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Forest Destruction and its Effects.

THE question of the action of forests on rainfall has been debated by foresters, agriculturists, engineers, and others for a long period, the discussion probably dating back to the time at which scientific forest conservancy was first introduced. In the tropical and sub-tropical parts of the world this is not, however, the point of primary importance. The vital factor for the community at large is the determination of how far the destruction of forests in catchment areas and on the sides of hills and mountains in the drier parts of a country affects, in the first place, the level of the water in the big rivers, a matter of extreme importance when the rivers are utilised for irrigation or power works; secondly, the decrease in the local water supplies and in local precipitations upon which the cultivator is dependent; and, thirdly, erosion and avalanches, and the destruction they cause in the fertile valleys beneath. Sudden floods may also cause enormous damage to railways, towns, and so forth. In India, which was the first part of the British Empire to give consideration to this aspect of the forest question, the matter has been the subject of discussion and reports through the whole of the past century, a statement which will perhaps come as a surprise to many in Great Britain.

The problem of affording protection to forests for the above causes alone is by no means new. In France and Germany special laws for the protection and extension of the forests and the protection of agricultural lands by means of the forest have long been in operation; and similar laws exist in the Italian States. So far back as 1475 the subject attracted the attention of the famous Venetian Council of X., by whom a law was passed on January 7 of that year, regulating in great detail the clearance of the forests on *terra firma*. The mountain forests especially were protected by judicious regulations, which were renewed from time to time down to the very year of the extinction of the old republics. Tuscany and the Pontifical Governments were equally provident.

History has since shown that the wholesale destruction of forests in Spain, Italy, Sicily, Greece, and Macedonia has resulted in a great deterioration of climate over considerable tracts, due to loss of moisture, the sterilisation of the soil, and excessive erosion.

Although now well known, the chief action of the forest may be stated briefly as follows: The great

factor in mountainous and hilly country is the maintenance of tree growth on parts of the area. In the case of bare slopes the rain rushes rapidly down, causing erosion, only a fraction percolating into the soil, and is carried rapidly away, giving rise to spates and perhaps to serious floods, since the old channels of these streams or rivers are no longer able to carry the excess water of flood levels. A hot sun bursting out on to the slope after the rain quickly dries up the thin layer of moisture covering it. In the hotter parts of the globe subject to heavy rainstorms or monsoons the rushing water starts gullies which eventually become ravines, all surface soil is rapidly washed away, and in the course of years the hillside is eaten into, rubble and boulders being sent down to cover up valuable lands below. When the area is under trees, a portion of the rain, falling on the crowns, drips slowly down on to the layer of humus beneath and sinks into it. The larger portion, perhaps, falls direct on to the forest floor, where it is gradually absorbed in the soft covering which takes it up as a sponge. The water then percolates slowly downwards, filling up springs and underground reservoirs, and reaches the streams in a retarded manner. The flow in the latter is consequently more even and regulated, as also the amount of water which eventually reaches the rivers. The latter can therefore be more depended upon to maintain a normal level when it is required to utilise them for irrigation or power works. The roots of trees protect the surface by holding up the soil, and thus directly prevent denudation.

It is possible to give some concrete examples of the effects of the destruction of teak forests in India during the first half of last century, owing to the large demands for this timber from rapidly expanding markets.

The slopes on the west coast of the Bombay Presidency were once, even in the early days of British occupation, covered with magnificent, valuable, and extensive teak forests. These have long since been cut out, some disappearing for good. The denudation of the Deccan Highlands and the Eastern Ghâts has resulted in excessive erosion and the gradual silting up of the rivers. When the Dutch, French, and English first built settlements on the Coromandel Coast, it was possible to take ships up the Godaveri and Kistna. The English port of Narasapur and the French one of Yunaon, both on the Godaveri, were once the chief ports on this coast. They can now be reached only at high tide by small native shallow-draught craft. Last year the present writer had arranged to go down the Godaveri from Sironcha, on the frontier of South Chanda (Central Provinces) and the Hyderabad State, to Rajamundri, as he wished to carry out investigations in connexion with the effects of forest denudation on this river. It was early in March, the commencement of the hot weather season only. Inquiries elicited the fact that few rafts were now going down, owing to the extensive sandbanks already drying off in the river, and that even by dugout canoe, delays from stranding on sandbanks would be inevitable. Some hundred years ago this great river was the chief artery or high road into the interior! At Masulipatam, Dutch ships used to ride at anchor close up to the port, whereas at the present day even small native vessels have to anchor five miles out in the roads owing to the silting up. Between 1840 and 1850, Dr. Gibson, the first Conservator of Forests in Bombay, drew up a list of the rivers and creeks on the Malabar coast, where on arrival in those parts ships used to ride at anchor, all the creeks having silted up within the memory of men then alive.

Dr. Cleghorn, who afterwards became the first Conservator of Forests in Madras, directed attention to the destruction of tropical forests at the meeting of the British Association in Edinburgh in 1850. A committee was appointed to consider this matter. Dr. Cleghorn submitted its report, which was confined to India, the only country for which information was available, at the meeting of the Association at Ipswich the following year. The report summarised the position, as then known to the few in India who had given attention to the matter, pointing to the great and uncontrolled destruction which was taking place, both at the hands of timber merchants and owing to the careless habits of the native populations, who grazed their cattle at will in the forests and fired them every year in order to encourage the growth of new grass. The indigenous tribes in the hilly country also practiced unchecked shifting cultivation, a practice second only to the lumberer in the destruction of fine forests. Under this method, which was a common habit in Europe in olden times, a patch of good forest is felled and the material burnt *in situ*; coarse grains are then sown on the clearing. The cultivator then sits down and awaits the harvest. Two or three crops are taken off the area; the weeds then became too strong (as he never troubles to weed) and he moves on to a fresh area. The enormous destruction of virgin forest this practice entails, when practised for centuries, has to be seen to be credited. Yet many

of the tropical and sub-tropical forests in British Colonies and Dependencies are still subject to this the most pernicious and precarious form of so-called agriculture (as also to over-grazing and firing), the administrations responsible not having yet, apparently, understood the evils which attend it. The difficulties facing these Governments in prohibiting the practice or controlling it were all experienced in India, in one form or another, and overcome.

The encouragement given to the growth of tea and coffee and similar crops by British administrations in the Empire, whilst eminently praiseworthy if carried out on well-considered lines, has been productive of great harm in the past, and even the present day can scarcely be said to be free from anxiety on this score. In a report written in India in 1876 with reference to coffee planting, the following criticism is made:

"The planters who come over from Ceylon are now giving a very high price for land, and the whole mischief may be effected in a very short time. It must not be supposed that coffee is at all a permanent cultivation; we have only to look at the Sampajee Ghât in Coorg, the Sispara Ghât in the Nilgiris, and parts of the Annamalais to see at once that it is very often very little better than the shifting cultivation of the natives. It pays a coffee planter to take up a tract of primeval moist forest on our mountain slopes for a few years; he gets bumper crops the third, fourth, and fifth years, but denudation of the soil and erosion goes on rapidly, and it does not pay him to keep it up many years."

Two other examples may be mentioned. In Ajmere-Merwara in Rajputana, all the waste and forest land was handed over to the people by Government in 1850. The hills were rapidly denuded of timber and grazing was uncontrolled. The crops are irrigated from tanks (ponds) formed by building embankments across ravines. Some of these were very old. The rainfall is scanty and comes in heavy showers. The water, rushing down in torrents, quickly eroded the denuded hillsides, the tanks filled up with silt and debris or the embankments burst. In 1869, at the end of a two-year famine, the region was described as follows: "The cattle had perished, the people had fled, large villages were entirely deserted and the country was almost depopulated." All this was due to the mistaken policy of giving to the people what they had clamoured for, the uncontrolled use of the forest lands. An even more classic example is that of the well-known Hosiarpur *Chos* in the Punjab. These hills were formerly fairly well wooded. A rapid increase in population followed the advent of British administration in 1846. The consumption of forest produce augmented, the herds of grazing cattle multiplied excessively, and complete denudation ensued. This was followed by erosion, broad stretches of sand invading the plains beneath, with the result that the arable lands of 940 once prosperous villages were covered with sand, which laid waste upwards of 70,000 acres of fertile lands. In 1900 this formerly rich district was traversed by numerous broad, parallel, sandy belts cut out of the crop-bearing and fertile area.

In India these matters are now well understood, and the Forest Department, supported by the Government, has control of the great forest areas. Proofs of the disadvantages and disasters following the uncontrolled wasteful utilisation of the forests in mountainous and hilly country are not therefore wanting. It is known that the same processes are at work, and the same mistakes are being made, in our Colonies. It is the habit of British administrations to work in water-tight compartments. Probably the major portion of the difficulties being experienced in different parts of the Empire have been solved, or are approaching solution, in one or other of the provinces in India. They present no new features, as some appear to think, as the above-quoted examples go to prove. The chief difficulty is that action is delayed until almost irretrievable damage has been done and then the forester is asked to reafforest the areas so denuded. This entails an enormous expenditure, great skill, with success ever hanging in the balance.

Attention was directed to this subject at the meeting of the British Association in Edinburgh in 1920, when a paper dealing with the Indian forests was read. Resolutions of the same kind were also passed by the World's Forestry Congress held at Rome in May 1926. As an outcome of last year's meeting of the British Association at Oxford, the chairman of the Forestry Sub-Section, Lord Clinton, drew up for the council a brief statement dealing with the destruction of forests on hill slopes, with special reference to the tropical forests of the Empire. This memorandum has been submitted to the Secretary of State for the Colonies, by whom it is being communicated to the Colonies and Protectorates. It may be hoped, therefore, that the chief factors of destruction, namely, shifting cultivation, excessive grazing and the firing of forest lands, may receive that measure of considered control which the expert forestry services under the Colonial Office are fully capable of inaugurating if supported by the several administrations.

Racial Likeness.

Biometrika. Vol. 18, Parts 1 and 2. (London: Galton Eugenics Laboratory, University College, 1926.)

THIS instalment of *Biometrika* presents a strong claim on the interest of students of physical anthropology centred in the account which Prof. Pearson gives of the "Coefficient of Racial Likeness." This is a single numerical expression designed to measure the degree of resemblance (or divergence) of two groups of mankind. While this coefficient is the chief feature of research described in these memoirs, there is a second which should not be overlooked. The latter is an expression measuring the degree of resemblance of two groups in respect of a single character. It differs consequently from the coefficient of racial likeness, which sums up evidence furnished by a number of contributory characters.

Miss Hooke is responsible for the first paper, entitled "A Third Study of the English Skull." The previous studies were made by Dr. Macdonell (*Biometrika*, vol. 3, p. 191, and vol. 5, p. 86) upon human skulls found in London, the first series coming from Whitechapel, and the second from Moorfields. Both were regarded justifiably as representative of Londoners of the seventeenth century. Miss Hooke disposes of a collection of skulls from Farringdon Street, and refers them to the seventeenth century likewise. Tables of measurements supplement the descriptions, while type-contours extend the basis of comparison with other groups. The coefficients of racial likeness have been determined, and when the results of comparing the Farringdon Street groups with those from Whitechapel and from Moorfields in succession are surveyed, the conclusion is reached that "the three are very similar, but not sufficiently so to warrant the assumption that they are drawn from a single homogeneous population" (p. 102). Resemblance is discovered between the Farringdon Street skulls and certain Scottish skulls, but marked divergence from the skulls at Rothwell, Northants, measured and described by Prof. Parsons.

Dr. Morant contributes the second paper, reporting his inquiry into the characters of British crania at different historical epochs. First he reviews representatives of the Long Barrow (neolithic) population, followed in succession by those of the Bronze Age, the Iron Age, and the Anglo-Saxon period of dominance. The survey of these groups includes references to the arithmetical means of the measured characters, to the coefficient of racial likeness, to the coefficient termed 'a' (which measures the degree of likeness in respect of any single character), to measures of variability, and to type-contours. Discussion of the conclusions is carried into the next memoir.

This paper contains the observations made by Miss Hooke and Dr. Morant conjointly on the conclusions to which their researches have led them. The ascertained values of the coefficient of racial likeness are brought together impressively in Table I. One coefficient is particularly remarkable, by reason of the emphasis it lays upon resemblance. The resemblance thus emphasised is that of the Whitechapel skulls to the British Iron Age skulls. This resemblance surpasses in closeness everything else in the table.

The fourth paper is by Prof. Pearson himself. He recalls the difficulty of comparing two groups of mankind when the numbers of one or both are relatively small. He points out the difficulty of summing-up on the results of comparing characters one by one. He describes steps leading to a formula capable of measuring the degree of resemblance (or divergence) of the two groups. This formula he terms the coefficient of racial likeness; and (in regard to its indications) the nearer the numerical value is to zero the more closely associated are the two groups, in the sense that they are more probably samples of the same population.

Prof. Pearson has at his disposal no less than 757 coefficients of racial likeness. Their numerical values range widely, 110 of them being less than unity, while 39 are higher than 31. Prof. Pearson suggests a classification with twelve subdivisions called grades. In Grade I. are all coefficients less than unity. They denote very intimate association. At the other end of the scale is Grade XII., including all coefficients in excess of 31, indicating very wide divergence. A boundary is fixed arbitrarily at the number 13, and this is to mark the extreme limit at which resemblance can be claimed.

The series of coefficients is next reviewed; and in regard to those with high numerical values indicative of wide divergence, Prof. Pearson is able to claim that in the vast majority of the instances available the coefficient brings confirmation to conclusions formed on independent grounds. In a corresponding manner, when scrutiny is directed to the coefficients denoting very intimate association, it is difficult to find any pair of groups "which embraces two craniologically distinct races" (p. 114). Such facts ought to establish confidence in the intermediate values and indications of the coefficient. Of these values it is remarked that some are in their purport entirely novel, while others correct views held previously as to the relation of certain groups of skulls. One of the four examples illustrating these conclusions proclaims that the English skull is nearer to that of the men of the British Iron Age than to that of the Anglo-Saxons. The conclusion

reached by Miss Hooke and Dr. Morant in regard to the close association of the Whitechapel series and the British Iron Age skulls has been mentioned already. Here the setting is slightly different, and the relevant coefficients are adduced in support of the conclusion which it embodies.

Turning to the records, it appears that in association with the seventeenth century English (Whitechapel series) the British Iron Age skulls yield a coefficient of 0·38, whereas with the same English series the Anglo-Saxon skulls yield a coefficient of 2·98. At this point it is worth recalling that in 1904, when dealing with the Whitechapel and Moorfields series, Dr. Macdonell found confirmation of the suggestion made by Prof. Pearson that the Whitechapel skulls are closer to the Long Barrow British than to the Round Barrow British, Romano-British, Anglo-Saxon or "mediæval English" represented in the museums of this country. About sixteen years later, Prof. Parsons urged the claims of the Anglo-Saxon skull in this respect, against those of the Long Barrow skull. The evidence of the coefficient of racial likeness acquires a special interest in view of this difference of opinion, and the present series of memoirs provides the following data upon this subject.

COEFFICIENTS OF RACIAL LIKENESS.

Whitechapel and British Iron Age .	0·38±0·20
Whitechapel and Moorfields . .	2·05±0·18
Whitechapel and Anglo-Saxon . .	2·98±0·19
Whitechapel and Farringdon Street .	4·15±0·18
Whitechapel and Long Barrow (p. 100)	7·44±0·18,
(or p. 55)	3·71±0·18

The coefficient consequently places the British Iron Age skulls closest to the Whitechapel skulls. Thus it displaces both the Long Barrow skulls and the Anglo-Saxon skulls from the distinctive position claimed for them by their respective advocates. The data illustrate also the varying values of the coefficient resulting from the comparison of the Whitechapel series with each of the two other seventeenth-century series of Londoners.

Returning now to Prof. Pearson's paper, it will be found that he discusses the influence exerted upon the value of the coefficient by the number of the skulls available in the groups compared with each other, and again by the number and also the character of the observations employed. A plea for standardisation in these matters is also advanced by Prof. Pearson.

The application of the coefficient of racial likeness to the series of British crania has been taken above as an appropriate illustration. But although the associations there indicated and their grading may be novel, they are neither impossible, nor even extremely improbable. With such reflections in mind, attention is directed to the remarkable association assigned to Mori-ori and Fuegian skulls by the corresponding coefficient. Almost equally strange is the association indicated as existing between his Mori-ori (non-Mongolian) Tibetans.

The perusal of the list of records leaves a certain impression of caprice in the manifestations of the coefficient of racial likeness. For example, in one and the same population, namely, Londoners of the seventeenth century, the coefficient may range from 1·41 to 4·85 for male skulls and from 0·96 to 5·77 for female skulls, according to the characters employed and the pairs of groups compared. Again, the comparison of various pairs of Romano-British groups yields a range of the coefficient from 0·5 to 17·48. These records must needs be borne in mind and the explanations carefully weighed before the very striking values of the coefficients relating to Tibetans, Mori-ori, and Fuegians are made the basis of arguments affecting the movements of human racial types. At present, caution enjoins reliance upon the coefficient only where its numerical values are extreme (whether low or high) and its emphasis (whether laid upon resemblance or divergence) correspondingly pronounced.

In the fifth paper, Dr. R. W. Reid, emeritus professor of anatomy in the University of Aberdeen, describes two skeletons from St. Magnus Cathedral, Kirkwall, Orkney. The Icelandic Sagas and the Orkneyinga Saga provide Dr. Reid with evidence that the patron saint was executed (murdered is more correct), that the executioner used an axe, that after interment for twenty years the body was enshrined over an altar in Christ's Kirk, Birsay, and that after a sojourn there and in another church, the shrine was transferred to the cathedral. From the same sources Dr. Reid has ascertained that the body of the famous Norse St. Rognvald was buried likewise in the cathedral (of which he was actually the founder).

Each skeleton occupied a recess curiously excavated high up in a pillar of the choir of the cathedral. Dr. Reid comes to the conclusion that the remains from the south pillar are those of St. Magnus, and that those in the north pillar probably belonged to St. Rognvald. The osteological descriptions are accompanied by tables of measurements and by contour tracings.

Dr. Reid's conclusions make as close an approach to absolute identification as can be expected in the circumstances. Although not actually brachycephalic in terms of the proper index, both skulls by reason of their width tend in that direction. This point is mentioned in view of an opinion, based on experience elsewhere, to the effect that this tendency is very frequently to be remarked in the skulls of medieval ecclesiastics.

The photographs of the skull assigned to St. Magnus suggest the possibility that two kinds of mutilation, effected at different epochs, are present. It seems not impossible that a spade may have inflicted supplementary injuries now indistinguishable from those due to the executioner's axe twenty years earlier. The difficulty of the problem has long been recognised, and a discussion thereof will be found in the "Collected Scientific Papers and Addresses" of the late Prof. Rolleston (vol. 1, p. 286). W. L. H. D.

Archæology of Iron.

Iron in Antiquity. By Dr. J. Newton Friend. Pp. viii+221. (London: Charles Griffin and Co., Ltd., 1926.) 10*s.* 6*d.* net.

THE application of the analyses of metal objects to the study of archæology, especially in connexion with the problems of the bronze age, is becoming increasingly important owing to its bearing upon questions of cultural diffusion. If, for example, it were possible to determine by analysis the origin of the copper found in the various centres of early culture in which copper did not occur or had not been mined but had to be imported, we should probably be well on the way to solving some of the more obscure questions of pre-history. The work of the committee of the British Association which is seeking the source of Sumerian copper on these lines, when completed, may be expected to indicate how far such research is likely to be of practical utility in furnishing evidence in archæological and ethnological argument. This point is not without interest in the present connexion, as Dr. Friend, whose competence as an archæologist and metallurgist has been proved in a number of communications to the technical journals, in his "Iron in Antiquity" has not confined his attention to the study of that metal alone. He has felt it incumbent upon him to survey briefly the technological side of the stone, copper, and bronze ages, and has thus put readers who may not be archæologists in possession of the facts which are necessary to an understanding of the special problems with which primitive users of iron had to deal. Further, he refers incidentally to the arguments relating to the diffusion of culture which have been based by Prof. Elliot Smith upon the early use of copper in Egypt.

As regards the beginnings of iron, Dr. Friend is of the opinion that meteoric and not telluric iron was the form in which it was first used. The figures he quotes in reference to the amount of meteoric iron which probably was available for the use of early man appear adequate to meet the arguments of those who hold otherwise. It would have been an advantage had the primitive furnace, especially as it occurs in Africa, received a little more detailed treatment. It would then have been more clearly apparent that the process of smelting iron is one which presented no very great difficulty to primitive man. It would seem, however, that both early and primitive peoples were not fully capable of dealing with the product of the furnace. While the Vikings, for example, were able to produce satisfactorily an object of some size, such as an anchor, a thin strip of metal such as a sword, which would retain an edge and not bend, was frequently beyond their powers. The regular occurrence in sagas and legends of swords of fame each with its own special name is some measure of the difficulty the smith experienced in producing a satisfactory weapon. In its rarity it called for special commemoration. References to the ease with which the spears of African natives were bent are frequent.

Dr. Friend gives some interesting details relating to the quality and character of the metal in iron objects found in pre-Roman and Roman Britain. It is noteworthy that samples of Roman iron which have been tested for corrodibility compare favourably with modern mild steel of corresponding size.

Although Dr. Friend's collection of data from various sources is admittedly not exhaustive, as supplemented by his own observations and researches, it will be of very real assistance to students of archæology. The results of the qualitative and quantitative analyses are particularly useful and frequently illuminating. All sides of the subject are covered. The author touches upon the various uses to which iron was put—for ornament or for currency as well as for implements and weapons — whether it be in the prehistoric period, in early Egypt and Mesopotamia, India, China and Japan, or among primitive peoples. It may, however, be said in passing that the chapter on Africa is scarcely adequate in view of the importance of iron-working in that continent and the amount of information about it which has been collected in recent years; and more attention might well have been given to China and Japan. Dr. Friend has not omitted to mention the interesting religious beliefs and superstitions which attach to iron, the avoidance of its use for ceremonial purposes, and the attribution of a magical character to the smith. A striking example to which he might perhaps have directed attention is found in the avoidance customs which affect the relations of the general population with the iron-working tribes who are responsible for the supply of weapons in certain parts of East Africa; while in England, in addition to Wayland the smith, we have a good example of the smith-magician in that curious folk-song of the "Coal-Black Smith." Nor does he allude to the significant variant of the 'fairy-wife' folk-tale, once current in

Wales, and elsewhere, in which the wife vanishes when struck by iron.

As Dr. Friend does not confine himself entirely to the subject of iron, it may not be out of place to allude to one or two points in connexion with copper. The statement is repeated that Africa, excepting Egypt, had no copper and bronze age but passed directly from stone to iron. No doubt this is true generally; but no mention is made of the vast amount of copper which has been taken from the ancient workings in Rhodesia and the Katanga. Even now in Rhodesia the natives smelt copper in primitive furnaces. What was the destination of all the copper from these early workings, which has been estimated at an enormous number of tons? It is urgently necessary that the dumps at the ancient mines should be examined for evidence of date before they disappear in the course of the mining operations of to-day. A committee of the British Association has been appointed with the view of following up clues furnished by objects which have come into the possession of the mining companies; but whether anything can be done must depend to a great extent on the possibility of raising funds for the prosecution of inquiries on the spot.

Another curious point arises in connexion with the water-clocks in the form of a perforated bronze bowl which have been found at Wookey Hole and elsewhere. Dr. Friend is of the opinion that they are a British invention, although they occur in India and Ceylon presumably at a later date. Apparently he is not aware that they occur in Algeria also. What adds to the interest of this fact, but by no means makes it easier to explain, is that there also occurs in Algeria a primitive form of lathe which is identical in form with the lathe used in the peasant cottage-industry of wood-turning in Buckinghamshire.

The New Thermodynamics.

The New Heat Theorem: its Foundations in Theory and Experiment. By Prof. W. Nernst. Translated from the second German edition by Dr. Guy Barr. Pp. xvi+281. (London: Methuen and Co., Ltd., 1926.) 12*s.* 6*d.* net.

