it not been postponed to the last morning of the meeting.

The three papers forming the basis of the discussion were all highly stimulating and suggestive. Mr. M. H. Dubreuil's paper on autonomous groups in industry was essentially a plea for greater delegation of responsibilities in industry as a means of associating the workers with the success of the business which employs them. M. Dubreuil pointed out that this involves the discovery of responsibilities in accordance with the character and extent of the special abilities of the worker, and not in accordance with the abilities possessed by persons in the business entrusted with quite different tasks. The secret of scientific progress in the internal organisation of work lies in these terms of differentiated abilities.

Many problems of equipment, distribution of work, supplies, processes, etc., outside the scope of the abilities of the general manager could usefully be appreciated by the workman, and M. Dubreuil envisaged the subdivision of the business into relatively autonomous groups corresponding to the various tasks revealed by analysis of its technical structure. To this technical subdivision might be added a subdivision of the general budget, so that members of each group might act as if they really formed an independent business, thus ensuring an interest in the profit ensured by the good management of the fraction of the budget entrusted to them. M. Dubreuil believes that organisation of work on these lines is to be preferred to many profit-sharing systems.

This plea for experimental study of the structure of industrial organisation was followed by another striking paper, by Prof. F. Meyenberg, on the improvements in industrial relations arising from the intervention of the management consultant. Prof. Meyenberg pointed out that the independent consultant possesses definite advantages. He is not tied to a daily routine and can give his whole time to questions of organisation. Being free from departmental bias, he can keep in view the harmony of the whole organisation. Moreover, his experience in different branches of industry makes it easier for him to recognise common principles and to avoid undue attention to relatively unimportant details. In addition, since such a consultant is concerned primarily with the large field of management and not with questions of technology or production, any essential knowledge of the particular trade required to avoid difficulty in the introduction of management methods can easily be acquired by a man of the ordinary technical education essential for any consultant. These advantages and the freedom from the deadening effect of tradition on those who have spent long years in an industry give the management consultant a wide sphere of service in industry which is far from being generally appreciated or utilised.

In Prof. Meyenberg's opinion, some of the prejudice against the use of an outside consultant is due to the fact that the wrong man has sometimes been called in. This is probably a less important factor than the conservatism of the average industrialist, but the importance of the quality of the consultant needs no emphasis. Prof. Meyenberg made the further suggestion that such consultants might be recruited from the captains of industry themselves.

The third of the three papers, that of Mr. R. J. Mackay, was concerned with experiments in readjustment of relations between finance-capital, management and operative labour. Mr. Mackay pleaded for experiments in reversal of the customary relations between absentee owners and working personnel, such that capital will only be attracted if the capitalist has confidence in the efficiency of the team which desires to hire his capital. Among other rather revolutionary suggestions in an admirable plea for the improvement of the relations between capital, management and labour, Mr. Mackay submitted a case for the division of medium- or large-sized businesses into relatively independent responsible groups of working personnel, and indicated its bearing upon the wider utilisation of biological laboratory technique for vocational selection, guidance and placement of existing and potential industrial personnel of all qualities.

These three thoughtful papers pleading for wider use of experimental methods in studying the structure and development of industrial organisation give a highly significant picture of the wide field which industrial management offers for the use of scientific methods. The future of industry, and to a large extent the structure of society, are bound up with the application of impartial studies in this field, and the Department of Industrial Co-operation is to be congratulated once again upon the way in which it has attempted to indicate the possibilities in this direction to the British Association and to the public.

American Stratosphere Ascent of July 29, 1934

A BRIEF account was given in NATURE of July 28, 1934, p. 132, of a projected American ascent into the stratosphere in the balloon *Explorer*, jointly organised by the National Geographic Society and the U.S. Army Air Corps. The following week it had to be recorded that the flight had failed, but that the pilot, Major W. E. Kepner, the observer, Capt. A. W. Stevens, and the alternate pilot, Capt. O. A. Anderson, had escaped by parachute from the falling balloon. Most of the valuable instruments were completely destroyed ; but it would now appear that many of the records made on photographic strip have been saved.

