NATURE

SATURDAY, JANUARY 28, 1928.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON

No. 3039, Vol. 121]

Science Teaching in England.[1]

THE inclusion of the history of science in the curriculum of higher educational institutions, although very belated, is on many grounds warmly to be welcomed, and there appears to be no reason why its complement, the history of science teaching, should not also be given a place, particularly in the time-table of the future science teacher. At first sight it seems somewhat strange to speak of the history of science teaching, unless we use the word 'science' in a very wide sense; for the teaching of positive, experimental science is of such recent growth that it can scarcely claim to have a history; but what it lacks in age it makes up in importance, at least as a sidelight on the development of the scientific spirit. This is evidently the view of Miss Turner, who, in a volume recently published upon science teaching in England, has devoted only about one-half of her text to the history of teaching proper; her aim has been "to indicate in outline the growth of the scientific spirit in England, and the relationship of that growth to the development of a system of education into which the teaching of science gradually became incorporated." For this reason she transports us back in time to Thomas Aquinas, Roger Bacon, and Descartes, whose eminence as philosophical thinkers and writers was in no way matched by their achievements as scientific investigators, and who in the light of modern developments can scarcely be regarded as science teachers.

Apart from the writing of books and treatises, it may be said that systematic teaching of experimental science did not exist until the latter half of the nineteenth century. Teaching before that time was confined to a few private individuals, whose names have mostly been forgotten, and to such pioneering bodies as the Royal Society and the Royal Institution, the results of whose labours must at the time have been very small. The first educational movement that struck at the esoteric character of science was the founding of Mechanics' Institutes early in the nineteenth century, and this was supplemented later by the formation of local literary and scientific institutions for the express purpose of popularising literature and science.

In reading Miss Turner's interesting sketch of the dawn of science teaching in England, one cannot fail to be impressed by the extraordinary retarding power of tradition, especially in the ancient and pious foundations of Oxford and Cambridge and

[1] History of Science Teaching in England. By D. M. Turner. Pp. x+208. (London: Chapman and Hall, Ltd., 1927.) 7s. 6d. net.

in the great public schools. Although isolated attempts were made to teach experimental science in Oxford so early as the year 1704, it was not, we are told, until the second half of the nineteenth century that science secured a recognised place in the universities and a standard of academic teaching became established. Those early giants, Dalton, Young, Robert Brown, Darwin, Joule, Davy, and Faraday, received no training in experimental methods; and even the great mathematical physicists, Green, Stokes, Clerk Maxwell, and Kelvin, had no chance to do experimental work while they were at Cambridge. The backwardness of university science teaching in those days must not be charged to the investigators themselves, but to those in authority, whose policy seems to have been based upon the Platonic injunction of pursuing astronomy with the help of problems, like geometry, and of letting the heavenly bodies alone. On the whole, it must be confessed that Oxford and Cambridge played a very minor, if not an inglorious, part in the dissemination of natural knowledge; that task was left to the Mechanics' Institutes, local scientific societies, private individuals, and later on to the Royal College of Chemistry and the School of Mines. Under the lead of Huxley the last-named did really effective work in bringing science within reach of the masses.

The course of events in the schools was very similar to that in the ancient universities, the dead hand of tradition inhibiting any tendency to advance. The grammar schools and their derivatives, the nine great public schools, turned a deaf ear to the claims of science until well on in the nineteenth century, and it was only near its close that systematic instruction in science became at all general. Later developments are within the experience of most living teachers, but the recording of them was well worth while, if only as a guide for future workers. Some disappointment will, however, be felt that no attempt is made to use the past for illuminating the present by reference to the difficulties and disabilities of present-day science-teaching, and to indicate solvents for removing some of the blots that still disfigure the educational escutcheon. Miss Turner's story, illustrating as it does that inertia to the very idea of change is among the most characteristic qualities of the academic mind, nevertheless shows clearly that the thoughts of men do widen, and that therefore we should attempt to discern the lines along which future advance will proceed, so that we may try to facilitate its progress. Much excellent work is being done in our secondary schools; there is also some that is unworthy of the name either of science or of education; and there is a large intermediate class of teaching which is ineffective for one or more reasons; it may be too academic; it may be crippled and despiritualised by fear of the examination bogy; and what is still more important, the general organisation of the school may handicap or stultify the best efforts of the most gifted teachers.