ONE of the most important branches of thermodynamics as applied to chemistry is the relation of heat of reaction with chemical equilibrium data and the calculation of the effect of temperature on the equilibrium constant. The fundamental equation here is that first deduced in its present form by van 't Hoff in 1884:

$$d \log_e K / dT = Q/RT^2,$$

where K is the equilibrium constant, Q the heat of reaction, T the absolute temperature, and R the gas constant. The effect of temperature on Q was known previously in the relation deduced by Kirchhoff, and special cases of the above equation had been used by Horstmann, Gibbs, and others. This is a differential equation, and its integration necessarily introduces an arbitrary constant, the value of which could be found only by experiment. It is the discovery of Nernst, published in 1906, and generally known as Nernst's theorem, which enables one in many cases to find the integration constant without any information as to the states of equilibrium. This is the practical aspect of the theorem, and it will be realised that it opens out important fields of application both in the laboratory and in industry.

In the shape used by Nernst, the maximum work, or diminution of available energy, is correlated with the heat of reaction in a form which is a consequence of van 't Hoff's equation, but Planck has shown that the content of the theorem can also be expressed in the statement that the entropy of every pure solid substance vanishes at the absolute zero. The entropy has been related to molecular statistics by Boltmann, Gibbs, and Planck, and in this field the quantum theory has found its place. It is therefore clear that an entirely new branch of the theory of heat has been created in recent years, and it is possible to speak of the 'New Thermodynamics' as distinguished from the classical science evolved from the work of Joule and Carnot by Lord Kelvin, Clausius, and others.

The book under notice is Prof. Nernst's own version of the new theory and of the experiments which have gone so far towards its verification. It is written in the style associated with its author; there is nothing superfluous and the mathematical apparatus is kept in its proper place. The translation has conveyed the spirit as well as the content of the original extremely well, and the book is one which ought to be a welcome addition to the library of every chemist who has occasion to make use of physical-chemical methods. It must be emphasised that Nernst's theorem has important industrial applications, and that the book is one which will be found intelligible by readers who have only a moderate knowledge of mathematics.

The first part of the book deals with the specific heats of solids and gases, and the experiments which showed that at very low temperatures the specific heats of solids become very small. It was this result which gave such an important confirmation to the quantum theory as applied to material systems. The theory in the case of gases is much less complete, and there is a comparative lack of experimental data in this field. In Chap. vi. the formulation of the new theorem is dealt with, in a direct and practical manner, and then follows an attempt to explain its physical basis,

which is said to be contained in the law that "there cannot be any process taking place in finite dimensions by means of which a body can be cooled to the absolute zero." Important mathematical formulæ used in the applications of the theorem are next summarised, and then the application of the theorem to numerous cases follows in the rest of the book. Complete numerical data, curves, and references to the literature are given.

Perhaps the most interesting part of the book, from the theoretical point of view, is that dealing with the calculation of the chemical constants, which, together with thermal data, are required in the applications of the theorem. It cannot be said that this branch of the subject is yet in a very advanced state, but sufficient is given to enable the reader to understand the nature of the problem to be solved. J. R. P.

Our Bookshelf.

The Importance of Diet in relation to Health. (The People's League of Health Lectures.) Pp. xii + 130. (London: George Routledge and Sons, Ltd., 1926.) 3*s*. 6*d*. net.

THE subject matter of this book consists of a course of six lectures entitled "What to Eat and Why," given, under the auspices of the People's League of Health, by a distinguished group of lecturers.

In the first lecture, on "The General Principles of Diet," Prof. Leonard Hill points out the importance of diet, sunshine, and open air in the prevention of tuberculosis and rickets. Overfeeding is stressed as being the most general error, caused by the temptation of "the arts of cooking, by pastry cooks and sweet shops." "More people are probably killed off too early by intemperance in eating than by alcoholic intemperance." The food requirements of different classes of individuals are given, and the use and misuse of some of the commoner articles of diet are discussed. The second lecture, on "The Food of Mankind treated Historically and Geographically," by Sir D'Arcy Power, affords an extremely fascinating picture of the habits that have prevailed from the earliest times. The customs of the Egyptian, Grecian, and Roman Empires are compared with those of Anglo-Saxon and Norman times, showing the evolution of present-day usages. The chapter draws an important lesson, showing the relationship of moderation in food to health and character.

Prof. W. D. Halliburton's lecture on "Vitamins and the Diseases caused by Badly Chosen Diet" urges the importance of milk, green vegetables, and whole-meal bread. Many will endorse the lecturer's remark: "Cursed be he who removes his neighbour's landmark, and those who interfere with their neighbours' food ought to be equally banned." But Prof. Halliburton's remark that "It is the poor, whose ignorance leads them to suppose that white bread is the best and whose poverty compels them to eat the cheapest fat," is especially poignant, as we see from the previous lecture that throughout the ages the poorer classes have invariably endeavoured to follow the habits of the more well-to-do.

Dr. H. Scurfield follows with the application of the points already discussed to "Infant Feeding." The figures he has to give concerning the decrease of infant mortality in Great Britain are encouraging and compare favourably with progress made abroad. Dr. M. J. Rowlands explains the importance of "The Feeding and Breeding of Cattle in Relation to the Health of the People." It is pointed out that as vitamins are of vegetable origin, they must be liberally supplied to the cow if the milk is to be of proper quality. This is frequently overlooked, especially in winter feeding. Besides reducing the quality of the milk, the lecturer considers that neglect of these substances is the main cause of bovine tuberculosis. The last lecture, on "Food Preservation and Adulteration," by Prof. W. E. Dixon, is comforting, for he shows clearly that the addition of preservatives is unnecessary for all foods except sausages. Australia and New Zealand send butter to the United States, where added preservatives are absolutely forbidden, so they can quite easily provide us with the same quality.

The whole book is extremely readable and interesting, and should be widely studied by those interested in welfare work.

Acoma, the Sky City: a Study in Pueblo-Indian History and Civilization. By Mrs. William T. Sedgwick. Pp. xiii + 314 + 33 plates. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1926.) 18*s*. 6*d*. net.

ACOMA, a pueblo stronghold of the Keres people of New Mexico, has a double claim on the interest of the student. Its inhabitants, now about five hundred in number, are the least known, the most reticent, and the most inscrutable, of the Indians of the pueblo area. Their history as told in the stories of the conquistadors, the poems of Villagrá, and later records, embodies examples of valour and endurance as striking as any in the history of the Spanish conquest of America. Mrs. Sedgwick has a thrilling story to tell—from the entry of the Spaniards into New Mexico in 1539 and the expedition under Coronado in 1540, when they first saw Acoma, until the final crushing of revolt among the inhabitants of that pueblo in 1699. To the Indians it seemed well-nigh impregnable, as indeed it appears to-day, and its capture was a remarkable feat of arms.

In culture the Acomas are akin to the Zuñi; but even that indefatigable and sympathetic inquirer, Mrs. Elsie Clews Parsons, was to a great extent baffled by the difficulties of obtaining information from them. To give a more or less coherent account of their beliefs and organisation, Mrs. Sedgwick has made use of the analogies of closely related cultures, but only with good reason. In this matter her judgment and her experience among the people themselves may be trusted. Although her account of the Acoma culture is not based entirely or even to a great extent upon first-hand observation, she has done a service both to the student and the general reader in presenting the historical and the anthropological material in an eminently readable form within the covers of one book.

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.*]

The Aurora of October 15, 1926, in Norway and Sounds Associated with it.

SOME curious phenomena accompanying the splendid aurora of Oct. 15, 1926, were observed by me. On the night in question I was working as observer of international determinations of longitude at the top of a hill named Voxenaasen in the neighbourhood of Oslo (approximate altitude, 470 metres). I was at work in a field observatory with a transit instrument registering star transits and chronometer beats for time determinations, when an initial aurora attracted my attention. My assistant was Mr. G. Jelstrup, electrotechnical student.

I was able, during intervals between my observations of time and polar stars, to observe the aurora, which was certainly one of the most splendid I had ever seen. But what is of preponderant interest is the following fact: When, with my assistant, at $19^h\ 15^m$ Greenwich Civil Time, I went out of the observatory to observe the aurora, the latter seemed to be at its maximum: Yellow-green and fan-shaped, it undulated above, from zenith downwards—*and at the same time both of us noticed a very curious faint whistling sound distinctly undulatory, which seemed to follow exactly the vibrations of the aurora.*

The sound was first noticed by me, and upon asking my assistant if he could hear anything, he answered that he noticed a curious increasing and decreasing whistling sound. We heard the sound during the ten minutes we were able to stay outside the observatory, before continuing our observations.

From $20^h\ 1^m$ to $20^h\ 6^m$ (Greenwich Civil Time) we registered on our radio-receiving set the rhythmic time-signals from the LY station (Bordeaux). We secured the whole series of tops—but at the same time the 'aurora statics' disturbed the pen of the registering instrument. The impulses thus registered are of varying strength, and each of them is of course exceptionally well determined in time, being 'received' at the same time as the scientific *time signals*. I therefore think that they may be of some interest. The maximum impulses of 'aurora statics' and their duration were:

No.	Greenwich Civil Time.	Duration.
1 . . .	$20^h\ 4^m\ 28^s{\cdot}60$	$0^s{\cdot}08$
2 . . .	$20^h\ 4^m\ 29^s{\cdot}49$	$0^s{\cdot}10$
3 . . .	$20^h\ 4^m\ 39^s{\cdot}90$	$0^s{\cdot}25$
4 . . .	$20^h\ 4^m\ 40^s{\cdot}50$	$0^s{\cdot}25$

As regards the intensity of these impulses, I find that in each case the vertical component was greater than 100 microvolt/metre.

When, after the reception of the time signals, we again went out of the observatory, the curious sound had absolutely ceased, and later in the night, when also the aurora had vanished, we noticed that the atmosphere was as if swept clean from statics and disturbances of our wave-length.

Concerning the curious sound, I would only remark that the weather was absolutely calm when it was heard. As regards our antennæ system, it may be said that it consists of 5 strands of 40 metres each. Our receiver set is an aggregate, consisting of a three-circuits tuner, two high-frequency valves, one modulator, one heterodyne, four low-frequency valves, relay and chronograph.

HANS S. JELSTRUP,
Astronomer to the Norwegian Geographical Survey.
Oslo (Norway), Dec. 1, 1926.

To the above most interesting communication from M. Jelstrup I may add the following:

On Oct. 15 I had the aurora stations at Bygdö, Oslo, Oscarsborg, Tömte, and Kongsberg in action from about 18^h Greenwich Civil Time to about 2^h on the following morning, and photographs were taken all the time from single stations, and from two or three stations simultaneously. About 70 successful photograms for the determination of height were secured.

Only a few of these have as yet been measured and calculated, and they show the ordinary heights of the aurora, from 90 kilometres to more than 400 kilometres. Fig. 1 shows one of the best photographs of curtains at $19^h\ 5^m\ 46^s$, taken from Oslo to the west. The simultaneous photograph from Oscarsborg proves that the lower border of the left curtain was from 124 to 131 kilometres above the earth, the middle curtain from 103 to 114 kilometres, and of the right from 110 to 132 kilometres.

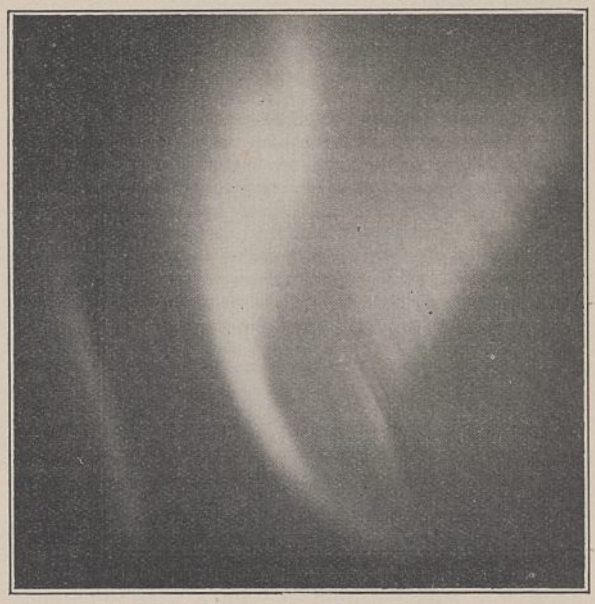

FIG. 1.—Aurora curtains photographed on Oct. 15.

During the period from $19^h\ 15^m$ to $19^h\ 25^m$ when M. Jelstrup heard the whistling of the aurora, I regret that no successful photograms were taken. From the visual observations made simultaneously at Bygdö by the meteorologist Röstad, who helped me during the work, I quote the following:

$19^h\ 10^m$. Dense masses of rays and curtains down to the horizon in E. and S.E.

$19^h\ 12^m$. The same down to the horizon in W., to the polar star in N., to the horizon in E., and down to 40° over the horizon in S.

$19^h\ 14^m$. The same to the Great Bear in N.

$19^h\ 16^m$. The same in the N. and S. down to 15° over the horizon. Red in S.

$19^h\ 21^m$. Strong diffuse arc through Can. venat. from the horizon in N.W. to the horizon in N.E.

$19^h\ 24^m$. Pulsating aurora begins.

19h 26m. Strong pulsations over the whole heavens. Red in S.

During the radio signals mentioned by M. Jelstrup the following observations are noted :

20h 3m. The pulsations have ended. All over the heavens a diffuse light. In the pocket spectroscope the yellow-green auroral line could be seen everywhere, from the entire heavens, from the snow, and from everything which was illuminated by the diffuse aurora.

20h 9m. Some pulsating bundles of rays.

20h 12m. The pulsations stronger and rays begin to appear.

It seems to me probable that the sound which, as M. Jelstrup says, exactly followed the vibrations of the aurora, could not come directly from the latter but from the surroundings, trees, antennæ, and so on, and were caused by electrostatic discharges, which in their turn were caused by influence from the varying electrostatic charges of the aurora overhead.

CARL STÖRMER.

Bygdö, Oslo,
Norway.

Clerk Maxwell and the Cavendish Laboratory.

OF all the notable contributions to the record of the Cavendish jubilee given in the issue of Dec. 18, perhaps the most interesting to many is the one by Sir Joseph Larmor on Clerk Maxwell ; for it suggests the way in which his equations, like those of the writer himself, contained the germs of many future developments, and incidentally directs attention to a Royal Society abstract which was unfortunately omitted from Maxwell's "Collected Papers." It was customary at that period for the Royal Society to publish not only the complete paper in the *Phil. Trans.*, but a thorough abstract also in the *Proceedings*—a practice which, perhaps unfortunately, has been departed from. The abstract referred to appeared in Dec. 1864, and gave in concise form the substance of one of the most remarkable memoirs of last century, "A Dynamical Theory of the Electromagnetic Field."

The abstract is exceptionally clear and luminous, and I should judge was written by Clerk Maxwell with some enthusiasm. It is, as Larmor says, full of ideas which have survived and developed since, though they have been supplemented and for a time apparently replaced by relativity and quantum considerations. It is possible, however, that posterity will see in Maxwell's ideas of more than half a century ago rather more than we perceive now ; just as we now see in Faraday's "Thoughts on Ray Vibrations" more than seemed likely at the time. In order to make that Maxwell abstract more readily accessible to the present generation, and on the Continent, I suggest that it might be reproduced in NATURE.[1]

I venture to think that mathematical physicists are often too satisfied with incorporating their ideas in a compact form, not in its fullness readily intelligible, and refrain from elaborating their full significance after anything like the same fashion as men of letters elaborate and discuss and attend in detail to the great utterances of the past. The novelty of Clerk Maxwell's views at that period is sufficiently demonstrated by the reception or non-reception of them by Lord Kelvin and by the great physicists of the Continent. They were never altogether overlooked in Great Britain, but not until they were clinched by Hertz did they make their way in Europe ; and the present generation is so occupied with its own rapid advances that a reminder of the ideas held by a pioneer long before most of them were born might be opportune and serviceable.

Incidentally, I would put on record a mention of what will doubtless elsewhere be referred to, namely, the remarkable gathering of physicists at Cambridge in celebration of Sir J. J. Thomson's seventieth birthday ; a gathering which, though partly of a domestic character, was a sign of the enthusiasm and prolific genius of our own times, and could not have been surpassed in any city or university of the world. Indeed, if an earthquake or other catastrophe had overwhelmed the room in which that meeting was held, on the evening of Dec. 18, the science of physics would have taken long to recover from an irretrievable loss. The world at large, and even the disciples of other branches of science, do not realise to the full the magnitude of the developments which are now going on, both in actual achievement and in luminous speculation. We live in a time of upheaval, for the ultimate result of which we may have to wait many years ; but there was in that gathering an element of hope, in the large group of younger workers, many present, others referred to, who show no sign of resting from their labours or being satisfied with the consolidation of past achievement, but are actively engaged in following up clues and in applying their well-prepared minds to future and perhaps still more fertile discoveries.

OLIVER LODGE.

Dec. 21.

The Mystery of Money.

I DO not think the writer of the very full review published in NATURE (Nov. 27) of my book, "Wealth, Virtual Wealth and Debt," really understands my new theory of money or the solution of the economic paradox, which he states, surely rather prematurely and prophetically, will be rejected by every student of economics. After all, I suppose every student of chemistry rejected the theory of atomic disintegration when it was first proposed a quarter of a century ago.

The reviewer quotes me to the effect that the aggregate of money, *irrespective of its quantity*, represents the aggregate value of the wealth which the community prefers to be owed rather than to own—which negative quantity of wealth I term the *Virtual Wealth* of the community—and then states that the argument is not lucid, even to the trained student, especially when he reads on a later page that the virtual wealth has in fact little to do with the quantity of money. He alleges I do not seem to realise that people retain money balances for their convenience, although on p. 205 I state, "It suits some of the people's convenience and affairs all of the time and all of the people's some of the time to be owed rather than to possess wealth so that they may be at liberty to select at their own time the sort and quantity they need . . . in exchange for their money." Similarly, with regard to my proposals to issue national money in lieu of bank credit, ending with : "In truth, Prof. Soddy's real plea is for the nationalisation of banking," the criticism is a travesty of what I do propose and the 'real plea' about the last thing I would advocate.

As regards the new theory of money, it follows the ordinary quantity theory, familiar to every trained student, in regarding the value or purchasing power of the unit of money as being inversely proportional to the quantity in circulation, considered as a single independent variable. This is the same thing as saying, as I do, that the value of all of it is the same, whatever that all may be. I should have rather expected from the trained student and

[1] We hope to be able to find space to reprint the abstract in an early issue.—ED. NATURE.

the economist the criticism that my new theory was a mere round-about and unnecessary re-enunciation of the old quantity theory, though they are in fact quite different. On my theory the value of the aggregate quantity of money is a negative non-existent quantity of wealth, not amenable to the laws of conservation, and alterable, though not very widely, by purely psychological factors. On the quantity theory it is related, in some indefinite and unexplained way, with the quantity of goods in existence, and, by what will I think come to be regarded as a very curious blunder, also with the velocity of circulation of money, although changes in the velocity of circulation affect equally rates of production and consumption and leave the quantity of goods in existence unchanged.

I can only deal in limited space with a few of the other criticisms. As regards the War inflation, I do not want "to put the clock back." The evils the country is now experiencing are the direct consequence of the attempt to put the clock back to pre-War as regards the value of money. I want for the future to stop all possibility of juggling with the value of the £ sterling as much as with that of the lb. avoirdupois. The reviewer states that my proposals would bring to the ground "the whole credit structure, with all the assistance it renders to industry." My object is absolutely to destroy the whole system of fictitious credit in which, not the lender, but the general public gives up what the borrower receives, paying the principal out of the purchasing power of the money they own, and the interest out of taxation, and to replace it by a system of genuine credit in which the lender gives up what the borrower receives. As for the "assistance" the existing system renders to industry, look around and meditate upon Cacus who dragged the oxen back into his den that it might appear he had let them out. Where else but in the so-called science of business would it be deemed unimportant who provided and gave up the money for a loan so long as it was provided?

The reviewer himself answers his own doubt as to how the £M2000 of new money to replace bank credit would be issued. "The new money would unquestionably be paid into the banks," who have "in future to keep pound for pound against" *current-account* "deposits." The money will continue to be, as it already is, in circulation by cheque. There is no addition to the quantity, but it is proposed to rectify the omission of the banks to pay the State for it when they issued it and put it into circulation. The 'penalisation' of holders of War Loan by the redemption of their stock is imaginary. The stock would be bought on the open market, and if they do not want to be 'penalised' they need not sell it.

I admit my proposals do not fully solve all the problems facing Great Britain in its excessive dependence on export trade for its food, and merely claim that they would make their solution easier rather than more difficult. The reviewer misrepresents me as advocating "floods of new currency . . . [being] issued by the State *pari passu* with the optimism of the producer" despite the absence of foreign buyers. Money is issued *pari passu* with increase of production to maintain the index number, or the *average* level of home prices, constant, and to keep them from falling with the increase of production. Goods unwanted and for which there are no buyers would fall in price, and the goods the buyers wanted would rise in price *relatively* as now. It is the average price-level which is maintained constant.

FREDERICK SODDY.

131 Banbury Road, Oxford.

IT is always unprofitable to both author and reviewer to attempt to reconcile conflicting views by further explanation on either side. Space alone precludes a successful issue. Such differences can only be left to the arbitrament of the reader. In this case he can clearly judge on the count of lucidity. A few further points may be within the limits of his patience.

Prof. Soddy's conception of "virtual wealth" is a phantasy. Every deposit in a bank is balanced by an asset, presumably of genuine value and backed by real goods or definite rights. These deposits constitute part of the aggregate quantity of money The author contends in his letter that their value is a "negative non-existent quantity of wealth." Passing by the difficulties of determining how a quantity can be non-existent or how a value (connoting the abstract) can be a quantity (connoting the concrete), let the reader note that the review agreed (with the author) that the purchasing power created by bank loans is abstracted from the community, through the consequential reduction of the general purchasing power of money. Hence, if the borrower gains (temporarily and upon his undertaking ultimately to repay it to the bank) what the community loses, and if that loss is real—as Prof. Soddy truly argues—how can the gain, which is expressed quantitatively by the deposit created by the bank loan, be non-existent?

While accepting the author's statement that the nationalisation of banking is the last thing he would advocate, the reviewer still adheres to the opinion that it would be impracticable to give the State all the credit powers of the present banking system unless it also owned and conducted that system. The State is indeed contemplated (p. 198) as replacing the banks as a lender of £2,000,000,000.

Prof. Soddy urges that after the State has issued this amount of new currency, each bank when it lends in future is to give up what the borrower receives. We may start then with a simple balance sheet of:

STAGE 1.

Liabilities.		*Assets.*	
Capital . . .	£20	Cash	£120
A's Deposit . .	100		
	£120		£120

B, wishing to borrow £100, goes to the bank, which is to give up to him £100 cash. Let it do so. B spends the cash in buying, say, a house from C, and C deposits the cash in the bank. The balance sheet then appears:

STAGE 2.

Liabilities.		*Assets.*	
Capital . . .	£20	Cash	£120
A's Deposit . .	100	B's advance . .	100
C's Deposit . .	100		
	£220		£220

So the process goes on until the ratio of cash to deposits reaches the safe limit of 1 to x. How does this differ from the present system? Not one whit. But Prof. Soddy will retort that he has stipulated that the bank must keep pound for pound against deposits, so that stage 2 can never be reached. Exactly, and so the review stated that the banks can earn no interest, and that the whole credit structure would thereby be brought to the ground.

Lastly, does Prof. Soddy seriously consider that holdings of £2,000,000,000 of interest-bearing War Loan could be permanently cancelled by its purchase

on the open market in exchange for 'new national money' issued by the State, such money bearing no interest at all? If so, he has yet much to learn of human nature. W. H. COATES.

[No further correspondence on this subject can be accepted.—ED. NATURE.]

Transmission of Excitation in Plants.