Some of these results have recently been described in London at the International Conference on Physics in a contribution by Bowen, Millikan and Neher, while in the *National Geographic Magazine* of October Capt. Stevens contributes an article on the general aspects of the flight from which some further ideas of the faultless organisation and mechanical skill of

the enterprise may be obtained. The whole was a triumph of self-registration devices. Contributions of instruments were made by educational and other institutions in many parts of the United States. There were tubes of spore cultures, three spectrographs, one for ozone, one for sky and one for horizon; three electroscopes for cosmic ray ionisation, one exposed, one inside 4 in. of lead shielding and another weighing 600 lb. with a 6 in. covering of lead. These were contributed by Millikan and Neher. A contribution by Swann and Locher was a counter apparatus arranged for recording cosmic ray intensity from four different directions from the vertical to the horizontal. There were coarse and inter-range barometers for recording pressure variations automatically at high altitudes, and a dozen or more parachutes for men, heavy instruments and gondola.

Besides a perfect barograph record of the event which shows that a minimum pressure of 60 mm. was reached, electroscope records of cosmic ray ionisation from ground-level to 60,000 ft. were obtained. These have led Millikan to the conclusion that the only source of the observed cosmic ray energies now in sight is matter annihilation: most of the ionisation observed at sea-level is due to incoming photons produced during the destruction of matter in higher altitudes. Records of sun and sky brightness, internal and external temperature, the altitude of the inversion of the temperature gradient between 20,000 ft. and 38,000 ft., were also obtained. Capt. Stevens concludes by saying, "our most cheering thought of the recent ascent is that we feel we have successfully solved the problems of living and working efficiently in the stratosphere . . . not a single piece of scientific equipment attached to the gondola failed us during the flight; every instrument worked exactly as planned".

The mishap was due to a rip in the lower part of the balloon which was first noticed at the highest altitude. The men owe their lives to the perfection of the carefully designed scalloped band attached to the balloon fabric to which the gondola was roped. This band held the balloon steady in a drop of about 55,000 ft. in about 1½ hours and kept the rips from extending.

Inheritance of Anatomical Structure in Plants

THERE have been very few investigations of the inheritance of anatomical structure in plants. A recently issued work by E. W. Sinnott, Helen Houghtaling and A. F. Blakeslee* is a contribution to this subject, based on a comparison of the vascular anatomy in, (*a*) the polyploid forms of *Datura* (*n*, 2*n*, 3*n*, 4*n*), and (*b*) the 12 trisomic (2*n*+1) mutants and such of their secondaries as were available. Among the few earlier studies, the authors have overlooked the work of Penhallow on the anatomy of a hybrid *Catalpa*, and the papers of Gates and Bartlett on cell measurements in tetraploid *Œnothera*.

The flower pedicel was chosen for anatomical study, as comparable material could most easily be obtained from this region. Seventeen anatomical traits of this structure were quantitatively studied. In the polyploid series, as in previous results, there was progressive increase in size of the structure and its constituent cells, but not always in the proportion expected. The cortex was relatively large in the haploid, and relatively small in the 3*n* and 4*n* mutants, the smaller cortex being due to fewer cells. These facts, and others from the heteroploid series, lead to the conclusion that cell size and cell number are independently controlled.

There were certain exceptions to the increasing cell size in the polyploid series. The pericycle fibres remain of the same size, perhaps because they are frequently found to be multinucleate. The leaves increase in thickness, due to increase in cell size and elongation of the palisade cells, those of the tetraploid having at least twelve times the volume of those in the haploid. Similarly the petiole in cross-section is about sixteen times as large in the tetraploid as in the haploid, the same applying generally to the cells, which therefore show a geometric rather than an arithmetic ratio of increase.

In the heteroploid series, all having 25 chromosomes, the anatomical differences were equally marked and were due to the genic constitution of the extra chromosome. Certain of the primaries, such as 'spinach', were even larger than the tetraploid, this being due almost entirely to larger cell size. Different elements of the anatomy show considerable independence in their response to the presence of specific chromosomes. The conception of genic balance applies very well to some of the secondaries in comparison with their primaries, but this is by no means always the case, and various attempts are made to explain aberrant results. Curious facts which emerge are that the starch grains, especially in the secondaries, may have a very large or very small mean size, and that while the style of the flower has two vascular bundles in the 2*n*, 3*n* and 4*n* forms, in the haploid it always has five or six.