Although lip-service may be done to science in the prospectus and at the annual prize-giving, the classical tradition still holds undisputed sway in too many of our schools, where the classical side is recruited mainly from the most promising pupils, whose success in after-life is claimed as convincing proof of the superiority of gerund-grinding and the study of grammatical forms. What hope is there of progress? History answers that we must look to the man rather than to the machine. In the past, reforms have been effected by men like Huxley, Clerk Maxwell, and Sanderson of Oundle, who combined high ability with outstanding fearlessness of character. It is to schools like Sanderson's Oundle, which do not fear to break with tradition and yet retain those character-forming elements that constitute the pride and justification of our great public schools, that we must look to supply the innovators and catalysers that our educational system still requires.

Primitive Marriage and Kinship.

(1) *The Mothers: a Study of the Origins of Sentiments and Institutions.* By Robert Briffault. In 3 volumes. Vol. 1. Pp. xix+781. Vol. 2. Pp. xx+789. Vol. 3. Pp. xv+841. (London: George Allen and Unwin, Ltd.; New York: The Macmillan Co., 1927.) Each vol. 25*s*. net.

(2) *The Mystic Rose: a Study of Primitive Marriage and of Primitive Thought in its Bearing on Marriage.* By Ernest Crawley. A new edition, revised and greatly enlarged by Theodore Besterman. In 2 volumes. Vol. 1. Pp. xx+375. Vol. 2. Pp. vii+340. (London: Methuen and Co., Ltd., 1927.) 30*s*. net.

STUDENTS of primitive mankind still indulge too frequently in bitter and futile controversy; their reputation on this score is deservedly bad, and anthropology, I fear, could well be described as the study of rude man by rude people. Among the various hotly discussed subjects, perhaps the most contentious is primitive sexual life and mating—the much disputed 'marriage of the missing link.'

The appearance of two remarkable books on this

subject, each standing for one side of the vast controversy, is a notable event, and affords a good opportunity for a statement of the problem as it now stands. One of the books, Crawley's "Mystic Rose," well brought up-to-date by Mr. Besterman, is exactly twenty-five years old, yet it is not only entirely fresh, but also in many respects it is bound to lead modern research for yet another quarter of a century. The other book, Mr. Briffault's "The Mothers"—in size and erudition an imposing achievement—leads us back to the early 'seventies, to the speculations of Bachofen, Morgan, and MacLennan. It is, in fact, an attempt to revive their now antiquated point of view that mother-right combined with sexual communism was the original form of organisation. Between them these two books represent a long span of anthropological history; the new contribution its past and the old one its future; while both mirror the present deadlock.

The anthropology of to-day can be divided into two camps on the issue of primitive marriage and kinship: those who believe in original monogamy and those who uphold the hypothesis of promiscuity. Was primitive man sexually promiscuous, or was he monogamous? Was he a thoroughgoing communist in wives and chattels, or a possessive individualist? Was he complaisant or jealous? Was it patriarchy or mother-right which shaped early institutions? Range Andrew Lang, Westermarck, Crawley, Lowie, and Kroeber on one side, and Frazer, Hartland, Rivers, Müller-Lyer on the other, and the latter will vote for communism, group-marriage, mother-right, and complaisance in the 'missing link' or primitive man, and the former for his monogamy, jealousy, and private possession.

(1) In my opinion, the problem has been distorted by this black-and-white, yea-or-nay treatment, and I regard it as the main defect in Mr. Briffault's book that he fights on the side of communism, as well as of mother-right, without compromise or reservation. The main thesis of the book is that mother-right was the source of social organisation, that male influence was entirely irrelevant in the dawn of culture, and that kinship, political organisation, the beginnings of law, economic life, magic, and religion were created and completely dominated by woman. To establish this, Mr. Briffault maintains that the maternal instinct is the sole origin of all tender emotions, hence also of all human organisation. Sexual love, on the other hand, leads to cruelty rather than to affection, and has been socially and culturally barren. "The mothers are the basis and the bond of the primitive social group. . . . The male takes no share in the rearing of the young. . . . Fatherhood does not exist."