IN his letter in NATURE of October 23, Prof. N. G. Ball throws doubts upon the validity of my conclusions that in Mimosa (1) the transpiration-current has nothing to do with the conduction of the excitatory impulse, and (2) that the conduction is a phenomenon of propagation of protoplasmic excitation. I would refer Prof. Ball to my work "The Nervous Mechanism of Plants" (1926) for accounts of experimental demonstrations fully justifying the above conclusions. Limited space available allows me to refer here only to a few of the more important results.

The possibility of stimulating Mimosa by application of extracts of the stem to the basal end of a cut shoot has been adduced as evidence in support of the transpiration-current theory. This is by no means conclusive, as I have already pointed out in "The Nervous Mechanism of Plants," p. 17: "It is conceivable that certain vegetable extracts might act as stimulants; vegetable alkaloids of a poisonous nature, for example, produce excitation when applied in minute doses to the cut end of the stem. It would, however, be quite unreasonable to conclude from the result that an alkaloid is excreted from the plant under the action of a minimally effective stimulus." The following facts will be found to discredit the theory of transpiration-current.

1. The transpiration-current theory is based on the supposition that injury to wood caused by the wound, produces a stimulating substance which, being carried by the transpiration-current to the leaf, stimulates it to movement. It follows from this theory (*a*) that an intense wound-stimulus is essential for stimulation; (*b*) that the impulse should only travel upwards in the same direction as the ascent of sap; (*c*) that the velocity of the transpiration-current should be the same as that of the excitatory impulse; and (*d*) that in conditions where there can be no ascent of sap there should be no transmission of impulse.

I will take these points one by one. (*a*) I have shown that Mimosa can be excited by an electric shock one-tenth of the intensity of that which evokes human sensation. No wound is produced, yet the excitation produced by such an excessively feeble stimulus is transmitted to a considerable distance. (*b*) The excitation is found to be *simultaneously conducted both upwards and downwards.* It is also found that, under moderate unilateral stimulation, *the transmitted excitation ascends along one side of the stem to the apex and descends down the other.* The transpiration-current could not possibly have produced this result. (*c*) Accurate determinations of the velocities show that the rate of transmission of excitation is several hundred times quicker than that of the ascent of sap. (*d*) The tip of the uppermost leaf of Mimosa was stimulated by the application of a drop of hydrochloric acid: an impulse was generated which travelled to a considerable distance downwards against the direction of the normal ascent of sap. Subsequent chemical examination proved that the stimulant had not been transported, but had remained localised at the point of application.

These experimental results leave no doubt of the unfounded character of the transpiration-current theory. Nor can this theory be considered to have established its claim to acceptance until it has been demonstrated that excitation induced not by flame alone, but by stimulus of every kind—chemical, mechanical, electrical—is transmitted across the water-gap in the fundamental experiment upon which the theory has been built.

2. I next adduce positive evidence which proves that the transmission in the plant is one of protoplasmic excitation. This is demonstrated by the fact that the transmission is correspondingly modified by all conditions which modify the transmission of excitation in the animal nerve. The polar action of a constant electric current is identical in the two cases; when the current is feeble, stimulation occurs at cathode-make, the excitation being transmitted to a distance; with stronger current, excitation is produced at cathode-make and at anode-break. In both Mimosa and animal nerve, the velocity of transmission is increased within limits by a rise of temperature, and diminished by a fall. In both, transmission may be arrested temporarily or permanently by various physiological blocks. When the conducting tissue in the animal or plant is cooled, the speed of the impulse is slowed down, culminating in its arrest. The conducting power is temporarily arrested by a block produced by the passage of an electric current in a portion of the conducting tissue through which the impulse is being transmitted. This electrotonic block is removed on the stoppage of the current. Finally, poisonous solutions abolish the conducting power of both animal and plant.

These results offer conclusive proof that the conduction in the plant is a phenomenon of propagation of protoplasmic excitation, as in the nerve of the animal. J. C. BOSE.

Bose Institute, Calcutta,
Nov. 17.

The Behaviour of Cultures of *Leishmania tropica*, *L. infantum*, and *L. braziliense* in the Sandfly, *Phlebotomus papatasii*.

EXPERIMENTS were carried out to determine the behaviour of *Leishmania braziliense* and *L. infantum* in *P. papatasii*. The sandflies were infected by feeding through a membrane of rabbit skin on emulsions of flagellates in inactivated rabbit serum or defibrinated rabbit blood, and control experiments were performed with *L. tropica* in sandflies similarly infected.

L. tropica from cultures introduced into the sandfly *P. papatasii* (irrespective of the age and source of the strain of *L. tropica*) behaved exactly as *L. tropica* ingested by the sandfly from oriental sores, *i.e.* infection was always present in the uppermost end of the cardia, and in two cases out of twenty, flagellates were also found in the pharynx. Further, in cases of light infections the flagellates were confined to the uppermost part of the cardia only and, in some cases, sandflies which had fed on an emulsion of 100·000 flagellates per c.mm. were found to contain no flagellates at all. Passage of *L. tropica* from cultures through *P. papatasii* appears to increase the pathogenicity for man of the organism, as the following experiment shows.

A subculture made on August 27 from a culture taken directly on July 7 from an experimental human lesion was used for the experiment. September 15, Sandfly No. 172 (hatched in laboratory, September 15) *P. papatasii* ♀ fed on emulsion of culture (100·000 per c.mm.) September 26: Sandfly died and was dissected. Numerous flagellates were found in the midgut, particularly in the uppermost part of the

cardia, which was almost completely choked up by flagellates. The majority of the flagellates were long free forms. The stomach of the sandfly was inoculated into a scarified point on the right forearm of a volunteer. At the same time, flagellates from the same culture on which the sandfly fed were inoculated into two scarified points on the left forearm of the same volunteer.

Result—November 1: Leishman-Donovan bodies were found in a papule on the right forearm on the site of the inoculation with material from the sandfly.

Nothing has so far (November 16) been observed on the sites inoculated with flagellates from culture.

Leishmania infantum and *L. braziliense* ingested by sandflies (*P. papatasii*) from emulsions of flagellates behaved quite differently from *L. tropica*. Although active division and, in the case of *L. braziliense*, marked morphological changes occurred in the sandfly (development of short stumpy forms into long and thin forms and exflagellation of Leishman-Donovan bodies), the flagellates were confined to the stomach, and, in two cases out of twenty in *L. braziliense*, flagellates were also found in the lowest part of the cardia. In no case were the flagellates found in the uppermost part of the cardia in the neighbourhood of the œsophageal valve, nor were any forms found attached to the epithelium.

The researches of the Indian Kala-azar Commission on the development of *Leishmania donovani* in *Phlebotomus argentipes* and our own observations on the development of *L. tropica* in *P. papatasii* tend to show that the sandfly in which flagellates of a species of Leishmania are found attached to the epithelium and free in the uppermost part of the cardia is the carrier of that species of Leishmania, *e.g. P. papatasii* is a carrier of *L. tropica* and *P. argentipes* is a carrier of *L. donovani*.

Should the above observations be repeated with recently isolated strains of *L. infantum* (infantile leishmaniasis is absent from Palestine) there would be very strong evidence to the effect that *P. papatasii* is not the carrier of *L. infantum*, and the carrier of this parasite is to be sought in *P. perniciosus*, *P. sergenti*, or a member of the *minutus* group of the genus Phlebotomus. The fact that cultures of *L. tropica* behave exactly as ingested Leishman-Donovan bodies in *P. papatasii* is important, for it suggests that the simple and rapid process of observing the behaviour of cultures of a given species of Leishmania in sandflies may be used for determining which Phlebotomus sp. is the transmitter of that particular species of Leishmania.

S. ADLER.
O. THEODOR.

Microbiological Institute,
Hebrew University,
Jerusalem, Nov. 16.

The Origin of Fatuoids in Cultivated Oats.

THE sudden appearance of fatuoids, that is, forms resembling the wild oat *Avena fatua*, in varieties of the cultivated oat *A. sativa*, has for many years attracted much attention both by its genetic interest and agricultural importance. The opinion has been widely held that they originate through natural crossing between *A. sativa* and *A. fatua*, but in recent years they have been more generally regarded as simple loss mutations from *A. sativa*. The heterozygous form, which is intermediate between the normal and the fully developed fatuoid, usually appears first, and in nearly all cases previously recorded these heterozygotes segregate normals, heterozygotes, and fatuoids in a ratio of approximately 1 : 2 : 1.

A combined genetical and cytological study of this problem, begun early in 1924, has revealed many new and interesting features. Not only have three, or possibly four, different types of heterozygous fatuoids been discovered, thus bringing the problem closely into line with the speltoid problem of cultivated wheat, but distinctive chromosome conditions have also been found to be correlated with the genetic behaviour and with the character of the segregates in the different types. The first and most common type, giving the 1 : 2 : 1 ratio of normals, heterozygotes, and fatuoids, has been described in NATURE, 115, 677-678, 1925, and *Scientific Agriculture*, 6, 303-313, 1926. Briefly, all the segregates are of approximately equal vigour, and all have the normal number of chromosomes, namely, forty-two; but while in the normals these form twenty-one bivalents, in the heterozygotes the arrangement is frequently nineteen bivalents, one trivalent, and one univalent, and in the fatuoids it is often nineteen bivalents and one quadrivalent.

The second type also gives a ratio of approximately 1 : 2 : 1, though the numbers so far obtained are too small to determine this exactly, but the fatuoid segregates from it are all dwarfed and partially sterile. In this case the normal segregates again have twenty-one bivalent chromosomes. The heterozygotes, however, have an extra chromosome, and their complement is either twenty-one bivalents and one univalent, or twenty bivalents and one trivalent. The dwarf fatuoids in this type have two extra chromosomes, the total of forty-four being arranged usually as twenty bivalents and one quadrivalent.

Normals and heterozygotes are segregated in approximately equal numbers by heterozygous fatuoids of the third type. The fully developed fatuoid form appears only very rarely, and is always dwarf and sterile. The normal segregates, again, have the normal twenty-one bivalents. The heterozygotes, however, have lost one chromosome and have only nineteen bivalents and one univalent. The sterile dwarf fatuoids have completely irregular meiotic divisions, including faulty pairing, and their total chromosome number is only forty.

The fourth type has arisen from the third, and is similar to it except that the heterozygous segregates are much more numerous than the normals, the ratio being about 5 : 1. In four heterozygous plants of this type which have been cytologically studied, the chromosome number is forty-one, as in heterozygotes of the third type. Certain differences in the chromosome behaviour, such as the more frequent formation of trivalents and the lagging of one or two bivalents, have been observed, but until the genetical constitution of the particular plants has been determined, it is impossible to say whether these minor differences have any special significance.

The close correlation between cytological conditions and genetic behaviour in these different types of fatuoids seems to indicate clearly that fatuoids arise from normal oats, not by either gene mutation or natural crossing, but by any one of several different chromosomal irregularities, which upset the normal chromosome balance and permit the expression of other characters.

Discussion of the particular hypothesis which best fits the observations must be left for the full account of this work, which will shortly be prepared.

On the practical agricultural side there has emerged the possibility of developing commercially valuable varieties of oats which are entirely free from fatuoid factors.

C. LEONARD HUSKINS.

Department of Botany,
King's College, London, W.C.2,
Dec. 8.

X-ray Evidence for the Existence of Different Modifications of Fatty Acids.

IN continuation of the work on the high order X-ray reflections of fatty acids done in this laboratory (J. A. Prins and D. Coster, NATURE, July 17, 1926), I tried to get the high orders with stearic acid. In determining the long spacing of a crystal of stearic acid obtained by slow crystallisation from acetone, I found the remarkable fact that the crystal showed a long spacing of 43·95 A.U., whereas a thin layer obtained by melting the acid on a glass strip gave a spacing of 39·75 Å.U. Crystals obtained from alcohol and petrol also showed the larger spacing. A film obtained by evaporating an alcoholic solution on a glass strip gave the smaller spacing, but an acetonic film gave the two spacings, the relative intensities of which were altered by slight changes in the way of forming the film. Apparently these facts point at the existence of different modifications of stearic acid.[1]

As, on the other hand, Garner, Randall and Ryder (*Jour. Chem. Soc.*, 125, 881, 1924; 127, 720, 1925), from a determination of the heat of crystallisation and molecular volume, concluded that undecoic acid exists in two enantiotropic modifications, it seemed worth while to test this point by an X-ray investigation. According to Garner (*loc. cit.*) the transition takes place between 12·5° C. and 17° C. I determined, therefore, the long spacing of a layer of undecoic acid obtained by melting on a glass strip, first at 20° C. and a second time at 12·5° C. the apparatus not being changed between the two exposures (the lower temperature was obtained simply by opening the windows). At the higher temperature a spacing of 25·4 Å.U. was found, which spacing has already been measured by Müller and Shearer (*Jour. Chem. Soc.*, 123, 3156, 1923). At the lower temperature, however, these lines had practically disappeared and another set of lines of strong intensity occurred on the plate, these lines belonging to a spacing of 30·1 Å.U. When the temperature was raised again to 20° C. and a photograph was taken after some hours, the lines due to the longer spacing, though not wholly disappeared, were much fainter, whereas the intensity of the lines belonging to the smaller spacing had much increased. These facts give a strong support to the view suggested by Garner and his collaborators.

After these results were obtained the beautiful work of Piper, Malkin and Austin (*Jour. Chem. Soc.*, Sept. 1926) on the different modifications of the even fatty acids came to my notice. As is stated by these authors, the different spacings of stearic acid seem to be independent of the temperature, and only to depend on the manner the reflecting layer is obtained.

The higher orders are now being investigated in order to get some information about the molecular structure of the different modifications.

I am much indebted to the kindness of Prof. P. E. Verkade of Rotterdam, who put a quantity of very pure undecoic acid at my disposal.

G. M. DE BOER.

Physical Laboratory of the University,
Groningen, Holland.

A Rock of Unknown Origin from Glacial Gravel at Ipswich.

A LITTLE time ago I found, in the sub-Chalky Boulder Clay glacial gravel, exposed in the brickfield of Messrs. A. Bolton and Co., Ltd., to the north of Ipswich, an erratic of unusual and arresting appearance. The gravel in which the specimen was embedded is that which, in my opinion, was laid down in the interval of time between the deposition of the Kimmeridgian Chalky Boulder Clay and that of the Upper Chalky Boulder Clay of East Anglia. As I had never before seen a rock in the Ipswich area of the type discovered, I submitted it to Prof. P. G. H. Boswell, of the University of Liverpool, and to Dr. Herbert H. Thomas, of the Geological Survey, for investigation. Both these experts, though giving me valuable information upon the nature of the erratic, were unable to inform me as to its probable source of origin, and Dr. Thomas, suggesting that this source might be in some area of old rocks, such as Scandinavia, advised me to submit the specimen to Prof. Victor Goldschmidt, of Oslo. This I have now done, and with Prof. Goldschmidt's permission, I give below the result of his examination of the rock.

"I have got your specimen, and I have examined it. If the boulder has its place of origin in Norway, it must be a sandstone from one of the pre-Cambrian formations. The rock is a breccia, consisting of fragments of a sandstone rock in a matrix. The sandstone of the fragments is without any doubt a sedimentary rock, containing well-rounded grains of quartz. The matrix is rather fine-grained; the matrix contains perhaps even pyroclastic material, but that could not be ascertained. The clastic grains of the matrix are angular. One may say that none of the Eocambrian, Cambrian, or other Palæozoic sandstones of Norway has any resemblance to your specimen. Among the pre-Cambrian formations there might be several possibilities for placing the boulder. It is most likely that it may be derived from the pre-Cambrian Telemark formation, which, among other rocks also includes quartzitic sandstones, breccias, and also pyroclastics. The general character of the rock, its degree of re-crystallisation, makes it possible, but of course not certain, that it is derived from the districts around the mountain Gausta in Telemarken. My friend, Prof. J. Schetelig, to whom I showed your boulder, also agrees with me. But neither of us has ever seen exactly the same rock *in situ*. We shall look for it in Telemarken. I shall send the boulder back to your address by mail to-morrow. The thin section I shall keep here, to have a possibility to identify the boulder, if I succeed in finding the breccia *in situ*."

I would wish to thank Profs. Boswell and Goldschmidt, and Dr. Thomas, for the help they have given me in this matter. The rock, which I have deposited in the Ipswich Museum, where it can be examined, is of a definite pinkish colour.

J. REID MOIR.

One House, Ipswich.

Thermal Agitation of Electricity in Conductors.

ORDINARY electric conductors are sources of spontaneous fluctuations of voltage which can be measured with sufficiently sensitive instruments. This property of conductors appears to be the result of thermal agitation of the electric charges in the material of the conductor.

The effect has been observed and measured for various conductors, in the form of resistance units, by means of a vacuum tube amplifier terminated in a thermocouple. It manifests itself as a part of the phenomenon which is commonly called 'tube noise.' The part of the effect originating in the resistance gives rise to a mean square voltage fluctuation V^2 which is proportional to the value R of that resistance. The ratio V^2/R is independent of the nature or shape

[1] Both lattice-constants have already been measured by Müller (*Jour. Chem. Soc.*, **123**, 2043, 1923; NATURE, **116**, 45, 1925), but he seems not to have paid much attention to the discrepancy between these two results.

of the conductor, being the same for resistances of metal wire, graphite, thin metallic films, films of drawing ink, and strong or weak electrolytes. It does, however, depend on temperature and is proportional to the absolute temperature of the resistance. This dependence on temperature demonstrates that the component of the noise which is proportional to R comes from the conductor and not from the vacuum tube.

A similar phenomenon appears to have been observed and correctly interpreted in connexion with a *current sensitive* instrument, the string galvanometer (W. Einthoven, W. F. Einthoven, W. van der Horst, and H. Hirschfeld, *Physica*, 5, 358-360, No. 11/12, 1925). What is being measured in these cases is the effect upon the measuring device of continual shock excitation resulting from the random interchange of thermal energy and energy of electric potential or current in the conductor. Since the effect is the same for different conductors, it is evidently not dependent on the specific mechanism of conduction.

The amount and character of the observed noise depend upon the frequency-characteristic of the amplifier, as would be expected from experience with the small-shot effect. The apparent input power originating in the resistance is of the order 10^{-18} watt at room temperature. The corresponding output power is proportional to the area under the graph of *power amplification—frequency*, at least in the range of audio frequencies. The magnitude of the 'initial noise,' when the quietest tubes are used without input resistance, is about the same as that produced by a resistance of 5000 ohms at room temperature in the input circuit. For the technique of amplification, therefore, the effect means that the limit to the smallness of voltage which can be usefully amplified is often set, not by the vacuum tube, but by the very matter of which electrical circuits are built.

J. B. JOHNSON.

Bell Telephone Laboratories, Inc.,
New York, N.Y., Nov. 17.

Oxygen = 17. Oϕ.

I KNOW that I am very ignorant, but old and unrepentant as I am I still live to learn from young people and watch their doings with delight, tho' maybe they are sometimes a little 'previous.' The argument behind Messrs. Harkins and Shadduck's letter (NATURE, December 18, p. 875) is doubtless irreproachable and unanswerable. Probably, therefore, I am more than stupid in being surprised at "the atom (presumably oxygen of mass 17) which is synthesised." Suppose, however, that a poor errant molecule of fair hydrone were the stricken 'atom,' it might well be 'electrolysed' and give OH = 17 + H = 1. Who will say me nay and make it clear that this cannot be? Uesanian orders are sometimes tall and the propinquity of the Wheat Pit may well have influenced the Chicago laboratory, just as Cambridge, being an apanage of Newmarket, is given over to racing competitions and so demoralises the whole of our educational system.

I know full well, that it is wrong for a poor worm of a chemist to turn and put a common or garden interpretation upon the work of august and fashionable physicists: that they should be regarded as kings who can do no wrong. I have, however, preserved from my youth the memory of a king who wore no clothes and myself still work a little in the garden with not too much regard for weather. NATURE, too, disturbs my belief in things. In it, Dr. Jeans—who, being senior secretary of the Royal Society, a mathematician and a man who sees stars, must know everything—has recently assured us that the elements short of uranium are infinitely stable, even at the super-satanic temperature of 12,500,000 million degrees. If so, is a mere missile of mass 4 with a range of 6 cm. likely to knock spots off them? Cannot we rather picture the nitrogen molecule, in itself a hard nut to crack, as contemptuously asking, whenever hit by an α-particle: 'Who are you shoving of?' and moving on its way, naked and unashamed, uncaressed by the particle—this latter, attended as it is from its birth by the faithful electron, as then wickedly compassing the prostitution of fair hydrone?

My faith in the immaculate judgment of the 'Physicals' would be greater if they would curb their imagination by learning just a little chemistry and would seek to tell me what happens when I rub my stylo upon my coat sleeve: a fundamental question to which I can get no answer. The α-particle may be doing as the moving stylo does. When I read the heroics in NATURE of December 18, I am only too conscious of the greatness of the 'Electronicals': still, men with the unlimited speculative power they possess might sometimes deign to deal with matters which affect ordinary mortals and with the common objects of the laboratory floor.

HENRY E. ARMSTRONG.

Temperature Coefficient of γ-Ray Absorption.

RECENT improvements in design and technique for a gold-leaf electrometer, details of which will be published shortly, have made it possible to apply the instrument with success to the problem of a possible temperature coefficient of γ-ray absorption. Preliminary measurements with lead as absorber, over a temperature range of about 250° C., indicate that when due allowance has been made for the expansion of the lead, there occurs an increase in the absorption coefficient of approximately 0·2 per cent. per hundred degrees rise of temperature. That the effect is dependent on temperature, or indeed on any incidental at all, is somewhat of a surprise; and considerable interest is added by the recent account by H. S. Read (*Phys. Rev.*, 27, p. 373, 1926) of an effect of temperature on X-ray absorption, in which he records, for lead and the five other metals examined, a temperature increase in the coefficient of the same magnitude as here reported. Further investigation is contemplated.

L. BASTINGS.

The University, Durham,
Dec. 3.

The Supposed Law of Flame Speeds.

WITH reference to Prof. Bone's letter in NATURE of Dec. 11, p. 837, it is evident that the speed generalisation advanced by Prof. R. V. Wheeler and Dr. W. Payman must break down when one of the combustible gases in a complex mixture interferes with the burning of another. This has been shown to occur for carbon monoxide–hydrogen–air mixtures by Dr. Payman (*J.C.S.*, 115, 1454, 1919). In this case the speed of burning of carbon monoxide is much increased in the presence of hydrogen. The reverse effect occurs when mixtures of carbon disulphide not too far removed from the limit are mixed with certain other combustibles (*J.C.S.*, 121, 2561, 1922). By mixing suitable carbon disulphide–air and (say) ether–air mixtures having the same speed of flame, mixtures can be obtained which refuse to propagate flame.

A. G. WHITE.

45 Caledonia Road,
Saltcoats, Dec. 20.

Popular Long-Range Weather Forecasts.

SINCE last April, forecasts of the weather for fifty days ahead have been appearing in the *Daily Mail*. The forecasts, which are prepared by Lord Dunboyne, have excited a considerable amount of interest. The question of long-range forecasts has been engaging the attention of meteorologists for some time, and they would welcome any progress in this direction, even if in the first instance the forecasts were purely empirical. Lord Dunboyne has not published any account of the principles he uses, and it is not possible therefore to study the methods of the forecasts, but only the results obtained. The forecasts are given in the form of a diagram, and it is stated in the explanation that the higher the curve rises above a datum line the greater the probability of rain, and the lower the curve falls the greater the probability of dry weather. When the curve rises sufficiently far above the datum line, and rainy weather is indicated, the area within the curve is blackened, and similarly the lower parts of the diagram are shaded to indicate that dry weather is forecast.[1] In this way the periods when wet or dry weather is expected are shown at a glance.