* The Comparative Anatomy of Extra-Chromosomal Types in *Datura stramonium*. By Edmund W. Sinnott, Helen Houghtaling and Albert F. Blakeslee. (Publication No. 451.) Pp. iii+50+19 plates. (Washington, D.C.: Carnegie Institution, 1934.)

University and Educational Intelligence

CAMBRIDGE.—Prof. R. H. Tawney, of the University of London, has been appointed Alfred Marshall lecturer for 1934–35.

Dr. T. S. Hele has been appointed assessor to the Regius professor of physic.

Trinity College announces the offer of a research studentship open to graduates of other universities who propose to go to Cambridge in October next as candidates for the degree of Ph.D. Dominion and Colonial exhibitions are also offered to students of Dominion and Colonial universities who wish to go to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. Further information can be obtained from the Senior Tutor, and applications should reach him by July 1, 1935.

MANCHESTER.—In connexion with the meeting of the Chemical Society to be held in the University on November 9 and 10, a reunion dinner of past and present members of the Department of Chemistry has been arranged; arrangements are in the hands of Drs. G. N. Burkhardt and C. E. H. Bawn of the Chemistry Department. A party of a hundred fellows of the Chemical Society will visit the Shirley Institute of the British Cotton Industry Research Association on November 9.

The following resignations and appointments have been announced this session:—Mr. F. W. Priestley has been appointed lecturer in veterinary bacteriology in succession to Mr. C. A. McGaughey, resigned. Dr.

R. W. Fairbrother has been appointed lecturer in bacteriology, and has vacated the assistant directorship of the Routine Section of the Department of Bacteriology and Preventive Medicine, to which Dr. J. C. Kerrin has been appointed. Mr. D. T. Robinson has been appointed assistant lecturer in bacteriology, and Messrs. I. A. Cathie and James Dawson demonstrators in pathology.

OXFORD.—The preamble of a statute designed to promote the more effective co-operation between Council and Congregation has passed the latter body without opposition.

Congregation has empowered the professor of zoology and comparative anatomy to continue, under the title of "Bureau of Animal Population", the provision made in his department for research into the ecology of wild mammals and for the co-ordination of data obtained from published sources and from field observers.

Dr. R. T. Gunther, the newly appointed reader in the history of science, delivered his inaugural lecture on October 25. He lamented the disappearance of many of the original instruments used by the pioneers of scientific research, as, for example, the air-pump of Boyle and Hooke; in many cases the actual instruments were more needed than even the records. In paying a tribute to the memory of Daubeny, he mentioned that among those who attended Daubeny's lectures were Sir John Bennet Lawes, Pusey, Mark Pattison, Ruskin and Acland.

AMERICAN education is about to receive a powerful impulse towards co-operative unification through the agency of the American Council on Education. This body, founded in 1918 with the object of organising co-operative effort in relation to problems of higher education, is now extending its activities to include the entire educational field. This development was announced at the Council's annual meeting at Washington on May 18, a summary account of which was published in *School and Society* of May 26. It was made possible by grants from a number of educational foundations: the General Education (Rockefeller) Board, 300,000 dollars; Julius Rosenwald Fund, 20,000 dollars; Carnegie Corporation, 20,000 dollars; Josiah Macy Junior Foundation, 12,000 dollars. In a report entitled "Integration", the Council's director, Dr. C. R. Mann, traces the steps by which it was arrived at. In a significant passage, the report declares: "We in America have kept the development and control of schools independent of political government . . . agencies created by the people to help them achieve their aspirations. In other countries schools are agencies created by government for such uses as government may choose to make of them". It is to provide the leadership needed for the perpetuation of this American system in the face of the manifold pressures of the rapidly changing social economy of to-day that the Council is undertaking such a radical enlargement of the scope of its work, and it is significant that the Council has elected as its new director, in succession to Dr. Mann, Dr. George F. Zook, who has resigned his post as United States Commissioner of Education. Dr. Zook has declared that the influence which led him to resign was the conviction that the Council, on its new basis of activity, seemed to present "a wonderful opportunity for service in formulating fundamental policies in education now so needed".