It is difficult, perhaps, to reconcile this conception of the mother as a source of all affection and all social cohesion with the use which Mr. Briffault makes of her when he tries to explain the origins of exogamy by brutal expulsion of the males. In this context he describes her as: "a fierce enough wild animal . . . uncontrolled and violent . . . an object of horror . . . to the young male, terror-stricken by the anger of a despotic mother." The book is full of such provoking and fantastic exaggerations.

Mr. Briffault leaves no place whatever for the male in early culture. Such extremely important institutions as age grades, secret societies, initiation ceremonies and male political organisations are completely ignored in this work. Again, the rôle of the mother's brother in mother-right is scarcely accounted for; yet a male who intrudes into the very heart of maternal institutions is a formidable difficulty for the champion of an exclusively female culture. Avunculate, one of the most important features of matrilineal societies, is scarcely touched upon by the author—the word is not in the index.

The author then proceeds to prove that group marriage and sex communism exist, and in the course of this discussion commits himself to such extraordinary statements as that "among animals the maternal and derivative, parental, filial, and fraternal instincts operate in accordance with the 'classificatory,' and not with the 'descriptive' system of relationship. It would appear that it is the former that is in a biological sense 'natural,' and the latter which is 'artificial.'" The classificatory system in fact seems so 'natural' to Mr. Briffault that he does not discuss it at all, nor does he, in the whole three volumes, give any analysis of primitive kinship, a gap really astounding in a work dealing with mother-right—which is after all but one aspect of primitive kinship.

In the following chapters Mr. Briffault informs us that "girls and women who are not married are under no restrictions as to their sexual relations. . . . To that rule there does not exist any known exception." Since we know that, according to Mr. Briffault, married women also indulge in 'group-marriage' and other forms of 'licence,' continence and individual sexual relations seem to have been completely absent from primitive life. As a matter of fact, the statement quoted is a most

misleading generalisation, inaccurate in wording, unsupported by evidence, and based upon a fundamental misconception of human marriage and sexuality. After an account, given from his point of view, of primitive sex communism, group-marriage, sexual selection, and the various manners of concluding marriage, Mr. Briffault proceeds to attribute to woman the discovery of totemism, witchcraft and religion.

It would be easy to indict "The Mothers" for its dogmatic and one-sided affirmations; for the straining of evidence, sometimes to the breaking point; for unsatisfactory definitions—or absence thereof—in such capital concepts as marriage, communism, kinship, avunculate, and mother-right. Much space is wasted in futile controversy; above all in virulent attacks upon Prof. Westermarck, generally by first distorting his views and then destroying them. On the other hand, the contributions of Crawley and Sidney Hartland, and the new and important work of Schmidt and Koppers, are completely ignored. Briffault's three enormous volumes might almost be called an 'encyclopædia of matrimonial errors.' The work, however, will be useful to a student, even though he reject most of its conclusions; for it gives a clear, well-written, and certainly unreserved statement of one side of the main problem of anthropology. To the amateur it will prove attractive reading as an introduction; and will be the more useful for its dramatic, strong, and effective narrative, which rivets the attention more forcefully and leaves a sharper imprint upon the memory than a well-balanced, hence less colourful, account might do.

As a contribution to science the work has one or two real merits. It is the most exhaustive though one-sided account of the influence of maternity upon the cultural rôle of woman. In the discussion of that subject the author clearly sees and, to the best of his ability, discusses the relation of innate endowment to social institutions in the shaping of human nature; and, in my opinion, anthropology will in the future have to be more concerned with the place of culture within biological development and with the relation of instinct to institution, than with questions of 'origin,' 'evolution,' 'history,' or 'diffusion.'

(2) The biological foundations of culture, which Mr. Briffault attempts to consider in his new work, have already been fully discussed in the "Mystic Rose," where the psychology of human relations is explained by what Crawley has termed *physiological thought*. The book sets out to discuss the many strange customs and institutions which centre round sexual life—the couvade, sexual taboos, various avoidances, and ceremonies of marriage.

Crawley resolutely rejects all explanations in terms of survival from such original conditions of mankind as 'sexual communism,' 'mother-right,' and the total eclipse of the male sex. He regards these as imaginary fantasies constructed against all evidence. He also maintains that the "indiscriminate and careless use of the terms *survival* and *rudiments*" is one of the main sources of anthropological error. On both points anthropology will, in my opinion, have to follow his lead and become inspired by his methods.