From the curves it is possible to read off what are here called 'forecast numbers.' The day when the curve is below the datum line has a forecast number of 1; one with a curve on the datum line a forecast number of 2; a little above gives 3; considerably above the datum line but not up to a blackened area, 4, and when the curve rises to the blackened area the forecast number is 5. To compare the forecasts with the actual weather, readings have been taken from the *Daily Weather Report* from which weather numbers have been deduced. The weather number for each day is determined as follows: 5 is a day when more than 2 mm. of rain has occurred; 4 when the rainfall is between 0·2 mm. and 2 mm.; the other numbers are for days when the rainfall is less than 0·2 mm.; 3 is a day when the mean cloud amount is 8 or more; 2 when the mean cloud is between 3 and 7·9, and 1 when the mean cloud is 0 to 2·9. These cloud amounts are the means of the cloud amounts recorded at 9 A.M., 1 P.M., and 6 P.M. This seems to be a fair way of comparing the two sets of numbers. The only doubtful case is that of weather number 3, which represents overcast skies, for anticyclonic cloud may cover the sky in perfectly dry weather, and it would be unfair to class a forecast number of 1 as a failure, when the weather that occurred was anticyclonic, merely because the sky was overcast. But such weather, though it occurs in the winter, is not much in evidence in the summer, and the period under consideration is that from April to October; during this part of the year an overcast sky may very fairly be taken as half-way between rainy and dry weather, and the above criticism would not apply.

The diagrams are given for fifty days ahead, but they are amended from time to time, and therefore the forecast for a given week made six weeks ahead may differ from the forecast for the same week as given five, four, or less weeks ahead. To take, for example, the forecast for south-east England for the week commencing July 4 (Fig. 1). When this first appears in the *Daily Mail* for May 28 it shows the curve below the datum line for all the days except July 5 and 10, on which days the curve rises just above the datum line; that is to say, the forecast was for a week with a definite but small probability of fine weather. The next forecast for the same week shows the curve above the datum line for all days with a probability of rain on July 5 and 7; this probability seems to be reduced in the next diagram, and when we come to the forecast for three weeks ahead the curve has fallen below the datum line again except at the end of the week, when it rises a little above; for two weeks ahead a blackened area occurs on the last day, and the forecast for one week ahead is very similar. The actual weather experienced at Kew was as follows:

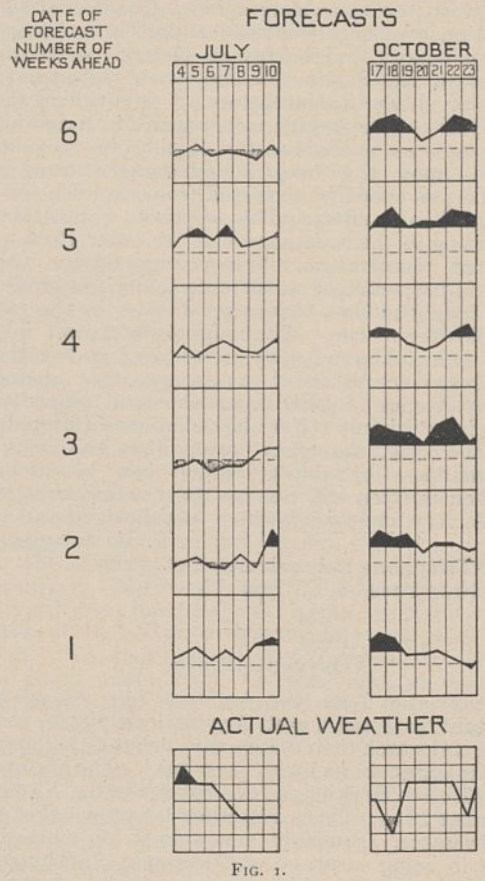

FIG. 1.

Date.	Rainfall.	Weather Number.
July 4 . .	5·0	5
,, 5 . .	2·0	4
,, 6 . .	0·6	4
,, 7 . .	Trace	3
,, 8 . .	..	2
,, 9 . .	Trace	2
,, 10 . .	Trace	2

Another week, that commencing October 17 (Fig. 1), when it first appeared in the *Daily Mail* for September 10, gave rain as probable at the beginning and end of the week, on all days, in fact, except September 20 and 21, but the curve was above the datum line for the whole week; the next curve was above the blackened area all the week. The forecast for four weeks ahead was

[1] Some slight changes have lately been made in the diagrams, but this does not affect what follows.

very similar to the first one, but the blackened areas were reduced. The forecast for three weeks ahead had the curve again above the blackened area all the week. The next two charts kept the blackened area at the beginning of the week, but the curve fell lower at the end of the week, and in the last forecast of the series it was below the datum line on the last day of the week. The following was the actual weather at Kew:

Date.	Rainfall.	Weather Number.
Oct. 17 . .	..	3
,, 18 . .	Trace	1
,, 19 . .	0·3	4
,, 20 . .	0·3	4
,, 21 . .	1·0	4
,, 22 . .	1·1	4
,, 23 . .	0·1	2

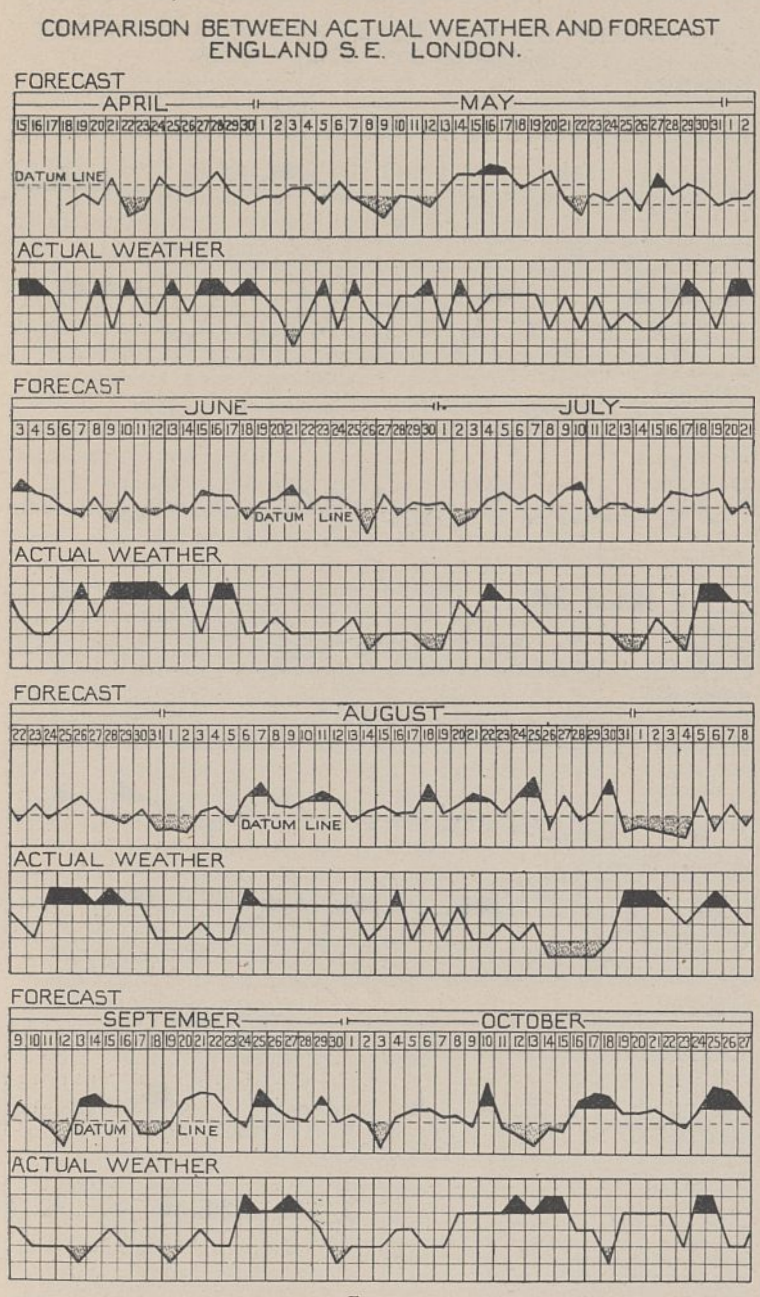

FIG. 2.

These weeks were taken at random, without first looking up the actual weather that occurred, and without trying to find a case where successive forecasts differed among themselves. There are other examples where still more striking changes occurred in successive forecasts for the same week, changes much greater than would be expected from the statement that "the curves are subject to slight amendment as time advances." So little concordant with each other are the successive forecasts for the same week that it is evident that, whatever value the forecasts may have, six weeks is considerably too long a period for the methods employed.

In order to compare the forecasts with the actual weather, diagrams have been made from the weather numbers for Kew and Scilly, and have been placed below the forecast diagrams for south-east England and for south-west England respectively (Figs. 2 and 3). This method of comparing the forecasts with the weather experienced was used by Dr. W. J. S. Lockyer in a short communication sent a few months ago to the editor of NATURE, who later invited me to prepare the present article. Only the forecasts for one week ahead have been made use of.[2] An examination of these two sets of curves shows that the forecasts, though agreeing with the actual weather at times, yet on the whole show no relationship with the weather experienced. No shifting of the curves backwards or forwards in time makes any approach to a fit between the two except in a few isolated cases. The best fit is probably that for Scilly in August, but even in this case it must be remembered that if the forecasts had been chosen for more than one week ahead the curves would not have been the same as those actually shown. On the whole, there is no such general agreement between the curves of forecast and those of actual weather as would be expected if the forecasts had any sound meteorological basis.

Another way of looking at the results is to take the differences between the forecast numbers and the weather numbers; 0 would mean that the forecast was entirely successful, and 4 that it was as unsuccessful as possible. Taking the forecasts for south-east England for one week ahead and comparing them with the weather numbers for Kew, we find that there were 30 cases with a difference of 0, 72 of 1, 45 of 2, 21 of 3, and 16 of 4. Taking 0 and 1 together we get 102 complete and partial successes as against 82 that were not

[2] As no charts were issued between April 30 and May 21 the forecasts which should have been for one week ahead for the period May 2 to May 22 were taken from the chart issued on April 30. Similarly, where forecasts for six weeks ahead for the period June 13 to July 3 are under consideration they are taken from the chart issued on May 21.

		One Week.					Six Weeks.				
		0	1	2	3	4	0	1	2	3	4
KEW.	Actual . .	30	72	45	21	16	30	57	29	28	9
	Chance . .	35	65	44	28	12	31	52	36	26	8
	Ratio . .	0·9	1·1	1·0	0·8	1·3	1·0	1·1	0·8	1·1	1·1
SCILLY.	Actual . .	34	67	43	31	9	30	55	34	24	10
	Chance . .	35	62	40	33	14	31	50	33	29	10
	Ratio . .	1·0	1·1	1·1	0·9	0·6	1·0	1·1	1·0	0·8	1·0

a success. This means that the forecasts were successful in 55 per cent. of the cases and failed in 45 per cent. The results for Kew for six weeks, and the results for Scilly both for one week and for six weeks ahead, come out at almost exactly the same percentage. At first sight this seems a definite measure of success for the forecasts, but a further examination of the figures shows that this seeming success is illusory, since the figures are very near to those which would be expected on pure chance. The above table gives the difference between the forecast numbers and the weather numbers for Kew and Scilly both for the forecasts one week and six weeks ahead, together with the numbers which should be expected on pure chance, and with the ratio between them.

From this table it will be seen that the distribution is very close indeed to that of pure chance. If the forecasts had any measure of real success the table should show a high ratio for differences of 0 and 1, and low values for differences of 3 and 4; but there is no indication of this.

To emphasise the fact that the distribution is solely due to chance, the weather numbers have been taken for Kew and have been compared with the forecast numbers for different months, May with October, June with September, July with August, and so on; moreover, the days have been reversed, that is, the first is compared with the last day of the month, the second with the last day but one, and so on; therefore by no possibility can the weather numbers have any connexion with the forecast numbers; the differences come out as follows:—

0	1	2	3	4
35	70	45	27	7

This is in striking agreement with the legitimate comparisons, and emphasises the fact that the latter too have the appearance of being governed by nothing but chance.

Yet another method of examining the figures is to take correlation coefficients between the forecast numbers and the weather numbers. The adjacent table gives these for each month for Kew and Scilly, and for forecasts of one week and six weeks ahead.

These coefficients have of course no significance; even the value of +0·6 for August in Scilly, standing alone, does not indicate any real relationship between the two sets of numbers.

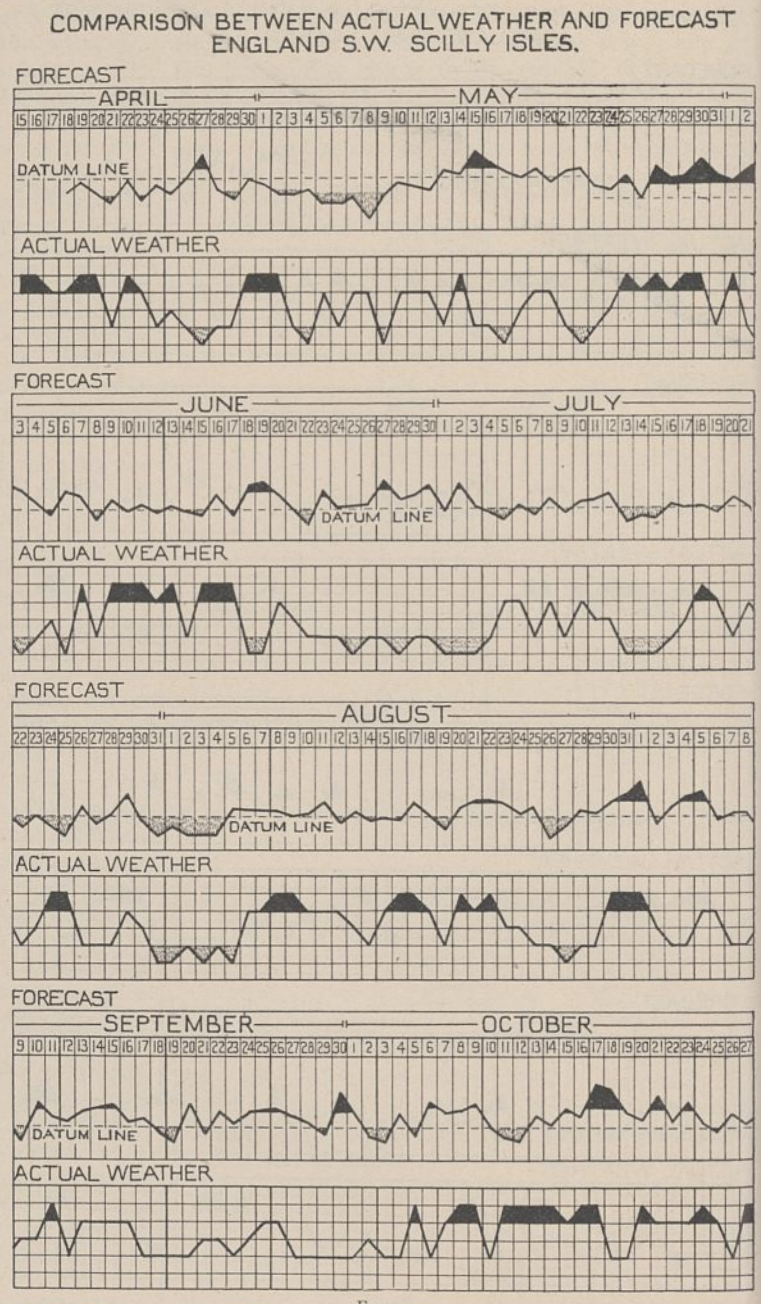

FIG. 3.

	Kew.		Scilly.	
	One Week.	Six Weeks.	One Week.	Six Weeks.
May . .	0	. .	0	. .
June . .	−0·2	−0·4	−0·3	−0·3
July . .	−0·1	−0·1	+0·1	+0·2
Aug. . .	+0·3	+0·1	+0·6	+0·4
Sept. . .	−0·2	−0·2	+0·4	+0·2
Oct. . .	−0·3	0	−0·1	−0·1

It would appear, therefore, from the foregoing considerations that the forecasts, even for one week ahead, have not any success. They are not, in fact, any better than could be obtained by purely fortuitous predictions, and they agree with what one would expect from chance in a very marked way. Nevertheless, it would be interesting to have some account of the methods used. Lord Dunboyne has made a study of meteorology for many years, and if he were to propound a theory of forecasting it would meet with due consideration from meteorologists.

C. J. P. CAVE.

Regions of Compression.[1]

By Dr. J. W. EVANS, F.R.S.

II.

THE accumulation of great masses of sediment destroys for the time being the isostatic balance of the earth's crust, which is restored by the outward flow of the plastic sima beneath them to other areas where the amount of deposits is less, or towards mountains subjected to erosion that diminishes the superincumbent load.

As a result of this outflow the surface on which these thick deposits have accumulated is correspondingly lowered. Such a depression of a previously approximately level floor of deposition may be described as a *sedimentation subsidence*.

Thus thick accumulations tend, by the direct result of their weight, to form and fill hollows in the earth's crust, and so provide for their own preservation. Hence it is that, as the late G. W. Lamplugh pointed out, the areas in which geological formations have now their most important outcrops are those in which they were originally deposited in the greatest thickness.

Where such a sedimentation subsidence has occurred, we must distinguish two constituent parts of the resulting structure: the basal or *external* portion, consisting of the older and more consolidated rocks that formed the original floor of the area of deposition, and the *internal* deposits made up of the sediments and other materials accumulated upon the former.

The depth of the accumulated sediments, and consequently the amount of the subsidence, is greater near the foot of the mountain slopes, and gradually diminishes as the distance from the mountains increased, although at equal distances it will be thicker opposite the outflow of important rivers and less where these were absent.

At a greater distance from the region or regions of erosion, where the amount of sediment deposited was less, the accumulation of calcareous material from the growth of organisms or the precipitation of carbonate of calcium, also derived originally in the main from organic sources, must often have played a similar part in causing subsidence by their weight.

The eruption of lava and ashes will have a like result, intensified by the removal of the material from beneath. The general tendency would, however, be for the load and depression to diminish as the distance from the source increased. At the same time, the inflow of the plastic material from the area of maximum sedimentation would add to the effect of the decrease of the load. Ultimately, at a greater distance, where the deposition was still more reduced, elevation would replace depression.

In the period of comparative quiescence that intervenes between paroxysms of earth movements, resulting in folding and thrusting, the horizontal compressive forces in the earth's crust, which had (for the time being) been exhausted, are once more slowly developing and increasing in strength. At last the crust yields to the pressure where the resistance is weakest. Other things being equal, this will be where the solid crust is bent most deeply down in a sedimentation subsidence. There it is no longer flat and horizontal, and directly opposed to the forces of compression. It has consequently very much diminished powers of resistance, precisely as a pillar bent out of the vertical line is incapable of sustaining the same weight as if it were straight and erect. The weakness of the crust in the subsided area is increased by the fact that the depression of the solid floor through some thousands of feet brings the rocks into regions of higher temperature, and the increase in temperature must be accompanied by a considerable decrease in strength, while the unconsolidated deposits of the interior of the subsidence can add little or nothing to its powers of resistance.

Accordingly, it is in a tract of subsidence that the crust gives way under the forces of compression. It is true that these forces operate on the whole surface of the globe, but immediately the portion with least resisting strength yields, however slightly, the remainder of the great circle on which the yielding takes place is released *pro tanto*, adjusting itself by a movement of elastic expansion, so slow that the resistance opposed to it by the viscosity of the subjacent plastic sima is inappreciable.

It must be remembered, however, that, as already indicated, there are other horizontal forces affecting the earth's crust that may increase or diminish the forces of compression locally, and these may in some instances determine whether the crust yields at one subsided tract or another. When such a yielding has taken place, the probability of the crust giving way at another point is at once greatly diminished, at any rate for the time being.

The first effective action of such compressive forces usually antedates by a considerable period the epoch of maximum disturbance, and is as a rule very gradual and gentle, so that it merely narrows slightly and deepens the area of subsidence. The deposition of great thicknesses of a succession of shallow-water strata is usually explained as due to subsidence by way of isostatic adjustment of the earth's crust, to correct the disturbance of equilibrium from the weight of the sediments accumulated. Prof. A. Morley Davies has, however, directed attention to the fact that there is a limit to such an adjustment, because the density of the sediments laid down is less than that of the plastic subcrustal sima displaced.

Let s be the original depth of the sea, and l the

[1] Continued from p. 17.

amount by which the sea-bottom is lowered; then $s+l$ will be the thickness of the deposits if they reach the surface of the sea. Let the density of these sediments be ρ_a, that of the plastic sima displaced ρ_b, and that of sea-water ρ_s. Then, if isostatic conditions prevail both before and after the sedimentation, we shall have $\rho_s s+\rho_b l=\rho_a(s+l)$: that is to say, the weight of the sea-water over a unit of area before the deposition of the sediments, *plus* the weight of the sima displaced by the subsidence, is equal to the weight of the sediment deposited. Hence $(\rho_b-\rho_a)l=(\rho_a-\rho_s)s$; so that

$$\frac{l}{s}=\frac{\rho_a-\rho_s}{\rho_b-\rho} \text{ and } \frac{l+s}{s}=\frac{\rho_b-\rho_s}{\rho_b-\rho_a}.$$

Accordingly $l+s$ (the total thickness of the sediments)

$$=\frac{\rho_b-\rho_s}{\rho_b-\rho_a}s. \quad (1)$$

If, however, the subsidence be slowly deepened as the result of gentle lateral pressure, *compression-subsidence*, it is possible for a much greater thickness of deposits to accumulate without rising above sea-level than would be possible according to these calculations, and this appears not infrequently to happen. But it must be remembered that this downward movement imposed on the crust will cause the displacement of still more heavy plastic sima below, and the isostatic balance will be destroyed, because the sediments deposited are less in mass than the material displaced. There should, therefore, be a defect of gravity in areas of deposition affected by gentle lateral pressure. This is, in fact, the case in the Gangetic Plain, as well as in the low tracts lying east and north-east of the Andes.

The strength of the original crust, reinforced by the lateral pressure, may nevertheless be sufficient, for a time, to resist the upward pressure from below. But, if the horizontal forces cease to operate, the downward fold of the crust will ultimately yield to the pressure of the plastic material beneath, and the terrain will rise until isostatic adjustment is restored. It is not improbable that the alternation of marine and continental conditions which is so frequently observed may, in some instances at least, represent changes of this description accompanying intermissions and variations of moderate horizontal compression.

With a continuance, and still more with an increase, of compression, the exterior framework of the subsidence will gradually close, and throw the interior sediments, still soft and plastic, into folds of ever-increasing complexity. As these develop, the interior accumulations will tend to rise instead of sinking, and to pile themselves up into mountain masses concentrated on a limited portion of the earth's crust, which will be once more loaded in excess of the isostatic balance. A new subsidence—a *folding subsidence*—will ensue, with greatly increased displacement of the sima.

When the isostatic balance is once more restored, the summit of the mountain folds will still rise high above the adjoining plains; but a much greater portion will lie far below, and the protection of most of the sediments of the internal structure from future destruction will be still further assured.

Let, as before, ρ_a be the density of the sial and ρ_b that of the sima, and let j be the depth below the sea of the base of the mountain folds, consisting mainly of sediments, including for the present purpose both the rocks of the original surface of deposition and the later, interior, sediments; and let h be the height of the mountains above the sea, m the height of the plains, and c the thickness of the sial of which they are formed.

Then, in order to preserve isostatic balance, we must have

$$\rho_a c+\rho_b(j+m-c)=\rho_a(h+j). \quad (2a)$$

So
$$\rho_b(j+m)-\rho_a(h+j)=(\rho_b-\rho_a)c. \quad (2b)$$

and
$$c=\frac{\rho_b(j+m)-\rho_a(h+j)}{\rho_b-\rho_a}=j-\frac{\rho_a h-\rho_b m}{\rho_b-\rho_a}. \quad (2c)$$

The upper portion of the folds will commence to be eroded as soon as they rise above the surface, and will never reach the height which is obtained by continuing and completing the portion of the folding that can now be observed. Consequently, the base of the folds is not now and never has been so deep as would have been the case, but for the progress of erosion and consequent removal of load.