Science News a Century Ago

Gas Lighting at the Royal Institution

In 1834 the lecture room and adjacent parts of the Royal Institution were lighted by oil gas supplied by the Portable Gas Company. The compressed gas was delivered regularly to the Institution in metal containers, which were connected up to the pipe system. It will be remembered that in 1825 Faraday had separated the new compound bicarburet of hydrogen (benzene) by distillation of the condensed oil gas liquor which collected in the vessels used by the Company.

On November 3, 1834, Prof. Faraday reported to the Managers that, owing to the dissolution of the Portable Gas Company, new arrangements must be made for the lighting of the Institution. It was resolved to use coal gas. A few weeks later the Managers were informed that the new supply had been laid on to the building, the pipes and fittings used for oil gas had been adapted for the coal gas, and the system found to give a satisfactory and sufficient light without further change.

Aurora Borealis of November 3, 1834

In the *Memoirs of the Literary and Philosophical Society of Manchester* (6, Ser. 2, 1842) a paper, originally communicated by John Dalton, is printed (though long delayed in issue), referring to an aurora borealis of date November 3, 1834. Dalton reports that "in the evening I observed a horizontal light very conspicuous in the magnetic north; it continued without much change for two or three hours. A little before eight o'clock (true mean time), I was informed by two of my pupils that a fine arch to the south was observable; on looking I beheld a beautiful and brilliant arch crossing the magnetic meridian at right angles; its summit was 10° + to the south of the zenith, about 4 to 5 degrees broad, and extending from about 20 degrees altitude east to 20 degrees west. The appearance of an auroral arch such as was presented . . . is a rare phenomenon. I do not remember to have seen more than one before, and that was nearly forty-two years since. I believe no modern meteorologist has expressed a doubt that this arch-like appearance in the sky is only a modification of the more common appearance of the Aurora Borealis. I have for the last forty years considered both arches and beams to be constituted of magnetic matter, and in ordinary circumstances invisible; but when a disturbance of the electric fluid takes place in the upper regions these beams, etc., serve to convey the electric fluid from one place to another to restore the equilibrium, which occasions the luminous appearances."

Celestial Phenomenon seen at Liverpool

On November 7, the *Times* published a letter from a correspondent, "J. B.", and also an extract from the *Liverpool Courier*, relating to an interesting spectacle seen at Liverpool on November 3. The account in the paper said that "on Monday evening, about 8 o'clock, a singular luminous appearance was seen in the heavens commencing near the western horizon and after extending through the meridian of the heavens, finally losing itself near the brilliant planet Jupiter . . . It presented the aspect of a beauteous transparent zone of light, of near equal width, from six to seven degrees. . . . The stars

were distinctly visible through its filmy structure, and here and there a thin vapoury cloud crossed it at right angles. . . . Whether this splendid heavenly phenomenon should be ranked among the meteoric, nebulous or electrical class we cannot pretend to say". In discussing the occurrence, "J. B." referred to a somewhat similar phenomenon seen in 1812 and said, "The conclusion I then drew respecting phenomena of this kind, was simply this, that the line of steady light which extended across the heavens . . . was produced or liberated by two gentle breezes or currents of wind meeting each other which by acting mechanically upon each other, liberated that meteoric light or energy of the atmosphere with which it had become highly charged at this period".

Prof. J. L. R. Agassiz on Fishes

In the *Proceedings of the Geological Society* of 1834 is mentioned Prof. J. L. R. Agassiz's paper "On a New Classification of Fishes, and on the Geological Distribution of Fossil Fishes" delivered at the evening session on November 5. After comparing recent fishes with fossil fishes, Agassiz said he had arrived at a classification differing considerably from the various arrangements previously adopted by naturalists; "and by attentive examination of scales, fishes may be divided into more natural orders than had hitherto been adopted". In this manner he adopted four orders which bore some relations to the divisions of Artedi and Cuvier, namely, the Placoidians, which comprised the cartilaginous fishes of Cuvier, excepting the sturgeon; the Ganoides, about fifty extinct genera and including Plectognaths, Syngnaths and Acipensers; thirdly, the Ctenoidians, which are the Acanthopterygians of Cuvier and Artedi, excepting those with smooth scales, and with the addition of the Pleuronectes; fourthly, the Cycloidians, which were principally the Malacopterygians.