The explanation of savage custom and institutions must be given in terms of primitive thought. When Crawley, in his brilliant analysis of savage mentality, declares that "primitive thinking does not distinguish between the natural and the supernatural, between subjective and objective reality," his wording is not quite satisfactory; yet even in this slight misrepresentation of what he terms "primitive logic," Crawley, in forestalling the theories of Lévy-Bruhl, Danzel, Vierkandt, and their followers, must be regarded as the pioneer of modern developments of the problem of primitive psychology. He himself, however, has eschewed the extravagances of some of his successors. He does not commit the fallacy of assuming that the savage has a mind different from that of civilised man. ". . . Human nature remains fundamentally primitive. . . . Primitive ideas . . . spring eternally from permanent functional causes. . . . Ordinary universal human ideas, chiefly connected with functional needs, produce the same results in all ages; and many so-called survivals, which have on the face of them too much vitality to be mere fossil remains, at once receive a scientific explanation which is more than antiquarian." These statements strike the keynote of the soundest developments in modern anthropology. In laying down this point of view, and in carrying it through consistently, Crawley has laid the foundations for the scientific treatment of primitive sexual and social relations.

The main form which "physiological thought" takes in the primitive mind, that is, in the human mind as we find it universally, is a strong apprehension of danger arising from contact with other human beings, especially when there is an element of the abnormal or unusual in the relation. Strangers, people in critical condition—such as sickness, death, or functional crisis—and, above all, people of the other sex, are surrounded with an

aura of supernatural fear. In savage culture such dangers are met by two devices: the taboo, and the ritual breaking of it.

Taboo is considered by Crawley as an inevitable by-product of human psychology; and, in a masterly survey of primitive social relations, we are shown how the various imperatives and prohibitions arise naturally out of savage life and savage outlook. Crawley constructs no hypotheses, invokes no *deus ex machina*—he explains quaint features and unrelated details in terms of intelligible and fundamental fact; he introduces order, he links up apparently disconnected phenomena and transforms the strange and unknown welter of "primitive superstition" into a familiar and comprehensible scheme of essentially human behaviour.

The taboo between men and women in its various aspects is treated against the background of mixed attraction and fear, of distrust undermining love—an attitude which is shown to dominate the relations between the two sexes. In this Crawley has anticipated the various theories of primitive society based on the principle of sex antagonism, theories set forth by Heape and several other writers long after the first edition of the "Mystic Rose" was published. In Crawley's work we also become acquainted for the first time with that emotional complexity underlying all social relations, especially as between men and women, which has been systematically worked out by A. F. Shand in his theory of sentiment ("The Foundations of Character"). Under the title of 'ambivalence' we have had similar phenomena dished up in a somewhat distorted shape in psycho-analytic literature. Crawley, in fact, can be described as the sane and sober forerunner of psycho-analysis, which, when the "Mystic Rose" was written, was unknown beyond a narrow circle of Viennese practitioners. It must also be remembered that psycho-analysis did not turn its attention to problems of primitive culture until a decade after the present book was first published. The "Mystic Rose," in the due emphasis which it places on sex, in its clear and courageous, but never fantastic or overheated, interest in that impulse, can be placed side by side with Havelock Ellis's "Psychology of Sex" as a pioneer in modern, scientific treatment of human love and mating.

In his theory of ritual and sacrament as mechanisms of breaking the taboo; in his theory of union; in his description of change and exchange; and in his analysis of the ritual in vital crises, Crawley has been a forerunner of several now developed branches of anthropology. To him can be attributed the first statement of the theory of *rites de passage*, afterwards so successfully developed by Schurtz, van Gennep, and Hutton Webster. He was the first to regard the sacrilisation of crises of life as the main function of religion—a theory to which he returned in his later work ("The Tree of Life"). His doctrines of change and exchange, of reciprocity and the principle of contact, are akin to the views of the French sociological school, especially of Durkheim, Hubert, Mauss, and Davy.