The gravitation data obtained by the Coast and Geodetic Survey of the United States in North America are best interpreted as indicating that the maximum depth of the folds is about 86 km. below sea-level. The average height of the crests may be taken as about 3500 m. above sea-level. We thus know roughly both j and h, but the value of c, the thickness of the sial of the plains, remains to be determined.

This amount is also concerned in the isostatic balance between the continental plains and the sea-bed. Let the depth of the sea outside the continental shelf be S, and the height of the plains above the sea be, as before, m. Then the mass of the sial below the plains must be in isostatic balance with the sea-water and the sima below it, down to the level of the base of the sial of the plains.

Hence

$$\rho_a c=\rho_s S+\rho_b(c-m-S) \quad (3a)$$

when ρ_s is, as before, the density of the sea-water.

So
$$(\rho_b-\rho_s)S+\rho_b m=(\rho_b-\rho_a)c \quad (3b)$$

and
$$c=\frac{(\rho_b-\rho_s)S+\rho_b m}{\rho_b-\rho_a}. \quad (3c)$$

But since $\rho_b(j+m)-\rho_a(h+j)$ also $=(\rho_b-\rho_a)c$, (2b)

we have $\rho_b(j+m)-\rho_a(h+j)=(\rho_b-\rho_s)S+\rho_b m.$ (4a)

Hence
$$\rho_b(j-S)=\rho_a(h+j)-\rho_s S \quad (4b)$$

and
$$\rho_b=\frac{\rho_a(h+j)}{j-S}-\frac{\rho_s S}{j-S}. \quad (4c)$$

If h is taken as 3·5 km., j as 86 km., S as 4·7 km., and ρ_s as 1·03,

$$\rho_b=1\cdot10086\rho_a-0\cdot059545.$$

In view of the uncertainty of the data, these figures can only be regarded as a provisional approximation; but they are sufficient to indicate the general nature of the relation between ρ_b and ρ_a. The probable values of ρ_b for different values of ρ_a are shown in the first and second columns of the accompanying table.

With any corresponding values of ρ_a and ρ_b we can determine the value of c from either of the equations (2c) or (3c). These values are set out in the fourth column of the same table.

ρ_a. Assumed density of the sial.	ρ_b. Corresponding density of the sima.	$\rho_b - \rho_a$. Difference.	c. Thickness in kilometres of the sial of the plains.
2·35	2·5275	0·1775	41·1
2·40	2·5825	·1825	41·4
2·45	2·6376	·1876	41·7
2·50	2·6926	·1926	42·0
2·55	2·7476	·1976	42·2
2·60	2·8027	·2027	42·5
2·65	2·8577	·2077	42·7
2·70	2·9128	·2128	43·0

It is remarkable how little the calculated thickness of the sial of the plains varies with the different values of the density of the sial and sima. It is considerably greater than the 15 km. deduced by Dr. H. Jeffreys from seismic considerations or the value assigned to it by H. Washington, 15 km. to 20 km., or, indeed, than I should myself have thought probable, but much less than the figures arrived at by Wegener. Although the data are only known approximately, it is difficult to see how the thickness can differ very considerably from 40 km., unless the depth, j, of the mountain folds is much greater and the difference $\rho_b - \rho_a$ less. For provisional purposes a density of 2·60 for the sial and 2·80 for the sima may be assumed. Such a density for the sima would imply that it is partly crystallised.

While the interior sediments of a subsided area are thrown into complex folds which sink ever deeper below the surface, the exterior rocks that formed the surface of deposition are forced down into hollows, which constitute folds simpler than those of the interior sediments and distinct from them. In the course of these movements they are stretched, and ultimately torn apart into lenticles. In addition, as a result of lateral compression and of isostatic adjustment, they may be and usually are fractured in thrusts and slip-faults. When the interior rocks have become compacted like those of the exterior, they too are forced to accommodate themselves by similar faulting to the forces acting upon them. Thrust-faults will predominate, and result in still further local accumulation in the subsided area and still further subsidence, a *thrusting subsidence*.

The approximate coincidence in the Boulonnais of the post-Jurassic infra-Cretaceous movements, as well as those of later date with the Hercynian folding, induced a number of observers, such as Godwin-Austen, Marcel Bertrand, and Charles Barrois, to formulate a law that movements tend to repeat themselves along the same tracts. That there is some truth in this principle cannot be denied. Unless folded rocks have been thoroughly consolidated and welded together, a renewal of the folding on the same lines will be comparatively easy, and in the case of faults it is a familiar fact that successive movements frequently take place along the same fault-plane. At the same time, T. O. Bosworth, in describing the relation of the Trias to the pre-Cambrian rocks of Leicestershire, has shown that the settlement of later rocks overlying an ancient ridge will cause deformation in the stratification more or less parallel to the contours of the surface of the older rocks. Probably still more important is the fact that the accumulation of the sediments at the foot of a mountain range will, on the principles already explained, tend to produce another system of folding parallel to the first. But this result will be controlled to a considerable extent by local conditions and more especially by the thickness of sial beneath; for it is probable that a sedimentation-subsidence forms more easily where the depth of the sial is less, as even at moderate depths and temperatures the sima is more yielding than the sial in the absence of volatile constituents. However, as Prof. Pruvost has shown, the correspondence is by no means so close, even in the Boulonnais, as to amount to identity of direction.

O. Barré, A. Bigot, and Paul Lemoine suggest the existence of a supplementary inverse principle, according to which an anticline succeeds to a previous syncline, and vice versa. This Lemoine illustrates by the buried ridge beneath the Thames Valley syncline and the supposed syncline beneath the Wealden anticline. But in the former case the synclinal axis is only approximately parallel to the ridge below it; and there is no reason to believe that the Palæozoic floor rises up on the south side of the Weald. It is far more likely that its descent on the northern side is in the nature of a monocline.

The tracts of folding and mountain building that I have discussed belong to great systems in different parts of the world with a direction approximating to the parallels of latitude, and would seem to owe their orientation to the meridional forces, which may themselves be attributed to variations in the angular velocity of the earth's rotation. I have no time to refer to the folds associated with the great ring of compression that encircled the Pacific in Mesozoic and early Kainozoic times. The position of this compression would appear to be determined by a general drift of continental masses towards the centre of that ocean, caused, I have suggested, by a maximum of gravitation beneath it.

To these two great systems of folding, their intersections and interference, may be referred nearly all the orographical features of the globe which have come into being since the close of the Caledonian activity in early Devonian times; while the mountain ranges that belong to neither category not improbably owe their position and orientation to the existence of pre-existing ranges which have determined the development of new regions of folding in the manner already indicated. We know too little of the distribution and orientation of the continental masses and their relation to the position of the equator and the poles and to the variations of gravitation in older Palæozoic and still earlier times to enable us to say how far the directions of earlier folding are consistent with these suggestions.

I make no pretension to enunciate a new theory of mountain building. It has been my endeavour to tell a connected and consistent story of the steps by which mountain folds have come into existence and developed; how they owe their origin in general to great accumulations of sediments, the product of the denudation of the mountains raised in a previous period of folding; how a tract of subsidence resulting from sedimentation and filled by sediment becomes a tract

of weakness in the earth's crust; how the time arrives when under the slowly increasing horizontal compression the subsided area yields and closes, so that the contained sediments are forced up in folds to form a new mountain range, while the earth's crust is left for the time being in a state of relaxation, at the mercy of minor forces which in the time of its strength it had no difficulty in resisting; how it is gradually consolidated once more by the reviving forces of compression, while new regions of weakness are being prepared by new accumulations of sediment, and another cycle of mountain building begins.

Obituary.

SIR WILLIAM AUGUSTUS TILDEN, F.R.S.

BY the death of Sir William Tilden on Saturday, Dec. 11, in his eighty-fifth year, British chemistry lost one of its best known and most loved representatives. Born before Frankland had endowed the atom with valency, or Cannizzaro had used the implications of Avogadro's hypothesis to fix its relative weight, his span of life bridged the gulf between conceptions so widely separated as the indivisible unit of that remote time and the *congeries* of protons and electrons of the present day.

As a boy, Tilden was sent to various private schools and finished that part of his education at Bedford Modern School, where, during the two years of his stay, he helped to found the school scientific society, which bears his name. So far as can be ascertained, his interest in chemistry was first aroused by the experiments which a visiting tutor at the last of these private schools carried out in class to illustrate his teaching. Being given the choice of a career, Tilden in 1857, on leaving school, chose that of chemist. But through a confusion of ideas on the part of his guardian, more pardonable then than now, he started as the apprentice of a pharmacist, the late Alfred Allchin of Barnsbury in North London, who had been Redwood's assistant in the Pharmaceutical Society's School in Bloomsbury Square. He was therefore of the company of Scheele, Dumas, and others, who found their way to eminence in chemistry through the discipline and experience of the old type of pharmacy.

While attending classes at Bloomsbury Square during his apprenticeship, Tilden was attracted to Hofmann's lectures at the Royal College of Chemistry in Oxford Street, which opened up to him a new world and exercised a profound influence on his career. In 1862 he became assistant to Dr. John Stenhouse, F.R.S., but a year later returned to the School of Pharmacy, this time as demonstrator in chemistry under Attfield—a position he occupied until 1872, when, abandoning pharmacy for chemistry, he became science master at Clifton College under Percival, afterwards Bishop of Hereford. It may not be without interest to note that one of his students at Bloomsbury Square, the late W. A. Shenstone, F.R.S., who like himself had been a Jacob Bell Memorial scholar, succeeded him at Clifton.

From Clifton, Tilden went to Birmingham in 1880 as professor of chemistry and metallurgy in the newly founded Mason College and took an active share in the development of that institution; but in 1894, three years before it achieved university status, he was called to the chair of chemistry in the Royal College of Science, South Kensington, in succession to the late Sir Edward Thorpe. On his retirement from South Kensington in 1909—he had succeeded the late Prof. J. W. Judd, F.R.S., as Dean of the College in 1905—he received a knighthood and was given the title of emeritus professor in the Imperial College of Science and Technology. Thereafter, he occupied himself with literary work—chiefly studies in historical chemistry—and, for recreation, with his garden, of which he was justly proud. Among the more important of his books may be mentioned "Short History of the Progress of Scientific Discovery," published in 1899; "The Elements" (1910); "Chemical Discovery and Invention in the Twentieth Century" (1917); "Famous Chemists: the Men and their Work" (1920).

In the field of original research Tilden was first busied with subjects of pharmaceutical interest, out of one of which, the study of dilute nitro-hydrochloric acid, a method was developed in 1874 for the production of nitrosyl chloride in quantity, a reagent used largely by him in the investigation of the terpenes. Pinene nitrosochloride, the first of the additive compounds formed by its aid, was isolated by him in 1875, and others followed; but his work on these unsaturated hydrocarbons, and the conclusions reached about their constitution, are less likely to be remembered than his discovery of the polymerisation of isoprene into caoutchouc, which supplied the first clue to the manufacture of indiarubber by synthetical means. Among the other subjects which claimed his attention, mention may be made of his work on the relation of specific heat to atomic weight which formed the subject of the Bakerian lecture before the Royal Society in 1900. By awarding him the Davy medal in 1908, that Society set its seal on the merit of his contributions to knowledge.

Recognition also came to Tilden from universities and scientific societies. He received the honorary degrees of Sc.D. (Dublin), D.Sc. (Victoria), and LL.D. (Birmingham); became a fellow of the Royal Society in 1880; was a fellow of the University of London; corresponding member of the Russian Imperial Academy of Sciences; and honorary member of the Pharmaceutical Society; president of Section B (Chemistry) at the Bath meeting of the British Association in 1888; president of the Institute of Chemistry in 1891–94; treasurer of the Chemical Society in 1899–1903, and its president in 1903–5. His British Association address was noteworthy as an expression of his views on the teaching of chemistry; his tenure of the chair of the Institute of Chemistry for the adoption of the figure of Williamson's statue of Priestley in Birmingham for the seal of that body; and his presidency of the Chemical Society for the initiation of the invaluable series of "Annual Reports on the Progress of Chemistry," and of the movement for the admission of women to the fellowship, which, to his regret, was not endorsed by the Society until after the War.

Always sure of a welcome at any meeting he might attend, and listened to with pleasure when he intervened in discussions or debates, Tilden maintained his interest

in chemistry and chemists to the end. Even when infirmity, which might have deterred many a younger man from making the effort, came upon him, he would travel from Northwood to attend meetings of the Chemical Society's council. These visits became less frequent as his sight began to fail, and after the summer of 1923 he was seen only once more at Burlington House, when, at the annual general meeting in 1924, as those who heard him will never forget, he made his last speech, rich in reminiscences of his early days as a fellow of the Society. To those who had the privilege of serving on his staff in Birmingham or London, he was ever the stimulating counsellor and appreciative chief. Nor were his students slow to recognise that in him they had a teacher who never spared himself in their interest, and, giving them of his best, he received in return that consideration which old-world courtesy invariably calls forth.

Sir William Tilden was twice married: first in 1869 to Charlotte, daughter of the late Robert Bush, and secondly, in 1907, to Julia Mary, daughter of the late C. W. Ramie. He is survived by Lady Tilden and by a son of the first marriage, Philip Armstrong Tilden, who has achieved distinction as an architect. The funeral at Northwood Parish Church on Wednesday, Dec. 15, was attended by a large body of mourners, including besides relatives the representatives of societies connected with chemistry, pure and applied, and many personal friends. W. P. WYNNE.

SIR JAMES WILSON, K.C.S.I.

WE regret to record the death of Sir James Wilson, late of the Indian Civil Service, on Dec. 22 at his residence, Annieslea, Crieff. He was a recognised authority on a variety of topics connected with India —administrative, economic, philological, and ethnographic. After his retirement from the Indian service in 1911, when he settled in London, being keenly interested in agricultural matters, he acted as superintending inspector under the Board of Agriculture and Fisheries, and became a governor of the Agricultural Organisation Society; in 1914 he was appointed permanent delegate for Great Britain, Canada, Australia, New Zealand, and South Africa to the Institute of Agriculture in Rome.

Sir James Wilson was born on Feb. 27, 1853, the son of the Rev. John Wilson, of Dunning, Perthshire. He was educated at Perth Academy and, after passing the Indian Civil Service examination in 1873, graduated at Edinburgh and then proceeded to Balliol College, Oxford, where he obtained the Boden Sanskrit scholarship, but did not stay long enough to take a degree. He went to India in 1875, and was posted to the Punjab. A distinguished administrative career, which included such high official appointments as secretary to the Punjab Government and the Financial Commissioner, membership of the Punjab Legislature, and, on Lord Curzon's selection, secretary to the Government of India in the Revenue and Agricultural Department, and finally Financial Commissioner of the Punjab, was recognised by the award of the C.S.I. in 1900 and the K.C.S.I. in 1909, two years before his retirement.

Apart from his official duties, Sir James Wilson's interest lay especially in investigating the dialects and folklore of his province. He wrote on tribal customs in the Gurgaon, Sisra, and Shahpur, compiled a gazetteer of the latter district, and wrote a grammar of Western Punjabi. Similar interests in folklore and dialect after his retirement produced "Lowland Scotch as Spoken in the Lower Strathearn District of Perthshire," published in 1915, "The Dialects of Robert Burns," and recently, "Scottish Poems of Robert Burns in his Native Dialect." He had also completed a book on the dialects of central Scotland.

WE regret to announce the following deaths:

Dr. Laurence Pullar, who, by a gift of £10,000, made possible the survey of the Scottish lochs carried out by the late Sir John Murray, and later, with Sir John, edited the six large volumes containing the results, on Dec. 22, aged eighty-eight years.

Dr. H. Campbell Ross, Director of the McFadden Research Foundation at the Lister Institute of Preventive Medicine, London, on Dec. 14, aged fifty-one years.

Mr. T. S. P. Strangeways, Huddersfield lecturer in special pathology and Director of the Research Hospital at Cambridge, on Dec. 23, aged sixty years.

News and Views.

THE New Year honours list includes the names of the following men of science and others associated with scientific work:—*Privy Councillor*: The Hon. W. G. A. Ormsby-Gore, Under-Secretary of State for the Colonies and president of Section E (Geography) of the British Association at the Oxford meeting in 1926. *Knights*: Dr. Henry Head, who has made distinguished contributions to our knowledge of the nervous system; Mr. A. E. Kitson, Director of the Geological Survey, Gold Coast Colony; Mr. J. C. W. Reith, Managing Director of the British Broadcasting Company; Dr. D. Milne Watson, Governor of the Gas Light and Coke Company, London. *K.C.B.* (*Civil Division*): Dr. G. Macdonald, Secretary to the Scottish Education Department. *C.B.* (*Civil Division*): Mr. H. T. Tizard, Principal Assistant Secretary, Department of Scientific and Industrial Research. *C.I.E.*: Lieut.-Colonel J. W. Cornwall, lately Director, Southern India Pasteur Institute, Coonoor, India; Mr. D. Anstead, Director of Agriculture, Madras; Mr. D. Milne, Director of Agriculture, Punjab. *K.C.M.G.*: Prof. W. Mitchell, Vice-Chancellor of the University of Adelaide, in recognition of his services to the Commonwealth of Australia. *C.B.E.* (*Civil Division*): Mrs. Eugénie Strong, Assistant Director of the British School of Archæology in Rome.

LORD BALFOUR, on behalf of the Prime Minister, will receive a deputation on Feb. 15 from the British Waterworks Association, the Salmon and Trout Association, the Society of Medical Officers of Health, and other bodies, who wish to persuade the Government to set up a central authority to deal with the vexed question of river pollution in Great Britain. In our leading article of Jan. 1 we

pointed out the necessity for scientific research in order to deal with many of the problems which present themselves, and outlined the preliminary investigations which have been carried out by the Select Committee on River Pollution during the last five years. The deputation will press for an extension of the relatively small amount of research already in progress, particularly in regard to the best methods of dealing with various harmful trade effluents. It would clearly be an advantage for the scientific investigations carried out by the State and dealing with water supply, sewage disposal, and river pollution, to be under one authority, since they are to a large extent interdependent. The movement towards keeping rivers free from pollution by industrial wastes is in no sense hostile to the industries causing the damage, the bodies concerned believing that the remedy is to be found in centralisation of effort and the application of scientific method to the many problems which have hitherto found no solution. The honorary secretary of the joint committee promoting the deputation is Mr. C. N. Hooper, Fishmongers' Hall, London Bridge.

THE opening of a public telephone service between London and New York this month proves that great progress has been made during the last two years by the radio engineers engaged on long-distance telephony. The charge is to be at the rate of £15 for three minutes' conversation and £5 for every additional minute. If other callers are waiting the speaker is limited to twelve minutes. If connexion be made with the number required but neither the person called nor a substitute accepted by the caller answers, a report charge of £2 only will be made. The problems that the engineers had to overcome mainly arose from the overloading of the ether with radio waves. The wave band chosen lies between 5000 and 6000 metres, and there are forty radio-telegraphic companies already taking up nearly all the available wave-lengths in this band. Very delicate switching devices controlled by the voice are used. When the London subscriber speaks, the circuit to New York is automatically switched on, and the circuit from New York to London is switched off. As soon as he ceases speaking the switches assume their normal position. When the New York subscriber replies, the converse operation takes place.

THE Post Office gave a very successful demonstra- of trans-Atlantic radio-telephony to the Press on Mar. 7 of last year, when for four hours conversation took place between English press representatives and their confrères in New York (see NATURE, Mar. 13, 1926, p. 387). The difficulties connected with atmospherics have not yet been completely overcome. The phenomenon of 'fading' occurs shortly after the time of sunset each day. It varies therefore with the season, occurring between 5 P.M. and 7 P.M. in winter, and between 8 P.M. and 10 P.M. in summer. When the time is 2 P.M. in Great Britain it is about 9 A.M. in New York. Hence between 2 P.M. and 6 P.M. the business times overlap. After this time, if the New York subscriber calls up, he will be put through to the London subscriber at his private residence. In the initial stages, however, it is not proposed to have a continuous twenty-four-hour service. The starting rates have been fixed on a commercial basis, and will be reviewed from time to time as experience is gained in working the service.

IN July last, Dr. W. J. S. Lockyer, director of the Norman Lockyer Observatory, Sidmouth, sent us a note giving the results of a comparison of the 50-day weather forecast for April-June prepared by Lord Dunboyne for the *Daily Mail*, with actual weather experienced. Sidmouth is in such a geographical position that the predictions for the division of Great Britain marked "England, S.W., Scilly Isles" on Lord Dunboyne's chart could be fairly applied to it. Dr. Lockyer therefore constructed a similar chart showing, on the same scale and for the same period, the weather forecast compared with fact. There was little resemblance between the two curves, but it seemed to us that the subject merited inquiry in more detail than Dr. Lockyer had been able to give to it. We therefore invited Capt. C. J. P. Cave to make such an examination over a longer period, and we were fortunate in obtaining his consent to do so. The results are described in an article which appears elsewhere in this issue, and the general conclusion reached is that the success or otherwise of the predictions is mainly a matter of chance. We sent Lord Dunboyne a copy of the article and offered him space for any comments he might care to make in reply to it. Lord Dunboyne, however, regretted that he had not the time to prepare such a reply, but his brother, Capt. the Hon. Robert Butler, has consented to do so, and we propose to publish his communication in an early issue.

EARLY on Jan. 1, a series of violent earthquakes disturbed the southern part of the Imperial Valley, which occupies the south-eastern corner of California and the northern part of Lower California, Mexico. Many buildings were destroyed in the border towns of Calexico and Mexicali, and water-mains were broken. It is estimated that about fifty shocks were felt during the first ten hours. The epicentre coincides very nearly, if not exactly, with that of the earthquakes of June 22, 1915, studied by Mr. Carl H. Beal (*Amer. Seis. Soc. Bull.*, vol. 5, 1915, pp. 130-149). On this day there were two violent shocks, both of intensity 9 (Rossi-Forel scale). The area disturbed by them was about 50,000 square miles, but the value of the property destroyed was only about one-third of that lost on Jan. 1. The Imperial Valley is almost entirely below sea-level and lies in a depression which, in recent geological times, was a branch of the Gulf of California. The district is traversed by some remarkable faults with a general north-west and south-east direction. One of these, the San Jacinto fault, apparently branches from the San Andreas rift, with which the Californian earthquake of 1906 was connected. It has been traced close up to the epicentral area of the earthquakes of 1915 and 1927, and is believed to traverse the Imperial Valley. Mr. Beal suggests that the earthquake of 1915 may have been caused by a displacement along this important fault.

SOME results of importance obtained from a careful examination of the prehistoric monuments of the island of Minorca, which extended over a period of some months, are described by Mr. Frederick Chamberlin in the *Times* of Dec. 30. It has generally been held that the *talayots* of Minorca, great mounds of huge, rough uncemented stones 26 ft.-30 ft. high, were comparable with the better known *nurhags* of Sardinia. This comparison was based on the view that the *talayot* in some, if not all, cases was built hollow with an entrance, resembling in this respect a chambered cairn. Mr. Chamberlin examined 186 *talayots*, some previously unknown. Of these, 107 were in a sufficiently good state of preservation to permit him to say that 32 only, or one out of three, had ever had an entrance of any sort, while three alone had an interior chamber, and only one more than one apartment. It is clear, therefore, that the *talayot* is not comparable to the *nurhag* and, indeed, is a monument without a parallel. Associated with the *talayot*, and usually within a hundred feet of it, is a class of monument known locally as a *taula*—a two-stoned monument 5 ft.-12 ft. high in the shape of a Greek T, the flat top stone being fully 12 ft. long. Ten of these are now known. Each is surrounded by a horse-shoe-shaped wall pierced by a doorway surmounted by a single-stone lintel. The two classes of monument clearly stand in relation one to another, though there does not appear to be any evidence of orientation. Sir Wallis Budge has expressed the opinion that the *talayots* are pyramids of a funereal nature, and the *taulas* altars for sacrifice or other funereal ceremonies. A third class of monument, called *naus* from its resemblance to a ship, of which sixteen are known, has an elliptical chamber 15 ft. long by 7 ft. high, and appears to have served as a tomb for dwellers in the numerous caves in the neighbourhood.