The number of species of fishes then known was estimated by Agassiz to be about 8,000, some three-quarters of which belonged to the Cycloidians and Ctenoidians, the presence of which had not then been discovered in the formations below the chalk. Agassiz said he did not know a single species of fossil fish found successively in two formations and he had examined more than 600 fossils on the Continent and 250 new species found in English collections. One third of the species in the London clay, the *calcairegrossier* of Paris, and at Monte Bolca, he added, belong to genera which existed no longer.

Zoological Gardens, Regent's Park

On November 8, 1834, the *Times* announced that "Yesterday morning the keepers belonging to the Zoological Gardens, in Regent's Park, commenced removing the numerous and valuable collection of birds and animals of tender habits into habitations adapted purposely for them during the winter season, which are heated in a peculiar manner. The arrangement of the various animals for inspection by visitors is admirably suited. The extremely cleanly manner in which all animals are kept is particularly creditable to the keepers. . . . During the winter some extensive improvements and additions to the gardens will be made; and they will then have to boast of being one of the most attractive and delightful promenades of the nobility and gentry in or near the metropolis".

Societies and Academies

PARIS

Academy of Sciences, October 1 (*C.R.*, 199, 621–648). PAUL LÉVY: The asymptotic properties of sums of linked contingent variables. M. GHERMANESCO: The theorem of Picard. DIMITRI RIABOUCHINSKY: Some new remarks on the hydraulic analogy of the movements of a compressible fluid. JACQUES VALENSI: Aerial helices: photography of the trajectories. Study of the secondary vortices. RAYMOND AMIOT: The adsorption by carbon of binary mixtures in aqueous solution. The mixtures studied all included phenol, with either saccharose, mannite, erythrite or glycerol. MIROSLAV ROMANOWSKI: The attainment of a 50 per cent hygrometric state round an Otto Wolff standard resistance of lacquered wire, exposed to variations due to inequalities of atmospheric moisture. A standard hygrometric condition for the resistance coils is obtained with solutions of sulphuric acid of density 1·33. The International Bureau has adopted this method, proposed by the Physikalisch-technische Reichanstalt, in preference to using a hermetically sealed container. ANDRÉ CHRÉTIEN and PIERRE LAURENT: The existence of a frequent type of iodine complex in organic solution. An application of measurements of the dielectric capacity to solutions of iodine in organic solvents. It is shown that the iodine – pyridine complex contains one molecule of iodine to two molecules of pyridine. Similar complex compounds were found for other bases. RAYMOND ROHMER: The hydrates of cobaltous sulphate. C. E. BRAZIER, I. MASEK and R. GUILHEN: The influence of the transparency of the atmosphere on the results furnished by the comparison of two pyrheliometers. LÉON LAUNOY: The action of cystine on the toxicity of antimony.

LENINGRAD

Academy of Sciences (*C.R.*, 3, No. 1). I. VINOGRADOV: Some new problems of the theory of numbers. N. MUSCHELISHVILI: A new general method for the solution of fundamental problems of the theory of elasticity in two dimensions. N. BYSTROV: An approximate solution of partial differential equations with three independent variables. P. S. NOVIKOV: Contribution to the theory of the relativistic continuum. S. ARCYBYSHEV: Penetration of copper into rock-salt by electrolysis and diffusion. V. SHPAKOVSKY: Velocity of the propagation of sound in carbon dioxide near the critical state. N. KUZNECOV-UGAMSKIJ: Temperature inversion and 'cold waves' in Middle Asia. W. SADIKOV, A. SHOSHIN, K. STARUCHINA and M. LIVSHITZ: Origin of carbon disulphide during the boiling of chicken meat. N. BROMLEY and V. ORECHOVITCH: Proteolysis in regenerating tissues. The autolysis of normal and regenerating tissues. I. KABAKOV and I. RYVKIN: Electrocardiographic studies on twins. KOLBANOVSKIJ and MIRENOVA: A comparative evaluation of methods for the development of combinative functions in pre-school children. Experiments with twin controls. V. SLODKEVITCH: The stratigraphy of the tertiary deposits of the western coast of Kamchatka. A. P. SEMENOV-TIAN-SHANSKIJ: A new genus of the sub-family *Pamphiliinæ* (Hymenoptera, Pamphiliidæ). A. SVETOVIDOV: The correlation between the character of food and the number of pyloric cæca in fishes.