THE first five parts, constituting the first volume of the "Nomenclator animalium, generum et subgenerum," have now been issued by the Prussian Academy of Sciences. Each part consists of 160 pages, $12\frac{1}{2} \times 9\frac{1}{2}$ inches, printed in three columns with about 50 names to the page. The work will be completed in four more volumes and will contain more than 200,000 entries. It is hoped that the last part will be issued at the close of 1929. The promoters of this great work seem to have found some difficulty in making it known, and it has therefore been decided to extend to March 31, 1927, the term during which the names of subscribers will be received. The subscription price is 15 marks for each part, or 75 marks per volume. After that date the selling price will be raised to 20 marks a part. Payments should be made by cheque or money order to the Preussische Akademie der Wissenschaften, Berlin, N.W.7, Unter den Linden 38. The Academy also offers the "List of Literature" used in the "Nomenclature," for 10 marks; it occupies 288 pages. During the progress of this laborious undertaking, two successive editors, F. E. Schulze and W. Kükenthal, have died. The present editor-in-chief is Prof. K. Heider, and the secretary is Prof. Th. Kuhlgatz. Our readers may fittingly be reminded that the British Association, the Linnean Society of London, and a few individuals in Great Britain have helped the work by donations amounting to about £500.

IT should scarcely be necessary for us to emphasise the extraordinary service that this publication renders to every working zoologist. It cannot, indeed, supersede Sherborn's "Index Animalium" in course of publication by the Trustees of the British Museum, a work which the German editors say "kann nicht genug bewundert werden." But the vaster scope of Sherborn's "Index," and the more exhaustive method by which it is compiled, indicate that no man living can expect to see its completion beyond 1850. The Prussian Academy, adopting a more rapid method, gives us a list of generic and subgeneric names down to 1922, those for the last twelve years being copied, without further reference, from the indexes to the "Zoological Record." The names of fossil animals are of course included, and almost excessive care has been taken to reproduce every variation in spelling down to obvious and ridiculous misprints. We have checked some of the earlier parts by other indexes accessible to us and have found an occasional date or page-number wrong (*e.g.* 1646 for 1846, 11 for 116), some initials incorrect, and the † indicating 'extinct' wrongly omitted or inserted. Such almost inevitable slips or misprints scarcely affect the usefulness of the work. Actual omissions are exceedingly rare, and if some unwarranted names have found their way in, they will do no great harm. Every serious student will continue, as heretofore, to verify his references. The great thing is to find the reference, and that is labour worth paying for.

ACCORDING to a report of the Nairobi correspondent of the *Times* which appeared in the issue of Dec. 28, Mr. L. S. Leakey, of the Cutler Dinosaur Expedition, has discovered a complete human skeleton at Nakuru buried at a depth of twelve feet in the flexed position with knees drawn up to the chin. With the skeleton were more than a hundred stone implements described as 'Mesolithic,' mostly lunates and backed points of obsidian with a few bone points. The skeleton is that of a 6 ft. man and is said to be "not negroid." The skull has a nose of medium width and is not prognathous. Mr. Leakey is stated to regard this man as belonging to the "Wayland-Magnosian" period of Uganda. Judging from the description, the implements would appear to belong to a type already found in this area which Mr. Wayland himself regards as comparable to Azilian. Mr. Leakey's work in investigating stone age remains in Uganda is being financed in part by the Percy Sladen Memorial Fund; but it is hoped that the interest which has been aroused by this discovery may call forth further financial assistance and also that the Kenya Government will agree to assist to a limited extent in 1927. Should the report be fully substantiated in all its details, the discovery is likely to prove of considerable importance in African archæology.

THE council of the *Field* Distemper Research Fund states that the investigations so far pursued have confirmed the view that canine distemper is caused by a filter-passing ultra-microscopic virus, and the symptoms of the disease itself have been disentangled from those of the many secondary infections that occur. Several puppies have been rendered so far immune by inoculation that infection afterwards with the virus produces only a slight and transitory effect. The material employed for the inoculation is at present of a crude nature and of uncertain and inconstant strength, so that the procedure has not yet reached the stage when it can be widely used, but progress in this direction is anticipated. The work is being carried out at Mill Hill in collaboration with the Medical Research Council; and the Duke of Portland, president of the Distemper Research Council, appeals for further donations to the fund, which should be forwarded to the organising secretary, Windsor House, Bream's Buildings, London, E.C.4.

WE have received the second annual report of the Board of Management of the London School of Hygiene and Tropical Medicine to the Court of Governors. The report, which is signed by Sir Alfred Mond, chairman of the Board, gives a brief account of the activities of the school and the progress made during the year. In the Tropical Division, Dr. Balfour reports that the extended courses of study have not led to any decrease in the number of students; in fact, the average number attending is slightly higher than last year. Since the Seamen's Hospital Society has signified its intention of maintaining the hospital at Endsleigh Gardens for a limited period only, the Minister of Health, upon representations made by the Board of Management, has appointed a committee to consider how the necessary clinical and pathological facilities for the study of tropical diseases can best be secured to the School. In order to increase the research work of the School, the Board has decided to apply the capital as well as the income of the Milner Research Fund to this purpose; as part of this plan, Dr. A. W. Grace has been nominated to proceed to the West Indies to undertake research on filariasis, and a contribution of £500 per annum for two but not more than five years has been made towards his expenses; the larger part of the cost of this expedition is being borne by the Royal Society. It is hoped that the formal opening of the Field Station of the Institute of Agricultural Parasitology, at Winches Farm, will soon take place; the work is under the intermediate direction of Prof. R. T. Leiper.

IT is satisfactory to learn from the report that the deficit taken over with the London School of Tropical Medicine has been wiped out, owing to an extra grant from the University Grants Committee and a donation from the executors of the late Mr. Alfred de Rothschild; but it is feared that the work of the Tropical Division cannot be carried on without loss, unless increased financial aid is forthcoming. Steps are being taken to enlarge the library, which at present is related entirely to the Tropical Division, so as to build up a library of hygiene, in advance of the opening of the new School. Unfortunately, the progress of the building has been seriously delayed by the coal strike, since the building committee, after careful consideration, felt they would not be justified in departing from their stipulation that only British steel should be used. However, the steel work should be completed within twenty-five weeks of the termination of the coal dispute, that is, approximately by the middle of this year. Meanwhile, steps have been taken to make appointments to the chairs of bacteriology and immunology, and of epidemiology and vital statistics; thus the Board has the advice and assistance of the two professors, Prof. W. W. C. Topley and Prof. Major Greenwood respectively, in settling the details of the accommodation in the new school and its equipment. During the year Prof. McDowall, of King's College, has given courses of lectures in physiology as applied to hygiene. We welcome the report as evidence of the increasing part the School will play in university life in London.

DR. C. S. MYERS gives a very interesting and lucid account of vocational guidance and selection in the *Nineteenth Century* for November last. By vocational guidance is meant the expert advice offered to a person in regard to his choice of employment; by vocational selection is meant the discovery of the best worker for a given job. Dr. Myers discusses the effects of having 'the round peg in the square hole,' and rightly attributes much industrial discontent, unhappiness, inefficiency, and high labour turn-over to the presence of people in jobs for which they are intellectually and temperamentally unfitted. A high labour turn-over in jobs where security of tenure does not prevail is indicative quite frequently of bad selection. The only satisfactory reason for taking up a particular job is that one has the ability to do it and also that one prefers it to any other: such is, of course, a counsel of perfection, but it is impossible to overestimate the evil effects of forcing a child for reasons extraneous to the work itself or to the child into situations for which he is not adapted. The author points out that children are not, as a rule, the best judges of their capabilities or even interests, being frequently influenced by fashion, prestige, or fleeting interests. Teachers often do excellent work, but not all are either sufficiently gifted or trained for the necessary diagnosis.

OF recent year, special study has been devoted to the problems of guidance and selection, and it is now possible by the application of psychological tests to assess a child's abilities and advise accordingly. Dr. Myers wisely insists in his article that a mere mechanical application of tests is useless: they are of diagnostic value, but must always remain the servant, not the master, of the vocational adviser. Everybody who has come in contact with industry in its different fields has been impressed by the dissatisfaction of many who have had to enter an uncongenial trade or profession and are now too old to change. One point relevant to this discussion might be stressed, namely, that society as well as the

individual parent must cease to look upon certain occupations as more respectable than others. How many miserable clerks would be happy as manual workers were it not that some grades of society consider clerical work more respectable than manual work?

THE Illumination Research Committee of the Department of Scientific and Industrial Research has issued Technical Papers Nos. 1, 2, and 3, dealing respectively with the terminology of illumination and vision, the transmission of window glasses and the effect of the enamelled steel reflectors used in works. The measurements on which the last two reports depend were made at the National Physical Laboratory by members of the staff. Of the importance and value of the two to industry there can be no doubt and they should command a ready sale. In a prefatory note to the first report the chairman of the Committee explains that as the technical terms used in illumination are not widely known, it has been thought desirable to publish explanatory notes so that readers of future reports would have full knowledge of the terms used in them. The prices of the three reports—9*d.*, 6*d.*, and 1*s.* respectively, seem high compared with the prices of corresponding publications of the United States Bureau of Standards or of those issued by the Support of Workings in Mines Committee of the British Mines Department, *e.g.* Paper No. 12 on Scotland, 24 pp., 4*s.* 2*d.* for 50 copies.

ARRANGEMENTS for courses of instruction in anthropology for the coming session are announced by the University of Paris. In view of the bias towards practical application in Colonial administration which is a feature of the work of the recently founded Institut d'Ethnologie, it is interesting to note that lectures are to be given there, beginning in late December or January, on descriptive ethnography by M. Mauss, descriptive linguistics by M. Marcel Cohen, anthropology by M. Paul Rivet, and extra-European prehistory by M. l'Abbé Breuil. The special provinces of French administration are covered by courses on the linguistics and ethnography of Africa, lecturer not stated, owing no doubt to the lamented death of M. Delafosse, and the linguistics and ethnography of eastern Asia and Oceania. The courses at other colleges and institutions of the University cover a wide range: in physical anthropology, M. Verneau on the races of the French Colonies; in ethnography, M. Mauss on the religions of non-civilised peoples, with special reference to Australian rites; M. Raynaud on the archæology of Central America and Peru, M. Cabaton on the Malays, M. Capitan on American ethnic affinities, and origins, M. Julien on Madagascar, M. Labouret on East Africa, M. Milliot on Morocco, and others. In sociology there are seven courses, including lectures by M. Granet on the extreme East, M. Massignon on Islam, M. Cabaton on Indo-China, and a general course by M. Fauconnet. There are some twelve or thirteen courses in various languages, and a course in prehistory will be given by M. G. Renard.

DR. EDWARD R. WEIDLEIN, Director of the Mellon Institute of Industrial Research, University of Pittsburgh, has been elected president of the American Institute of Chemical Engineers for the year 1927.

WE have recently received the annual report of Livingstone College, Leyton, London, E.10, for the year 1925–26. The College exists to instruct missionaries in the elements of medicine, and seventy-seven students took the various courses. The College paid its way except for about £35, but a deficit of £1375 still exists. A fund is being established to the memory of Dr. Harford, the first principal, and donations to this and for the general purposes of the College are asked for.

THE Rockfeller Foundation has published a fourth series of "Methods and Problems of Medical Education," dealing with the methods of obtaining, assembling, filing, and storing the record of the sick person. After a study of several admirable systems, that of the Presbyterian Hospital of New York City is believed to combine the maximum of aims to be attained and is set out in full detail with many facsimile reproductions. It combines not only a full history of the case while in hospital, but also means for following up the after history of a case after discharge.

THE annual analysis of books published in the British Islands during the past year which is issued by the *Publishers' Circular* shows that the total number of books published in 1926, namely, 12,799, was 403 less than that for 1925. This decrease, however, was due entirely to the smaller number of new editions, the total of actual new books, 9989, being slightly greater than in 1925. The number of books on science increased from 617 to 660, and those on technology from 609 to 629, while medicine remained the same with 399 publications, and agriculture decreased from 208 to 184. Scientific books included 20 translations and 83 new editions. Dividing the literature of 1926 into twelve main groups, fiction heads the list with the most publications, while science comes sixth and technology seventh. In 1914, science was third and technology fifth, and in 1925 the order was science seventh and technology eighth.

WE have received from Messrs. James Swift and Son (81 Tottenham Court Road, London) their catalogue of microscopes and accessories. Of microscopes, four models are constructed according to the specification of the British Science Guild; the 'Didaxis' is of new design, combining simplicity with strength and rigidity, and eminently suitable for students' use; the 'Universal Technical' is a high-class instrument particularly adapted for research work of all kinds. Two oil-immersion lenses of low aperture are catalogued, an $\frac{1}{8}$-in. N.A. 0·92 and a $\frac{1}{12}$-in. N.A. 0·95, which have been primarily designed for use with dark-ground illumination.

AMONG the works to be published early in the new year by the Cambridge University Press are "The Collected Papers of Sir James Dewar," in two volumes, edited by Lady Dewar, J. D. H. Dickson, H. M.

Ross, and E. C. Scott Dickson. The work will include not only the papers which appeared under Sir James Dewar's name alone, but those also which were published jointly with other investigators, excepting the series on spectroscopy by him and Prof. Liveing which have been issued separately. The same publishers also announce "Differential Geometry of Three Dimensions," by Prof. C. E. Weatherburn; Volume 2 of the second edition of "Principia Mathematica," by Prof. A. N. Whitehead and the Hon. Bertrand Russell; and a new volume in the series of Cambridge Mathematical Tracts, "The Theory of Integration," by L. C. Young.

THE Report of the Director-General of the Ordnance Survey for 1925–26 has recently been published. In trigonometrical work a field section is at work restoring the primary and secondary trigonometrical stations and marking them by concrete blocks. This has been completed south of a line between the Wash and the mouth of the Severn. Good progress has been made with the work of recomputing the co-ordinates of the primary and secondary trigonometrical points on the Gauss conformal projection. A revision of the magnetic survey of Great Britain was begun in the Channel Islands. In map production the third revision of the one-inch map of England and Wales is complete, and of the 146 sheets, 145 have been published in the popular edition. The revision of the map of Scotland was nearly finished and 9 sheets of the popular edition were published. All sheets of the quarter-inch layer map are published, two more sheets of the revised half-inch map, and one out of three sheets of the new ten-inch map. Progress has been maintained in the revision of the six-inch map, which is now again being published in quarter sheets.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Additional Research Fellows in the Department of Glass Technology, The University of Sheffield—The Registrar, The University, Sheffield (January 12). A laboratory assistant for photographic work, at the Building Research Station of the Department of Scientific and Industrial Research—The Director of Building Research, Building Research Station, Garston, nr. Watford (January 15). An assistant master, qualified in physics and mathematics, at the Royal Naval College, Dartmouth—The Headmaster of the College (January 26). A Warden of Goldsmiths' College—The Academic Registrar, University of London, South Kensington, S.W.7 (January 31). An assistant in entomology at the Pathological Laboratory of the Ministry of Agriculture and Fisheries at Harpenden—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (February 7). A professor of anatomy in the University of Adelaide—The Registrar, University of Adelaide, South Australia (March 1). A physicist in connexion with the Linen Industry Research Association, to take charge of a section dealing with finishing problems—The Secretary, The Research Institute, Lambeg, Co. Antrim.

Our Astronomical Column.

COMET COMAS SOLA.—The following is a continuation of the ephemeris for 0h U.T.

	R.A.	N. Decl.	log r.	log Δ.
Jan. 8.	2h 26m 6s	15° 13′	0·279	0·112
12.	2 28 48	16 4	0·276	0·121
16.	2 31 56	16 55	0·273	0·129
20.	2 35 48	17 48	0·270	0·138
24.	2 40 3	18 41	0·267	0·146

The brightness remains nearly constant, about mag. 12.

Mr. F. E. Cunningham supports the suggested identity with Spitaler's Comet 1890, vii., noting that Tisserand's criterion is satisfied.

SUNSPOT ACTIVITY, 1926–27.—The list of notable sunspots for the present year has already begun. A large spot, conspicuous also on account of its regularity of outline, was first seen during the last few days of December and was on the sun's central meridian in the forenoon of Jan. 1. The latitude of this spot was 7° S.; another large spot, also in equatorial latitudes, was reported in NATURE of Dec. 25, 1926, p. 925. It is evident that large spot disturbances are now appearing within a comparatively wide range of latitude—a sure indication that the sun has entered upon the maximum phase of this cycle. Judging, however, from the average latitude of spots and faculæ of the past year, the highest peak of the curve will not be reached before the end of 1927. The spots of 1926 were considerable and show an increase in mean daily area of about 50 per cent. greater than that of 1925. Eleven groups of spots, large enough to be seen with the naked eye, were reported in these columns at the time of their respective appearances, but there were at least half-a-dozen other groups of almost equal importance.

Particulars of the recent spot are as follows:

No.	Date on Disc.	Central Meredian Passage.	Latitude.	Area.
1	Dec. 26–Jan. 7	Jan. 1·3	7° S.	1/1200 of sun's hemisphere.

ANOTHER REPETITION OF THE MICHELSON-MORLEY EXPERIMENT.—Mr. Roy J. Kennedy describes in the November issue of the *Proc. U.S. Nat. Acad. Sciences* a repetition of this experiment. He reduced his light path to 4 metres (one-sixteenth of that employed by Prof. Dayton Miller), and enclosed the apparatus in an air-tight case, filled with helium at atmospheric pressure, thus reducing the disturbing effect of density changes to one-tenth of that in air. A further device used was raising one half of the surface of his mirror a small fraction of a wave-length, which was effected by cathode deposition of platinum. Experiments were made both at the Norman Bridge Laboratory, Pasadena, and in the 100-inch telescope building at Mt. Wilson. Observations were made at various times of the day, but most often at the time when Prof. Dayton Miller's conclusions would require the greatest effect. The effect at both stations was absolutely *nil*: "there was no sign of a shift depending on the orientation." Mr. Kennedy claims that a shift one-fourth of that announced by Miller would have been detected, and states that he will make further experiments to search for a possible shift in other directions.

Research Items.

DIFFUSION OR INVENTION IN CULTURE.—In *Psyche* (Oct. 1926), Dr. Bronislaw Malinowski has a most illuminating article on the life of culture, in which he attempts to show that the contrast insisted upon by some anthropologists between culture by 'diffusion' or by 'invention' is erroneous. He points out that every modern invention is made and re-made time after time in different places by different men. In the case of 'wireless,' though the invention is popularly ascribed to Marconi it can be traced back through Ampère, Faraday, Righi, Braun, Clerk Maxwell, Hertz, Lodge, and other workers. Thus the invention of radio communication can be treated as a single and singular event and ascribed to one man or another only by a misconception: the point of view of the Patent Office cannot rightly be taken up for the science of culture. Every cultural achievement is due to a process of growth in which diffusion and invention have equal shares. Culture is something always at work, which is there for the satisfaction of elementary human needs, which in turn creates new wants and provides means for their fulfilment. The value of so-called savage 'superstition' is to be found in the confidence that magical rite gives man in forgetting difficulties and in bridging gaps in his knowledge. Borrowing from others does take place, but whenever one culture borrows from another, it always transforms and readapts the objects and customs borrowed. Diffusion is modified invention, exactly as invention is a partial borrowing.

PUZZLE CRAZES.—In the *Nineteenth Century* (Dec. 1926) there is an interesting account by Mr. Henry E. Dudeney of puzzle crazes, with particular reference to the recent popularity of the 'cross-word puzzle.' He traces the development of pastime puzzles from very early days. One of the very oldest is what is now called the 'tangram,' known to the Chinese thousands of years before the Christian era. The Egyptians, too, were fond of puzzles, and there is in the British Museum a treatise of this nature called "Directions for knowing all Dark Things." Coming to more recent times, Niccola Fontana in the sixteenth century published a number of puzzles, some of which are still popular. Mathematical puzzles have interested numbers of people for centuries, while innumerable puzzles have been devised with string, matches, and coins. The word puzzles are for the most part restricted to the particular language in which they appear, and hence lack the universality of those of the mathematical type. Real puzzle acrostics do not appear earlier than the nineteenth century, but they were apparently popular at the court of Queen Victoria. Although puzzles, verbal or otherwise, have always been attractive, yet the popular craze for a particular type would seem to be modern, since it is dependent on easy locomotion, the Post Office, and cheap journalism. The 'cross-word' is not in its nature new, but in its present form it had its first success in the United States. The 'cross-word' is convenient in form, no apparatus being involved; each item can be complete in itself, *i.e.* one need not finish the whole puzzle at one sitting, and hence it is admirably adapted to modern forms of transit; it can be done in groups and hence is not a bar to sociability; there are an infinite number of possibilities, yet one does improve with practice; the habit is easily fixed, and there is constant challenge and stimulus. Sooner or later, the author thinks, the inveterate solvers will have acquired such a large and extended acquaintance with the words of the language that they will want something else. Then the 'cross-word' will end for this generation.

THE TREATMENT OF SYPHILIS.—Mercury has long been known as an effective drug in curing the obvious symptoms of active syphilis. Its use for this purpose has, however, been almost entirely given up since the discovery of the far more efficient salvarsan. Nevertheless, in some clinics it has been the custom, when all signs of the disease have been cured and the Wassermann reaction made negative, to follow up salvarsan treatment with a prolonged course of mercury in the hope of finally killing off any residual spirochætes and converting what may be a quiescent infection into a complete cure. In a very thorough study of the results of this procedure in 711 cases treated in Liverpool (Medical Research Council: Special Reports Series, No. 107. London: H.M.S.O., 3*s.* 6*d.* net), Prof. E. E. Glynn, Dr. R. E. Roberts, and Mrs. Bigland show clearly that mercury given in the later stages not only does not prevent relapses, but even actually encourages them. There is no evidence to show whether this is due to the breeding out of strains of the parasite resistant to mercury or to depression of the general health and resistance of the body; but it is an important practical point and raises some curious questions in pharmacology.

ACCLIMATISATION AND HIGH ALTITUDES.—In his recent ascent of the peak of Kibo, the summit of Kilimanjaro, Mr. D. V. Latham was able to make some valuable observations on the physiology of the human body in high altitudes in the tropics. These observations, together with an account of the climb, are published in the December number of the *Geographical Journal*. The peak is 19,710 feet in altitude. Shortness of breath was felt first at 12,000 feet, but was never distressing even at 19,000 feet, and it was noticeable that the body became acclimatised to respiration in reduced pressure. At 18,000 feet, on the fourth day of the climb, breathing was less difficult than at 15,000 feet on the first day, but above 18,000 feet, especially when the gradient was steep, it was necessary to stop and rest after every forty paces. The pulse rate during rest at varying altitudes was not markedly altered and the blood pressure did not vary. Muscular power was diminished at 19,000 feet, where even slight efforts meant appreciable fatigue. Mental processes were also slow at the summit. Mountain sickness in one of the climbers did not appear until 19,000 feet, and in another it became so severe at 15,000 feet that he had to descend 3000 feet for two days' rest, after which he climbed to 17,200 feet before the symptoms returned. Mr. Latham believes that this difficulty can be overcome by gradual acclimatisation, and he does not think that it is due to oxygen-want, since the sickness was always relieved by walking, when the oxygen demand was greater than when resting. The paper contains also some interesting observations on red blood cells at different altitudes.

ASEXUAL REPRODUCTION WITHOUT LOSS OF VITALITY IN THE ORGANISM OF BIRD MALARIA.—Prof. R. W. Hegner (*Science*, 63, pp. 479, 480, 1926) records that *Plasmodium præcox*, the organism of bird malaria, has been met with several times in the United States in the common English sparrow. Whitmore in August 1913 obtained this organism from sparrows in New York and inoculated it into canaries, and Hegner obtained this strain in 1918 and has maintained it in canaries in his laboratory. In 1924 another strain was obtained by Hartman from a sparrow in Baltimore, and this also has been maintained in canaries. The asexual cycle of the New York strain has been shown to be thirty hours and that of the Baltimore strain twenty-four hours; whether the period of the former has become longer

during its extended cultivation in canaries is not known. The number of asexual generations passed through by this strain since August 1913 is more than 3600. The Baltimore strain has passed through about 550 asexual generations and the periodicity seems to have been maintained unchanged, and this may be regarded as a measure of its vitality. Both the strains have maintained their virulence throughout the entire period. Prof. Hegner directs attention to the interest attaching to the rate of reproduction and to the virulence of these organisms living in a constant environment.