MELBOURNE

Royal Society of Victoria, August 9. DAVID E. THOMAS: The Muckleford fault in the Strangways area, Guildford. This fault was earlier postulated by Messrs. Harris and Thomas as a north and south fault separating beds of Lancefieldian age to the west from those of Darriwilian to the east. Excavations by the Guildford Plateau Mining Co. exposed the fault locally, and it is here studied in detail. Lists of graptolites are given for each horizon of the faulted areas. It is here shown that the Lower Ordovician rocks have at least 4,000 ft. of beds missing on the western side, that the overlying Tertiary alluvial wash is displaced nearly 100 ft., and that the covering basalt has been shifted only 50 ft., thus showing at least three movements along this fault line, the last movement being very recent. Comparative notes are also given on other late Tertiary faults affecting alluvial workings in Victoria.

ROME

Royal National Academy of the Lincei, June 1. F. SEVERI: The rational involutions on a surface as an equivalence series: preliminary properties (1). Q. MAJORANA: The propagation of light reflected from a movable mirror *in vacuo*. L. LOMBARDI and E. BOTTANI: Can the distribution of the continuous current in a homogeneous conductor vary under the influence of a constant magnetic field? (1) Weber's work on this subject (1933) is discussed and experiments designed to check it are outlined. M. GORTANI: Succession of graptolite fauna in the neighbourhood of Goni, Sardinia. From the observations made, it seems possible to subdivide the graptoliferous series into palæontological zones of stratigraphic value, corresponding with those typical of the British region. O. CHISINI: A theorem of the existence of multiple planes (2). J. REY PASTOR: Multiple cumulants. E. BORTOLOTTI: General views on Vitali's calculus and its extensions (1). In this, and a second note, to appear later, it is shown that the two types or cases, termed by Vitali the general and the special case, may be combined into a single, more general one. L. CAMPEDELLI: Computation of the invariant of Zeuthen and Segre for an algebraic surface. A. MASOTTI: Dynamic actions exerted by a translatory-circulatory current on a hypocycloidal profile with n cuspids. G. AGAMENNONE: The hourly frequency of Italian earthquakes. The records of the past seventeen years furnish no evidence indicating that Italian earthquakes are not distributed uniformly throughout the twenty-four hours. This conclusion is in direct contradiction to the view, previously expressed, that earthquakes in Italy are appreciably more frequent during the night than during the day. S. FRANCHETTI: The phenomenon of fusion in relation to a new equation of state and to the lattice structure of solids (2). L. SONA: An observation regarding the propagation of electromagnetic waves. M. STRADA: Crystalline structure of thallium cyanide. X-ray examination of thallous cyanide by the powder method indicates a cubic structure of body-centred type. If the cyanogen group is regarded as a single entity, the unit cell would contain a single molecule, the side of the cell being 3·82 A. If, however, the cyanogen ion is considered as composed of two elements occupying distinct, although neighbouring positions in the lattice, the unit cell will contain eight molecules and have a side of 7·64 A.; the powder method does not fix exactly the symmetry of the carbon and nitrogen atoms and their positions in the lattice. The apparent radius of the cyanogen ion is 1·81 A. A. CAVINATO: The use of the prism for determining the principal refractive indices of crystals (2). The theoretical considerations previously outlined are applied to the case of an exceptionally clear crystal of sulphur. M. CURZI: A serious infection of peaches by *Phytophthora*. T. PERRI: Growth of the crystalline in anurid amphibia (experiments on *Bufo viridis*, *B. vulgaris*, and *Rana esculenta*) (1). R. SAVELLI: Microchemical observations on certain endocellular secretory formations.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 403–459, July 15, 1934). E. B. FRED and P. W. WILSON: On photosynthesis and free nitrogen assimilation by leguminous plants. In an atmosphere enriched in carbon dioxide (from 0·03 to 0·1 per cent), increased photosynthesis is accompanied by increased nitrogen fixation. Excessive photosynthesis depresses nitrogen fixation; thus shading is beneficial if plants have excessive carbohydrate. The association of high carbohydrate with increased number of root nodules was shown by varying the percentage of nitrogen and oxygen in the atmosphere. Addition of nitrate-nitrogen is accompanied by decrease in size and number of nodules, due probably to the fact that the carbohydrate level is reduced through synthesis of protein. Carbohydrate synthesis is normally rarely sufficient for maximum development of nodules. LINCOLN CONSTANCE: A preliminary revision of the perennial species of *Eriophyllum*. Only five species and eleven varieties are retained. H. C. SHERMAN and H. L. CAMPBELL: Observations upon growth from the viewpoint of statistical interpretation. Data from white rats show a close approximation to the symmetrical distribution generally assumed in statistical work. ANDREW DINGWALL and H. T. BEANS: A spectrographic study of the occurrence of chromium and molybdenum in carcinoma of the human breast. With one exception, sixty specimens examined contained chromium or molybdenum but not both. Details of the technique are given. BORIS EPHRUSSI: The absence of autonomy in the development of the effects of certain deficiencies in *Drosophila melanogaster*. CHESTER STOCK: New Creodonta from the Sespe Upper Eocene, California. GERALD B. HUFF: A note on Cremona transformations. G. A. MILLER: Distinct groups whose subgroups are simply isomorphic. EGBERTUS R. VAN KAMPEN: Locally compact Abelian groups. RICHARD C. TOLMAN: (1) Suggestions as to the energy-momentum principle in a non-conservative mechanics. (2) Suggestions as to metric in a non-conservative mechanics. M. J. BUERGER: The temperature-structure-composition behaviour of certain crystals. A theoretical discussion introducing a new notation to express crystal structure. B. KROPP and W. J. CROZIER: The production of the crustacean chromatophore activator. Extract of *Palæmonetes* eye-stalks from light-adapted animals produces chromatophore contraction (and also depresses growth when applied in agar to lupin root tips; compare auxin). Similar extract from dark-adapted animals produces a much smaller effect. It is suggested that the chromatophore activator is not entirely dependent on eye-stalk substance. S. S.

STEVENS: The attributes of tones. Two tones of different frequency are presented alternately, and the energy of one is altered until the two sound of equal pitch, volume or density. Equal volume requires increased intensity and equal density requires decreased intensity of the higher tone. Increased intensity, with constant frequency, causes drop in pitch with low tones and rise in pitch with high tones, 3,100–3,300 cycles remaining constant for all intensities. There are thus four types of response in the ear.

Forthcoming Events

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

Sunday, November 4

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. Burton: "Protective Disguise among Animals".*

Monday, November 5

UNIVERSITY OF LEEDS, at 5.15.—Prof. Hans Driesch: "The Relations between Science and Philosophy".*

IMPERIAL COLLEGE—ROYAL SCHOOL OF MINES, at 5.30.—Dr. S. G. Brade-Birks: "The Relation of Pedology to Agriculture" (succeeding lectures on November 7 and 9).*

Tuesday, November 6

KING'S COLLEGE, LONDON, at 5.30.—Sir Murdock MacDonald: "Estimation of Flow and Storage. Dams and Reservoirs".*

INSTITUTION OF CIVIL ENGINEERS, at 6.—Sir Richard Redmayne: Presidential Address.

Wednesday, November 7

CHADWICK PUBLIC LECTURE, at 8.15—(at the Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1).—Dr. Margaret Fishenden: "Health and Indoor Climate".*

ROYAL SOCIETY OF ARTS, at 8.30.—J. A. Milne: "Arts and Commerce Promoted" (Inaugural Meeting).