CRYSTAL STRUCTURE IN BIOLOGY.—Of considerable interest to biologists is last year's Mather Lecture of the Textile Institute delivered by Sir William Bragg on "The Fine Structure of Animal and Vegetable Substances as Revealed by the X-rays" (*Journal of the Textile Institute*, vol. 17, No. 11, Nov. 1926). The method used in the analysis of crystal structure has been applied to the study of cotton and wool fibres. In the case of ramie fibres the X-rays reveal the presence of multitudes of very minute crystals with some regularity of internal arrangement, in that a certain axis of each crystal is oriented along the main axis of the fibre. Otherwise the crystals are in complete disarray. Herzog (*Journal of Physical Chemistry*, April 1926, p. 457) found the unit pattern of a ramie fibre to be contained in a right-angled 'cell' calculated to weigh four times as much as the actual molecule of cellulose; so that the crystalline structure of the fibre is really very simple, and formed by the repetition of a fundamental unit of pattern containing only four cellulose molecules. The structures of such diverse materials as sugar crystals, rubber, and even chain compounds like fatty acids, have been analysed in the same way. From the point of view of the biologist, this is getting vegetable structure down very fine, and the method opens up a new avenue of approach to the investigation of at least some types of histological and causal problems (see also NATURE, July 24, 1926, p. 120).

THE ORIGIN OF FJORDS.—The vexed question of the origin of fjords was dealt with by Prof. J. W. Gregory in a lecture on the fjords of the Hebrides to the Royal Geographical Society on Dec. 20. While not denying that ice may have played a part in moulding the shape of fjords, Prof. Gregory insisted that other origins must be found for the valleys themselves. He pointed out that the direction of the fjords has no particular relation to the grain of the country, and that the main flow of the ice sheets was frequently across, and not along, the fjords. Fjords originated in rents or fissures due to earth movements. The nature of the earth movements gives a classification into three divisions. First are the rift valleys, due to the sinking of a strip of land between parallel faults; secondly are those valleys, due to a shattering of belts of rock by many tension clefts and the removal of the material by wind, water, and ice; and thirdly, the fjords due to the subsidence of a strip of country against one major fault producing an asymmetric valley. Prof. Gregory attributes the fjords of the Hebrides, like the sea lochs and fresh-water lochs of western Scotland, to the indirect effects of the Alpine folding of Oligocene and Miocene times, and the later Atlantic subsidences. To the Alpine movements was due the rending of the earth's crust, and to the later uplift of the British area was due the gaping of the fissures. The action of the surf along the shore and of erosive agencies inland has since modified these tectonic valleys.

BITUMINOUS SANDS OF NORTHERN ALBERTA.—A further report by Mr. S. C. Ells, of the Mines Branch, Department of Mines, Canada, describes his investigations of the well-known impregnated sands of the Fort McMurray region, on the Athabaska River, northern Alberta, up to the end of 1924. Although the deposits are very extensive, occupying more than 2000 square miles, not more than 3 square miles are readily accessible for commercial exploitation; the rest of the deposits lie beneath a thick overburden and would thus prove relatively expensive to operate. The percentage impregnation varies between 12 and 15, occasionally higher in limited areas. The report gives concise information on the character of the sands, also results of numerous laboratory determinations and analyses. Possibilities of economic development are considered, especially with reference to sources of fuel, power, transportation, markets and climatic conditions under which work would have to be prosecuted. Various processes have been designed to extract the bitumen from the sands, and for utilising the raw material in its natural condition; some of these processes are capable of extension and improvement to adapt them to large-scale operations, others are in the more experimental stage; all important ones, however, are reviewed in the report (No. 632), a document of 244 pages fully illustrated with photographs and diagrams. In addition there are 8 detailed maps and 4 cross-sections; the latter show the relative position of the sands with reference to overlying strata and the trend of present topography. After all the careful field and laboratory investigation which these Athabasca 'tar-sands' have received, particularly at the hands of the author, it will be very disappointing if at least a portion of the available resources cannot be profitably worked.

VACUUM TECHNIQUE.—The issue of the *Physikalische Zeitschrift* for November 1 contains an article of 20 pages by Mrs. M. A. Shirmann, of the Physical Institute of the University of Vienna, on two improvements which have been introduced recently into the technique of high vacua. When a vessel has been exhausted and has to be sealed off from the pump, the sealing process sets free from the heated surface of the glass a certain amount of gas which in general, as the seal is close to the vessel, gets into the vessel. By connecting the vessel to be exhausted by a narrow tube to the trunk tube of the pump and sealing off close to the trunk, only a small proportion of the gas liberated gets into the vessel. The second improvement relates to ground glass joints and to taps in which the seal is effected without mercury or grease. In the case of a joint, the inner cone may be metal or, if not, its outer surface is coated with metal; the outer cone has metal deposited on its outer surface, and between the two metal surfaces an electromotive force is applied which draws the two surfaces together. In the tap the plug is of metal, the outer surface of the barrel is coated with metal, and an electromotive force applied between the metals.

DECAY OF FLUORESCENCE.—In the *Ann. des Phys.*, No. 23, p. 681, 1926, E. Gaviola describes an interesting application of the Kerr phenomena. He shows that a satisfactory electro-optical arrangement may be devised to perform the function of the toothed wheel in Fizeau's measurement of the velocity of light. With this arrangement he has been able to show experimentally, for the first time, that stationary waves, established by a Lecher wire system, possess the wave-lengths predicted by Maxwell's theory. The main purpose of the method, however, was to investigate the rate of decay of the fluorescence of solutions of dyes, and Gaviola finds that the average duration of the fluorescence of solutions of rhodamin B and of uranin in glycerine and in water is of the order of 10^{-9} second. The effect of concentration on the rate of decay, if such an effect exists, appears to be very small.

The Pretoria Meeting of the South African Association for the Advancement of Science.

THE twenty-fourth annual meeting of the South African Association for the Advancement of Science took place at Pretoria on July 5-10, 1926, under the presidency of Dr. E. T. Mellor. The meeting was very well attended, and 129 papers were read. Joint meetings of several sections were held. A popular lecture was given by the Hon. J. H. Hofmeyr, Administrator of the Transvaal, on "The Romance of Ægean Archæology." There was a reception by the Mayor and Mayoress of Pretoria, a conversazione by the Pretoria branch of the South African Biological Society, and visits to various places of scientific interest in the neighbourhood.

The president, Dr. E. T. Mellor, in his address, gave an account of "Science in Relation to Mining and other Industries in South Africa." He indicated how modern scientific thought and methods have entered into the everyday life of the people instead of being restricted to the laboratory. The Witwatersrand goldfield, he said, is probably the most concentrated and important one in the world, and in the development of South Africa, gold and diamond mining has played a very important part. Gold being stabilised in price, and with an unlimited market, permits friendly rivalry in efficiency of mines. Geology has benefited from mining through the study of auriferous conglomerate and the origin of gems. Deep-level mining yields information on rock temperatures at great depths. In physiology the effects of moisture and temperature on health have been studied. In pathology the study of respiratory diseases has been of greatest general benefit. Anthropology even has benefited as a result of mining. The discovery of deposits of platinum is the result of a geological survey. The importance of industrial research was indicated, and, in concluding, the president pointed out that science is not local but universal, and commended it as a life career of greatest interest.

"The Problem of Atmospheric Electricity" was chosen by Prof. P. G. Gundry for his presidential address to Section A. In speaking of pure and applied research, he stated that it is scarcely too much to say that no great forward step is ever made without being based on the work of those spurred by scientific curiosity alone. The place of South Africa in pure research such as astronomy is largely due to amateurs, to whose work also much of our knowledge of the electrical condition of the earth and its atmosphere is due. The Heaviside layer of the atmosphere, radio telegraphy, and the earth's electric field were discussed at length, as was recent work on very penetrating rays of cosmic origin. Ionisation of the air and Wilson's work on thunderstorms were described, and the suitability of South Africa for the study of thunderstorms was indicated.

Dr. St.C. O. Sinclair gave an account of "The Chemical Service of the Union of South Africa: its Organisation and Work" as his presidential address to Section B. This service is distributed between the staffs of the Division of Chemistry, the Schools of Agriculture, the Veterinary Research Institute and an industrial chemist. The Division of Chemistry has to undertake work for State departments, such as agriculture, justice, finance, public health, mines, posts and telegraphs. The staffs of the schools of agriculture act as research officers, teachers and extension officers. Biochemical problems and poisonous plants are dealt with at the Veterinary Research Institute. The systematic soil survey of the Union, brak investigation in relation to irrigation schemes, fertiliser experiments, the making of synthetic manure, investigation of the composition of fruit and its export under the best conditions, preservatives, tanning materials and prickly pear destruction were all discussed. The scope of the regulatory work of the Government Division ranges from work on food adulteration to the preparation of chaulmoogra oil esters for the treatment of leprosy.

The subject of Prof. P. A. van der Bijl's address to Section C was "Landmarks in the Development of the Science of Plant Pathology and Disease Control." Researches on fungoid diseases of plants, dealing with life-histories, biological races, disease resistance, mechanism of penetration by parasites and variations under environmental conditions, were discussed, as were bacterial plant pathogenes. Mosaic and protozoal diseases were also considered. The history of control measures against plant diseases was given and their importance indicated. The attention given to the study of plant diseases in different countries was noted, and the advantages to a country of systematic instruction through university training in plant pathology, as in America and South Africa, were indicated.

The presidential address to Section D was delivered by Prof. C. G. S. de Villiers, his subject being "Some Aspects of the Morphology and Ontogeny of the Skeletogenous Strata." The need of correlation of comparative anatomy, comparative embryology, phylogenetic palæontology and experimental zoology in investigations of the morphology of the chordates was first indicated. Neoteny was discussed and the origin of the mesodermal skeleton reviewed fully. The differentiation of the mesenchyme and the various views on the morphology and origin of the sternum in Amphibia were indicated. The ontogeny of the tissue giving rise to the zonal and appendicular skeleton is as yet unknown, though probably mesenchymatous. The nature of membrane bones requires further investigation. Phylogenetically, membrane bones are older than cartilage bones, and whether they acquire secondary relations to zonal, sternal, cranial or visceral skeleton, they are remnants of the original exoskeleton. Ontogenetically they may be derived from the cutis layer of the myotome. The use of the experimental method was noted. The solution of many obscure problems in osteology can only be solved when a clearer knowledge is obtained of the earliest differentiation of the mesodermal skeletogenous strata.

"The Need of a Scientific Basis for South African Native Policy" formed the subject of Mr. J. D. Rheinallt Jones's presidential address to Section E. Students of native policy in the past have been largely guided by historical considerations leading to partisanship. New lines of research are needed. The primitive mentality of natives needs careful study to determine if qualitative differences between the European and Bantu mind may be present. Levy-Bruhl's hypothesis of total difference in orientation of the native mind from that of the European was discussed. There appears to be something incompatible between the foundations of primitive culture and those of modern civilisation, but this does not necessarily prove that the difference is absolute and not one of degree. The modes of alteration of primitive mind were discussed, as was animism and its effects. The necessity for anthropological and psychological research was stressed.

Dr. S. Evans discussed "The Politician and Political Economy" in his presidential address to Section

F. The present misfortunes of many countries are, he said, due to ignorance and contempt for elementary economic principles by responsible authorities during and since the War. Lack of experience in subject or administration is no disqualification for ministerial responsibilities. Rhetorical idealism still has more power over the mind than knowledge or reason, and rhetoricians become ministers with power to interfere with the conduct of industries and commerce, of which they know nothing. The primary producers always suffer most from ignorance of the principles of political economy by those in power, and by support of sheltered industries at their expense. Europeans are not coming for agriculture to South Africa, as conditions which repel the capitalist have been created, and over-taxation of the mining industry has checked them and curtailed the profitable operation of gold. The probable life of the Witwatersrand goldfield was discussed. Johannesburg is becoming more independent of the mines, but their decreased spending power will affect the whole of South Africa adversely, unless made good by expansion in some other direction. The necessity of a policy to foster private enterprise and to introduce foreign capital and European immigrants for development of industries was urged.

The next annual meeting of the Association will be held under the presidency of Prof. H. B. Fantham, professor of zoology in the University of the Witwatersrand, Johannesburg, Transvaal, at Salisbury, Southern Rhodesia, in July 1927.

[The above brief summaries of the presidential addresses to the sections were sent by Prof. H. B. Fantham, who included also the names of authors and the subjects of papers read before the various sections. We regret that limitations of space prevent us from printing this account of the sectional proceedings.—ED. NATURE.]

The Fisheries of Ceylon.

DETAILS of the marine biological research carried out by the Ceylon Government are contained in the reports for 1924 [1] and 1925.[2] In the first of these reports is an account by Commander J. C. Kerkham, the Marine Superintendent, of the Government research vessel *Nautilus*. This, a German-built steam trawler 132 feet in length, has been fitted out with laboratory accommodation and apparatus for carrying out scientific trawling, dredging, and hydrographic investigations. In addition she is equipped with a steam-driven, direct-expansion ammonia refrigerating plant with two insulated chambers for the storage of fish.

A biological survey, commenced in 1920 by the Government trawler *Lilla* and continued by the new trawler, has been fruitful in disclosing the possibilities of two fishing banks, the Wadge and the Pedro: some results of a survey of these banks are given by Dr. Pearson and his assistant biologist, Mr. Malpas, in the 1924 report, and more details are now given in a further paper.[3] The banks give a combined area of 3000 square miles, with an average depth of 25 to 50 fathoms. The advantage to be gained by the employment of two steam trawlers by the Government is shown, calculations being based on a conservative estimate of 1¼ tons and 1½ tons of fish caught per diem for the respective banks. Steam trawling should not seriously affect the fisheries of the native fishermen—not only because the grounds are too far afield for them, but also because they fish chiefly for drift-net and line-caught fish that are not captured in the trawl. In 1925 actual catches were carried to Colombo in the cold-storage chambers of the research steamer, and it was demonstrated that the fish arrived in good condition and that a ready sale was obtained for them. It is considered that if an assurance of a steady supply of fresh fish could be guaranteed to passenger shipping using Colombo as a port of call, the present spasmodic demand made by them would become regular; and it is believed that the prosperity of the trawling industry would depend on the measure of support given by the shipping. The employment of up-to-date fishing methods is therefore urged.

In somewhat less hopeful vein comes the report for the Pearl Fisheries of 1925,[4] in which is an interesting account by Dr. Pearson of the previous scientific investigations from the time of the late Sir William Herdman's survey in 1902 to the present day. Dr. Pearson critically reviews the situation and puts forth his own views on the matter. The pearl fisheries in the past have been essentially intermittent, only 39 fisheries having taken place in 125 years. It was such fluctuation that was responsible for the failure of the ill-fated Ceylon Company of Pearl Fishers that started operations in 1905, burdened amongst other things with the pledge to spend between £3000 and £10,000 annually on cultural and experimental research. It has been the aim of scientific inquiry to seek the causes of this irregularity and hence, if possible, a remedy, so as to ensure a productive regularity in the industry.

Chief among the suggestions put forward has been that of the employment of cultural methods such as those used in the oyster industry of Arcachon. Dr. Pearson takes the view that previous workers have been unduly optimistic in their hopes and considers that the site and conditions of the Ceylon pearl fisheries are such that cultural methods *in situ* are out of the question, and that the fisheries must mainly be controlled by natural agencies. In this he is probably right, seeing that the pearl oyster is essentially a deep-water shellfish compared with the Portuguese oyster at Arcachon, which lives in the tidal zone. The fact that the pearl-oyster grounds are extremely narrow may be of great significance in the irregularity of the supply, since the two maximal spawning periods occur when the south-west and north-east monsoons are respectively at their highest, and the pelagic larvæ may be carried far from suitable ground by currents. To control the fall of spat in the open sea is beyond human power. As James Steuart said in 1843: "It is only when, in the infinite wisdom of the Creator of all things, the oyster brood descends upon the banks suited to nourish and support it . . . that it comes within our power to watch its advancing age . . ."

However, given a successful spat fall a good fishery is not necessarily ensured; in late life the oyster beds are liable to decimation, as Dr. Pearson shows by figures for the crops in recent years. Two of the greatest dangers to the growing crop are perhaps the action of currents, which may uproot the oysters

[1] Ceylon Administration Reports for 1924. Part 4: Education, Science and Art (F).

[2] Administration Report of the Government Marine Biologist for 1925. By Dr. Joseph Pearson. Pp. F16. (Colombo: Government Record Office.) 35 cents.

[3] Sessional Paper 14, 1926. Prospects of Trawling in Ceylon. Pp. 12. (Colombo; Government Record Office.) 20 cents.

[4] Ceylon. Sessional Paper 15, 1926: Reports on the Pearl Fishery of 1925. By Dr. Joseph Pearson. Pp. 80+11 plates (Colombo: Government Record Office.) 2.25 rupees.

from the ground or carry sand which becomes deposited and silts up the beds, and the inroads of such shellfish-eating fish as rays, a species of which, incidentally, carries one stage of the parasite that infects the oyster and so gives rise to pearls.

This is not to say that research in the past has been valueless nor that it is no longer necessary. It is very evident that scientific investigations are of the utmost importance in watching the histories of the various beds and deciding the most economic periods at which to fish them. There would still seem to be room, too, for a more detailed study of the habits and conditions required for the successful development of the oyster in the laboratory on the lines of the work now being carried out by the Ministry of Fisheries in Britain in its oyster research station at Conway.

The fishery in 1925, which appears to have been unfortunate owing to the failure of many divers to arrive at the beginning and to unfavourable weather conditions, brought in a net profit of Rs.1,67,017.

Interesting data on the growth of the pearl oyster are given; information arising from a number of linear measurements and weight determinations tends to lower the previous estimates of the ages of different-sized oysters.

It is gratifying to note that the staff of marine biologists attached to the Ceylon Government is growing, and we hope for much information of interest on tropical marine life in the future. F. S. R.

University and Educational Intelligence.

CAMBRIDGE.—Prof. A. E. Taylor of the University of Edinburgh has been appointed Leslie Stephen lecturer for the year 1927. Mr. H. Claye, Gonville and Caius College, has been appointed an Assistant Registrary.

Application should be made before June 1 to the Senior Tutor, St. John's College, by any graduate of another university seeking admission as a research student who wishes to be a candidate for the Strathcona Research Studentship of £150 a year at St. John's College.

The entrance scholarships and exhibitions awarded at twelve colleges at the end of last term include 33 for mathematics and 33 for natural sciences out of a total of 169 awards; other awards were 54 for classics, 24 for history, and 21 for modern languages.

LONDON.—The following courses of free public lectures are announced: "Current Views on Internal Secretion," by Prof. Swale Vincent, at the Middlesex Hospital Medical School, on Jan. 14, 18, 21, and 25, at 4 o'clock; "Biological Action of Light," by Dr. D. T. Harris, at University College, on Jan. 20 and 27 and Feb. 3, at 5 o'clock; and "Cytology in relation to Physiological Processes," by Dr. R. J. Ludford, at University College, on Jan. 20 and 27, Feb. 3, 10, 17, and 24, at 5.30 o'clock.

Mr. E. Matthews has been appointed demonstrator in the Chemistry Department of Guy's Hospital Medical School.

STATISTICS of universities, colleges, and professional schools in the United States are published biennially by the Federal Bureau of Education. In the 913 institutions which figure in the returns for 1923–24, published in *Bulletin* No. 45, 1925, the total number of students enrolled in that year amounted to 726,124, including 268,423 women. Of the 913 institutions, 144 were under public control, and these enrolled 255,630 students, of whom 88,770 were women, whilst privately controlled institutions enrolled 470,494, of whom 179,653 were women. There were also enrolled 189,943 additional students in summer schools, 4012 in winter short courses, and 140,846 in extension and correspondence courses. Turning back to the similar bulletin issued two years ago, one finds that the number of institutions reporting was then only 780. The addition of 133 reports "is due in part to the efforts of field agents of the Bureau of Education, who secured many reports by personal visits." This detracts somewhat from the value of the statistics for purposes of comparison of one period with another, and points to the futility of the comparisons that are sometimes made between the student statistics of different countries.

THE Report for the year 1925 of the Calcutta School of Tropical Medicine, Institute of Hygiene, and the Carmichael Hospital for Tropical Diseases, contains, in addition to a review by the Director, Lieut.-Col. J. W. D. Megaw, of the work carried out at the School since its opening in November 1920, a list of articles (nearly a hundred) published by members of the staff during the year, separate reports of the specially endowed researches in relation to kala-azar, hookworm, bowel diseases, leprosy, and diabetes, reports by the Superintendent of the Pasteur Institute (which has been so fully employed in the treatment of patients that it was unable to undertake research) and by professors in charge of departments. The School is said to be the only institution in India adequately equipped for post-graduate teaching of tropical medicine and hygiene, and for training young medical research workers, and, as such, it serves the needs of the whole of the Indian Empire. The endowment fund amounted at the end of the year to more than eleven lakhs of rupees (nearly £90,000), and the receipts of the year included an anonymous donation of one lakh of rupees, in addition to handsome contributions by the commercial communities of eastern India and by Indian noblemen and merchants. The expenditure of the year amounted to Rs.1,19,904, of which Rs.1,02,834 was on account of salaries.

THE Departmental Committee on Education and Industry appointed by the Minister of Labour and the President of the Board of Education jointly, has issued an interim report dealing with the machinery available "for enabling young persons to enter into and retain suitable employment." The principal elements of this machinery are the juvenile employment committees of those local education authorities which have decided to exercise their powers under the Choice of Employment Act and the juvenile advisory committees appointed by the Ministry of Labour in areas where no such decision has been taken. Since 1921 the administration of unemployment insurance for boys and girls up to the age of 18 years has been linked with the choice of employment work, so that one and the same local authority must be responsible for both. One of the chief recommendations made in this report is that central responsibility for both should likewise be vested in one and the same authority, namely, the Ministry of Labour, instead of being shared, as at present, with the Board of Education. Other recommendations are: To consider the setting up of a National Advisory Council for Juvenile Employment, on which local education authorities should be strongly represented; to encourage the application of psychological tests; to cause a special inquiry to be undertaken regarding the transfer of juvenile labour from one area to another; to establish a scheme for juvenile unemployment centres on a permanent basis; and not to permit either recourse to compulsion to secure the attendance of unemployed juveniles of 14 years and 15 years at courses of instruction, or the payment of maintenance allowances to juveniles attending unemployment centres or other approved courses.

Calendar of Discovery and Invention.

January 9, 1729.—While holding the Savilian professorship of astronomy at Oxford, Bradley attempted to detect the annual parallax of the fixed stars. Hooke at Gresham College, and Molyneux at Kew, attacked the same problem, and Bradley collaborated with the latter. He then erected a zenith sector at Wanstead. The observed movement of the stars for a time baffled him, but after much thought he was able to explain what he saw by his important discovery of the aberration of light; a discovery which was communicated to the Royal Society on Jan. 9, 1729, in the form of a letter from Bradley to Halley.

January 10, 1849.—Some of the earliest experiments in submarine telegraphy were made by Wheatstone, Sömmering, Morse, and Colt, but it was the introduction of the use of guttapercha by Werner Siemens which made submarine cables practicable. On Jan. 10, 1849, C. V. Walker, of the South-Eastern Railway, laid two miles of cable in the Channel off Folkestone, and by this and a land line of 83 miles communicated from a ship with London. There are now more than 300,000 miles of submarine cables in use.

January 11, 1816.—It was the terrible explosion at Felling Colliery, near Sunderland, in May 1812, which led to the formation of a Society for Preventing Accidents in Coal Mines through which Davy's attention was attracted to the subject. His investigation of the properties of fire-damp and the passage of flame through tubes, and his invention of the wire-gauze safety lamp, were described to the Royal Society on January 11, 1816. Many improvements in miners' lamps have been introduced since, giving greater safety and more light. In 1924 it was recommended that lamps should have 0·8 candle-power, and in recent years electric lamps have been largely adopted.