Friday, November 9

CHADWICK PUBLIC LECTURE, at 7.30—(at the Technical College, Huddersfield).—Dr. Matthew B. Ray: "Fifty Years of Public Health Progress".*

ROYAL INSTITUTION, at 9.—Dr. Franklin Kidd: "The Respiration of Fruits".

Official Publications Received

GREAT BRITAIN AND IRELAND

Technical Publications of the International Tin Research and Development Council. Series A, No. 12: A Rapid Test of Thickness of Tin Coatings on Steel. By Dr. S. G. Clarke. Pp. 6. (London: International Tin Research and Development Council.)

The Kent Incorporated Society for Promoting Experiments in Horticulture. Annual Report (Twenty-first Year), 1933. Pp. 268+14 plates. (East Malling: East Malling Research Station.) Free to Associate Members; to non-Members, 4*s*.

Proceedings of the Linnean Society of London, Session 1933–34. Part 3, including Presidential Address by Prof. F. E. Weiss: On the Northward Extension of the Mediterranean Flora. Pp. 89–140. (London: Linnean Society.) 1*s*. 6*d*.

Report of Delegates of the United Kingdom of the 27th Meeting of the International Council for the Exploration of the Sea, held in Copenhagen from June 4th–11th, 1934. Pp. 3. (London: Ministry of Agriculture and Fisheries.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1933—March 31, 1934. Pp. 7. (Sidmouth.)

Mines Department. Thirteenth Annual Report of the Secretary for Mines for the Year ended 31st December 1933, and the Twenty-sixth Annual Report of H.M. Chief Inspector of Mines for the same Period, with a Statistical Appendix to both Reports. Pp. xxiv+236. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

OTHER COUNTRIES

The Institute for Science of Labour, Kurasiki, Japan. Report No. 24: Reports of the Research Station for Agricultural Labour of the Institute for Science of Labour, Kurasiki, No. 1: Organization and Function of the Research Station for Agricultural Labour. By Gitô Teruoka. Pp. ii+22. 50 sen. Annual Report of the Director of the Institute for Science of Labour for 1933. Pp. ii+29. 60 sen. (Kurasiki.)

A Survey of the Air Pollution Problem of the City of Scranton and Lackawanna County. Conducted by H. B. Meller and Logan B. Sisson. Pp. 43+3 plates. (Pittsburgh: Mellon Institute of Industrial Research.)

Sveriges Geologiska Undersökning. Årsberättelse för år 1933. Pp. 9. 0.50 kr. Ser. C, No. 380: Agrogeologiska undersökningar vid Svalöv. Av Gunnar Ekström. Pp. 115+4 plates. 5.00 kr. Ser. C, No. 381: En kvartär Stromatolitkalksten från Bohuslän. Av A. H. Westergård. Pp. 48+13 plates. 2.00 kr. (Stockholm.)

Annual Report for the Year 1933 of the South African Institute for Medical Research, Johannesburg. Pp. 91+2 plates. (Johannesburg.)

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 41: Early Life History of the California Sardine (*Sardina cærulea*), with Special Reference to Distribution of Eggs and Larvæ. By Eugene C. Scofield. Pp. 48. Fish Bulletin No. 42: Maturity of the California Sardine (*Sardina cærulea*) determined by Ova Diameter Measurements. By Frances N. Clark. (Contribution No. 119 from the California State Fisheries Laboratory.) Pp. 49. (Terminal Island, Calif.: California State Fisheries Laboratory.)

U.S. Department of Agriculture. Miscellaneous Publication No. 188: Macrolepidoptera and their Parasites reared from Field Collections in the Northeastern Part of the United States. By J. V. Schaffner, Jr., and C. L. Griswold. Pp. 160. (Washington, D.C.: Government Printing Office.) 15 cents.

New Zealand: State Forest Service. Annual Report of the Director of Forestry for the Year ended 31st March 1934. Pp. 17. (Wellington, N.Z.: Government Printer.) 9*d*.

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