January 12, 1727.—On this day two hundred years ago died Jacob Leupold, of Saxony, famous for his skill in constructing mathematical instruments and machines. His great work, "Theatrum Machinarum," was published in 1723-1727. The contemporary of Savery and Newcomen, Leupold was the first to suggest a high-pressure steam engine. His sketch shows an engine with two pistons working two force pumps through beams, the distribution of steam being controlled by a four-way cock.

January 13, 1800.—Founded through the instrumentality of Rumford, the Royal Institution was incorporated on Jan. 13, 1800. The name Institution was adopted in imitation of the Instituto of Bologna, while its purpose was "for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching, by courses of philosophical lectures and experiments, the application of science to the common purposes of life." Its early development as a research institution was due to Davy and Faraday.

January 15, 1876.—In the Science Museum, South Kensington, is preserved the apparatus with which Andrews, of Belfast, made his famous experiments on liquids and gases and discovered the existence of a critical temperature. His work was done in the 'sixties. Writing to him on January 15, 1876, Kelvin said: "We are all greatly delighted in my laboratory with what you have given us—my old assistant MacFarlane is in raptures to see carbonic acid compressed to the liquid state in that always ready way. It will be a splendid lesson to my students, and I think that henceforth they will every lesson know more of the meaning of liquids and gases and vapours than I have ever been able to teach them." E. C. S.

Societies and Academies.

LONDON.

Royal Microscopical Society, November 17.—M. T. **Denne**: A new apparatus for casting paraffin imbedding blocks. It consists of a jacketed chamber in the upper surface of which troughs are formed, fitted with frames or 'lifters,' and adapted to receive the wax. A second reservoir contains water heated to a definite temperature by gas or electricity, and this is so arranged that it may be raised to fill the jacketed chamber or lowered to empty it. In operation, the hot water is caused to enter the jacketed chamber, the troughs are filled with melted paraffin, and the objects arranged in the ordinary way or oriented under a Greenough binocular, the paraffin being maintained at the correct temperature meanwhile. When ready, the reservoir receives the hot water, and cold from a main supply is forced into the jacket causing very rapid cooling. A second momentary application of the hot water from the reservoir frees the blocks by superficial melting, and they are lifted out of the troughs.—C. **Tierney**: Caballero's technique for mounting diatom and other type slides. The method consists essentially in manipulating the specimens with a fine hair in a hermetically sealed chamber attached to the microscope. A petri dish with a raised platform in the centre, on which the specimens and prepared cover-glass are placed, is filled with mercury. From the nosepiece of the microscope is suspended a wire carrying the hair and a glass cylinder which, when the body-tube is lowered, enters the mercury, thus forming a sealed chamber free from all air currents, condensation, and dust particles.

PARIS.

Academy of Sciences, November 22.—Émile **Borel**: A theorem on systems of linear forms with skew symmetric determinant.—C. **Matignon** and Mlle. G. **Marchal**: The heat of oxidation of beryllium. Starting with the pure metal prepared by the method of Stock, Praetorius, and Priess, the heats of solution in hydrofluoric and hydrochloric acids were determined, from which the heat of formation of beryllium oxide is deduced as 140·3 calories. Based on this figure, the heats of formation of various beryllium compounds have been recalculated.—Georges **Claude** and Paul **Boucherot**: The utilisation of the thermal energy of the sea. At depths of 1000 metres the temperature of the sea water is between 4° C. and 5° C., and in the tropics that of the surface between 26° C. and 30° C. The possibility of utilising this temperature difference to work a low-pressure turbine is discussed, and some experiments described in which a low-pressure steam turbine was made to work between the temperatures 0° C. and 28° C.—Léon **Guillet**: The addition of nitrogen to steel. In an earlier paper the case hardening of certain steels by the action of ammonia at 500° C. is described: the present communication gives measurements of hardness (Brinell) of these steels under varying conditions.—**Tilho**: The Nile at the borders of Tibesti near the centre of the Libyan desert (explorations of Prince Kemal el Dine).—Paul **Montel**: The domain corresponding to the values of an analytical function.—Maurice **Janet**: The possibility of plunging a given Riemannian space of n dimensions into a Euclidian space of $\frac{1}{2}n(n+1)$ dimensions.—Léon **Pomey**: The integration of a system comprising an infinity of ordinary differential equations with an infinity of unknowns.—N. **Podtiaguine**: Regularity of growth [of functions].—A. **Toussaint** and E. **Carafoli**: The kinematographic spectra of the plane flow of fluids round varied obstacles.—A. **Véronnet**: The rotation of a heterogeneous mass.

Evolution and fractionnation. The case of Jupiter and Saturn.—P. **Helbronner**: The twenty-first and twenty-second campaigns of the detailed geometrical description of the French Alps.—Th. **Vautier**: The increase of intensity and the duration of extinction of sound.—Léon **Bouthillon**: Radiogoniometers and radiophares with accentuated maximum.—L. **Longchambon**: The rotary power of tartaric acid. Discussion of a recent note on the same subject by E. Vellinger. Details are given of the changes in the rotary power of tartaric acid produced by dilution down to a concentration 0·00625. A tube 10 metres long was used in these measurements.—J. **Galibourg** and F. **Ryziger**: Contribution to the study of the Röntgen spectrography of pearls. A discussion of a Röntgen spectrograph as a means of distinguishing natural from cultivated pearls.—P. **Mercier**: The particles of long path emitted by the active B + C deposit of actinium.—Neda **Marinesco**: Some properties of large molecules in solution.—Charles **Dufraisse** and Paul **Gailliot**: Pecularities of the fractures of acrolein gels: rhythmic production of ridges. Fractured surfaces of acrolein gels, examined under the microscope, show remarkable regularities, the surface being covered with parallel, equidistant straight lines resembling a ploughed field. These surfaces form a diffraction grating (about 120 lines to the millimetre) and give spectra both by transmission and by reflection. A spectrograph of mercury vapour obtained with such a grating is reproduced.—**Tiffeneau** and Mlle. J. **Levy**: The desamination of some phenyl-amino-alcohols, $C_6H_5.CH(OH).CH(NH_2)R$. Preparation of acylophenones without transposition.—Pierre **Jolibois**: The constitution of the organo-magnesium compounds. In an earlier communication (*C. R.*, 1912, p. 353) the author has given reasons for preferring the formula $Mg(C_2H_5)_2.MgI_2$ to the more generally admitted $Mg.C_2H_5.I$. Work for and against this view published since 1912 is summarised, and the work of Job and Dubien, which supports the formula $Mg.C_2H_5.I$, is adversely criticised.—V. **Ipatief** and N. **Orlof**: The hydrogenation of xanthone and xanthene.—Y. **Altchidjian**: The utilisation of liquid fuels containing a high proportion of organic sulphur compounds as a source of an antidetonating combustible. It is suggested that from the work of Midgley and Boyd, organic sulphur compounds might be expected to act as antidetonants in internal combustion motors: this conclusion has been confirmed by experiments with mixtures of petrol and heavy oils containing sulphur obtained by carbonisation of bituminous limestones.—N. **Menchikoff**: Primary strata to the south of Oued Drâa.—Const. A. **Kténas**: The chemico-mineralogical nature of the enclosure of Fouqué-Kaméni (Santorin).—Pierre **Allorge**: The benthos with desmids of the lakes in the west and centre of France.—Pierre **Dangeard**: The variation of the plates (carapace) in Peridinium.—J. **Magrou**: The anatomy of plant cancer or crowngall.—Raoul M. **May**: The reaction velocity of *Calliactis effoeta* in the presence of alkaloids and of gland extracts.—P. **Delauney**: The biochemical synthesis of a chlorinated glucoside, β - 5 chlorosalicyl glucoside.

Official Publications Received.

BRITISH AND COLONIAL.

The Manchester Museum. Museum Publication 92: The 'Behrens Collection of Sumerian Tablets in the Manchester Museum. By T. Fish. (Notes from the Manchester Museum, No. 30.) Pp. 6+12 plates. 1*s.* 6*d.* Museum Publication 93: Report of the Museum Committee for the Year 1925-26. Pp. 20. 6*d.* (Manchester: At the University Press; London: Longmans, Green and Co., Ltd.)

Third Annual Report of the Research Association of British Flour-Millers, 1925-1926 (July 1st to June 30th). Pp. 24. (St. Albans, Herts; London: 40 Trinity Square, E.C.3.)

Journal of the Indian Institute of Science. Vol. 9B, Part 3: Aerial Testing. By J. K. Catterson-Smith. Pp. 21-28+11 plates. 1.8 rupees. Vol. 9B, Part 4: Circulating Currents in Wave-wound Armatures. By F. N. Mowdawalla and G. K. Pradhan. Pp. 29-35+18 plates. 1.8 rupees. Vol. 9B, Part 5: Madras (Fort) Radio Field Intensity Measurements at Bangalore. By K. Sreenivasan. Pp. 37-60+12 plates. 3 rupees. (Bangalore.)

Union of South Africa: Department of Agriculture. Science Bulletin No. 50: Some Physical and Chemical Changes occurring during the Ripening of Grapes (Second paper). By P. R. v. d. R. Copeman and G. Frater. (Division of Chemistry Series No. 67.) Pp. 54. 9*d.* Science Bulletin No. 51: Factors Influencing Overrun. By D. J. Retief. Pp. 24. 3*d.* (Pretoria: Government Printing and Stationery Office.)

Aeronautical Research Committee: Reports and Memoranda. No. 1031 (M. 42): The Torsion of Circular and Elliptical Cylinders of Homogeneous Æolotropic Materials. By S. J. Wright. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 176.) Pp. 5. 4*d.* net. No. 1035 (M. 44): Report on the 'Burning' of Aluminium. By J. D. Grogan. Work performed at the National Physical Laboratory for the Engineering Research Board of the Department of Scientific and Industrial Research. (B.1.a. Metals, Strength and Properties, 53.—T. 2208.) Pp. 12+3 plates. 1*s.* net. (London: H.M. Stationery Office.)

South Australia. Annual Report of the Director of Mines and Government Geologist for 1925. Pp. 9. (Adelaide: R. E. E. Rogers.)

Canada. Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1925. (No. 669.) Pp. ii+84. Bituminous Sands of Northern Alberta: Occurrence and Economic Possibilities. Report on Investigations to the end of 1924. By S. C. Ells. (No. 632.) Pp. vii+244+43 plates. 75 cents. Bituminous Sands of Northern Alberta. Topographical Maps (to Accompany Report No. 632). 12 maps in Case. Sodium Sulphate of Western Canada: Occurrence, Uses and Technology. By L. Heber Cole. (No. 646.) Pp. vii+160+15 plates+22 maps. 40 cents. (Ottawa: F. A. Acland.)

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending June 30th, 1926. Edited by Prof. Alexander Meek. (Published by the Marine Laboratory Committee of Armstrong College.) Pp. 44+2 plates. (Cullercoats.) 5*s.*

British Photographic Research Association. Report for the Year 1925–26. Pp. 16. (London.)

The Journal of the Institution of Electrical Engineers. Vol. 65, No. 360, December. Pp. 96+xxviii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

FOREIGN.

Smithsonian Miscellaneous Collections. Vol. 73, No. 4: Opinions rendered by the International Commission on Zoological Nomenclature. Opinions 91 to 97. (Publication 2873.) Pp. 30. Vol. 78, No. 4: Solar Activity and Long-Period Weather Changes. By Henry Helm Clayton. (Publication 2875.) Pp. 62. Vol. 78, No. 5: The Distribution of Energy over the Sun's Disk. By C. G. Abbot. (Publication 2876.) Pp. 12+1 plate. (Washington, D.C.: Smithsonian Institution.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 330: Coastal Currents along the Pacific Coast of the United States. By H. A. Marmer. (Special Publication No. 121.) Pp. iv+80. (Washington, D.C.: Government Printing Office.) 15 cents.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 580-A: Geology of No. 3 Reservoir Site of the Carlsbad Irrigation Project, New Mexico, with Respect to Water-Tightness. By Oscar E. Meinzer, B. Coleman Renick and Kirk Bryan. (Contributions to the Hydrology of the United States, 1926.) Pp. iv+39+2 plates. Bulletin 782: Ore Deposits of the Jerome and Bradshaw Mountains Quadrangles, Arizona. By Waldemar Lindgren, with Statistical Notes by V. C. Heikes. Pp. ix+192+23 plates. 50 cents. Professional Paper 142-A: The Molluscan Fauna of the Alum Bluff Group of Florida. By Julia Gardner. Part 1: Prionodesmacea and Anomalodesmacea. Pp. iv+79+iii+15 plates. Professional Paper 142-B: The Molluscan Fauna of the Alum Bluff Group of Florida. By Julia Gardner. Part 2: Astartacea, Carditacea, Chamacea. Pp. iv+81-99+i+plates 16-17. 10 cents. Professional Paper 142-C: The Molluscan Fauna of the Alum Bluff Group of Florida. By Julia Gardner. Part 3: Lucinacea, Leptonacea, Cardiacea. Pp. iv+101-149+ii+plates 18-23. Professional Paper 142-D: The Molluscan Fauna of the Alum Bluff Group of Florida. By Julia Gardner. Part 4: Veneracea. Pp. iv+151-184+ii+plates 24-28. Professional Paper 147-A: A Comparison of the Genera *Metaplacenticeras* Spath and *Placenticeras* Meek. By John B. Reeside, Jr. (Shorter Contributions to General Geology, 1926.) Pp. ii+5+2 plates. Professional Paper 147-B: The Montana Earthquake of June 27, 1925. By J. T. Pardee. (Shorter Contributions to General Geology, 1926.) Pp. ii+7-23+plates 3-13. 20 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

Splices and Tapes for Rubber Insulated Wires. Pp. 16. (Passaic, N.J.: The Okonite Co.; London Agents: Wm. Geipel and Co.)

List No. 148: Cambridge Dissolved Oxygen Recorder for Boiler Feed Water. Pp. 4. (London: Cambridge Instrument Co., Ltd.)

Diary of Societies.

FRIDAY, JANUARY 7.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. G. Slater: Glacial Tectonics as reflected in Disturbed Drift Deposits: Studies in the Drift Deposits of the South-Western Part of Suffolk. Part 2 and 3.

SATURDAY, JANUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we Feel and Move: (6) Speed, Strength, and Endurance.

MONDAY, JANUARY 10.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Frances M. Ballantyne: Air-Bladder and Lungs: a Contribution to the Morphology of the Air-Bladder of Fish.—Dr. G. Slater: (*a*) The Structure of the Disturbed Deposits of Møens Klint, Denmark; (*b*) The Disturbed Glacial Deposits in the Neighbourhood of Lønstrup, near Hjørring, North Denmark.—E. I. White: The Fish-Fauna of the Cement-Stones of Foulden, Berwickshire.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—Discussion: L. Henshaw: The Earthing of Metal Objects other than Conductors.—S. W. Melsom: The Earthing of Electrical Circuits.

INSTITUTE OF METALS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.30.—Prof. W. M. Thornton: What is Electricity? (Faraday Lecture).

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Prof. J. H. Andrew: The Value of Research.

SURVEYORS' INSTITUTION, at 8.—F. G. Baxendale: The Effect on Values of Town Planning Schemes in their Various Stages.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Sir Arnold Wilson: A Periplus of the Persian Gulf.

INSTITUTION OF THE RUBBER INDUSTRY (London Section) (at Engineers' Club, Coventry Street).—G. Martin: Ageing of Raw and Vulcanised Rubber.

TUESDAY, JANUARY 11.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. L. Dudley Stamp: The Conditions Governing the Occurrence of Oil in Burma.

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. Douglas Hay: The Economics of Power-Production and Utilisation at Collieries.

ILLUMINATING ENGINEERING SOCIETY (at Lighting Service Bureau, 15 Savoy Street, W.C.2), at 6.30.—W. J. Jones, H. Lingard, and T. Catten: Floodlighting.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Sir Robert Hadfield: Progress in the Development and Practical Application of Heat-resisting and Non-corroding Steel.

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—J. R. Beard and T. G. N. Haldane: The Design of City Distribution Systems and the Problems of Standardisation.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—Dr. A. Ekstrom: The Applications of Electricity to Agriculture (Lecture).

INSTITUTE OF METALS (Birmingham Local Section) (at Engineers' Club, Birmingham), at 7.—H. S. Caswell: Forces set up in Strip Rolling.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—I. Joseph: The Empire Model 5 Projector.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Birmingham University), at 7.15.—C. E. Wood: A Study of the Rotatory Dispersion of Certain Derivatives of Hydroxyacids.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—W. R. D. Jones: Magnesium and its Alloys.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—U. R. Evans: Some Aspects of the Corrosion of Metals.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Middlesbrough), at 7.30.—W. G. Richards: Rivets and Riveting.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Dr. G. H. Rodman: Insectivorous Plants and How they Live.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—J. H. Franklin: Notes on Preparations of the British Pharmacopœia, 1914.

RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—R. J. Reynolds: Some Experiments on the Production of Rapid Serial Skiagrams from the Screen Image by means of a Cinematograph Camera.

INSTITUTE OF CHEMISTRY (Manchester and District Section) (at Manchester).—Prof. J. B. Cohen: Air Pollution.

WEDNESDAY, JANUARY 12.

ROYAL SOCIETY OF ARTS, at 3.—Prof. C. R. Darling: The Story of a Wireless Valve (Dr. Mann Juvenile Lectures) (2).

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—Dr. E. U. Williams and L. E. C. Norbury: Normal Variability of the Action of Pituitrin on the Contractile Power of the Cæcum and Colon.—L. E. C. Norbury and C. N. Morgan: The Value of Lipiodol in Determining the Extent of Fistulæ-in-ano.—R. Maingot: Gummatous Colitis.—Dr. C. Dukes: Laboratory Tests for the Diagnosis of Cancer of the Rectum and Colon.—W. B. Gabriel: (*a*) Volvulus of the Pelvic Colon and Blind Cæcostomy; (*b*) Skin Grafts for Fistulæ.

INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—F. H. Livens: Dragline Excavators.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section, jointly with Fuel Section) (at University College, Nottingham), at 7.—Dr. J. G. King: The Production of Liquid Fuels from Coal.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—J. E. Conner: The Erection of a Rotary Portland Cement Kiln.

THURSDAY, JANUARY 13.

ROYAL SOCIETY, at 4.30.—F. W. R. Brambell, A. S. Parkes, and Una Fielding: Changes in the Ovary of the Mouse, following Exposure to X-Rays. Parts I. and II.—A. S. Parkes: On the Occurrence of the Oestrous Cycle after X-Ray Sterilisation. Part II. Irradiation at and before Birth.—R. M. Sargent: Recovery from Vigorous Exercise of Short Duration.—F. A. Pickworth: Basal Metabolism as determined by the Respiratory Exchange.—M. Dixon: On the Mechanism of Oxidation-Reduction Potential.—R. G. Canti and M. Donaldson: The Effect of Radium on Mitosis *in vitro*.—Dr. R. J. Ludford and W. Cramer: Secretion and the Golgi Apparatus of Islets of Langerhans.—S. Dickinson: Experiments on the Physiology and Genetics of the Smut Fungi. Hyphal Fusion.—Y. Azuma: (*a*) Effects of C- and K-Ions and Ultra-violet Rays upon Involuntary Muscles; (*b*) Effects of Ultra-violet Rays upon Skeletal Muscles.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—P. Dienes: On Cartan's Torsion of a Tensor Space.—J. E. Littlewood: On the Class-number of the Corpus $P(\sqrt{-k})$.—L. J. Mordell: On Power Series with the Circle of Convergence as a Line of Essential Singularities.—N. Wiener: (i.) The Spectrum of an Arbitrary Function; (ii.) On a Theorem of Bochner and Hardy.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section, jointly with Institution of the Rubber Industry) (at 16 St. Mary's Parsonage, Manchester), at 7.—Dr. D. F. Twiss: Rubber Solvents.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch) (at Royal Technical College, Glasgow), at 7.30.—Prof. T. Gray: The Present Position of the Low Temperature Carbonisation of Coal.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—Dr. W. Rosenhain: Hardening.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 8 St. Martin's Place, W.C.2), at 8.—H. W. D. Ward: Cadmium Colours and their Application to the Paint Industry.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Dr. A. Turner and others: Discussion on Epilepsy.

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch).—F. C. Turner: A New Load-Strain Recorder.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).—Informal Discussion.

FRIDAY, JANUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Dr. J. K. Fotheringham: Some New Determinations of the Secular Accelerations of the Sun and Moon.—S. D. Tscherny: Occultations of Stars by the Moon, observed at the Astronomical Observatory, Kiew, in the Year 1926.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—Hon. Sir Charles A. Parsons and R. J. Walker: Progress in Economy of Turbine Machinery on Land and Sea.

INSTITUTE OF METALS (Swansea Local Section) (at University College, Swansea), at 7.15.—Discussion on Pyrometers.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. L. Kirlew: The Thermionic Valve and its Characteristics.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—P. Hopkinson: Gas Furnaces and their Heating.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—J. A. Hall: Thermo-Electric and Resistance Pyrometry in Industry.

PHILOLOGICAL SOCIETY (at University College), at 8.—Rev. A. Darby: Functional Grammar.

COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Manchester).—A. W. C. Harrison: Lake Dyestuffs and their Application.

SATURDAY, JANUARY 15.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—J. S. Carson: Dry Cleaning of Coal.

PUBLIC LECTURES.

SUNDAY, JANUARY 9.

GUILDHOUSE (Eccleston Square), at 3.30.—Dr. A. B. Cook: Animism.

THURSDAY, JANUARY 13.

KING'S COLLEGE, at 5.30.—Prof. J. S. Huxley: The Mind: Biology.

FRIDAY, JANUARY 14.

MIDDLESEX HOSPITAL MEDICAL SCHOOL, at 4.—Prof. Swale Vincent: Current Views on Internal Secretion. (Succeeding Lectures on January 18, 21, and 25.)

SUNDAY, JANUARY 16.

GUILDHOUSE (Eccleston Square), at 3.30.—G. A. de Zoyza: The Soul of Buddhism.

CONFERENCE.

JANUARY 10 AND 11.

SOCIETY FOR EXPERIMENTAL BIOLOGY (at Bedford College, Regent's Park).

(First Session) *Monday, January* 10, at 2.15 to 3.45.—G. C. Robson: Some Effects of Competition and Selection.—Prof. A. E. Boycott: Experiments on the Habitats of Planorbis and Bithinia.—R. E. Chapman: The Relation of Bicarbonates to the Photosynthesis of Water Plants.—At 3.45 to 4.30.—Demonstrations:—Prof. W. Neilson Jones: Fungal Cultures (Mycorrhizal) grown in Atmosphere (*a*) containing, and (*b*) free from, Gaseous N_2.—Dr. M. C. Rayner: Aseptic Conifer-Seedlings.—M. A. Tazelaar and Prof. J. S. Huxley: Effect of Temperature Gradients upon Early Development in the Chick.—J. Hammond: The Fate of Fœtal Tissues grafted into the Uterus of the Rabbit.—At 4.30 to 6.—W. K. Slater: Aerobic and Anaerobic Metabolism of the Common Cockroach.—J. Needham: Carbohydrate Metabolism of the Developing Egg.

(Second Session) *Tuesday, January* 11, at 10 A.M. to 1 P.M.—Prof. J. S. Huxley, M. Shaw, M. Perkins, and J. T. Cunningham: Symposium: The Relative Growth of Parts.—At 2.15 to 3.45.—Dr. C. M. Yonge: Intracellular Digestion in the Metazoa.—G. F. Marrian: On Hæmerythrin: the Respiration Pigment of Phascolosoma.—At 4.30 to 6.—G. P. Wells: The Actions of Cations on Invertebrate Muscle.—V. J. Clancey: Recent Advances in the Study of the Scleroproteins.