Finally, in the last part, a penetrating and original analysis is given of primitive kinship and relationship: that pivot problem and eternal puzzle of the anthropologist. In my opinion it ranks side by side with the first few chapters of Westermarck's "History of Human Marriage" as the best treatment of kinship yet given. Had such writers as the late Dr. Rivers, Mr. Briffault, and other latter-day Morganians read, digested, and assimilated the last three chapters of the "Mystic Rose," we would have had better field-work and fewer speculations about 'anomalous marriages,' 'group-motherhood,' and 'savage communism.' Even on this last point, Crawley, though not especially interested in economics, had a sound and a realistic view. All anthropological evidence, he maintains, tends "to disprove the common idea that early society had a communistic and socialistic character. The 'rights' of the individual in property, marriage, and everything else were never more clearly defined than by primitive man." Recently we have been told by a great authority that the Melanesians are 'communistic.' That such a view is based on superficial observation, and that Crawley is right here, as almost everywhere else, I have attempted to prove ("Crime and Custom in Savage Society").

The foundations of Crawley's work are so sound, so firmly established in the bedrock of human nature rightly understood, and of human culture correctly interpreted, that anthropologists will have to build on them for generations to come. To show this, one aspect of his views might be further developed in this place. Crawley has taken the primitive conception of the danger in sexual selection as the fundamental and irreducible datum. He speaks of "that difference of sex and of sexual characters which renders mutual sympathy and understanding more or less difficult"; and he adds: "woman is one of the last things to be understood by man." Again: ". . . woman is different from man, and this difference has had the same religious results as have attended other

things which man does not understand." He also speaks of "the instinctive separation of the sexes hardening into tradition and finally made the subject of taboo."

Now I think that here it is possible for modern anthropology to go a step further and to interpret the psychological attitude of primitive man by its cultural function. I maintain that sex is regarded as dangerous by the savage, that it is tabooed and ritualised, surrounded by moral and legal norms—not because of any superstition of primitive man, or emotional view of or instinct about strangeness, but for the simple reason that *sex really is dangerous*.

The sexual impulse has to be experimental if it is to be selective; and it has to be selective if it is to lead to the mating of best with best. This is the eugenic principle which I believe governs human marriage as well as animal mating. Hence sexual jealousy and competition is to be found in human societies, and it harbours serious disruptive forces for any social group living in close contact. In animal societies, rut not only allows the law of battle and sexual selection to operate in especially favourable circumstances, but it also circumscribes the duration of the disruptive impulse and thus eliminates most of its dangers. In man rut is absent, and sex holds him in permanent readiness and tension. Cultural regulations, the various taboos and barriers step in and fetter him, where natural endowment has left him freer than the beast. They safeguard the family by the prohibition of incest, the clan by rules of exogamy, and the bonds of marriage by the ban on adultery and what might be called the principle of legitimacy. This argument cannot be fully developed or substantiated by evidence in this place; nor is it necessary for me to do so, since my views are developed at some length elsewhere ("Sex and Repression in Savage Society").

In human culture, however, no physical force is sufficient without moral support; no social regulations, however strongly backed by executive power, can be effective without mental assent. The social and cultural rules which separate primitive man and woman in daily existence, at initiation, during the crises of life, in economic occupations, and within certain social groups, cannot stand without the support of some system of thought and belief. Here, indeed, we find all those ideas which express the danger of sex—the ideas of evil and sin—at the very core of love and passion; the conviction that highest happiness in erotic union can only be obtained at the cost of infinite pains and precautions; belief, in short, that sex is religiously sacred, *sacer*, that is, at the same time holy and polluting. The universally human conception of sex must be explained, I think, by its function within culture rather than by mere reference to primitive psychology and the early conditions of life. The sexual taboo, then, and the ideas upon which it rests, appear to us indispensable corollaries of culture and of the influence of this on the increased plasticity of instinct which, since in man it has become more free, more experimental, and therefore more dangerous than in the animal, needs elaborate regulation. The barriers imposed upon sex by culture—that is, the taboos and the correlated primitive conception of sex dangers—appear to us as an inevitable by-product of the change wrought in human endowment by the passage from the state of Nature to that of culture.

I hasten to add that this functional view is implied at many points in Crawley's argument, though it is nowhere clearly formulated by him. It is really implicit in his own concept of the primitive *Weltanschauung*, in which beliefs and ideas do not exist as useless 'idle survivals,' not as 'speculations of rude philosophers,' or even as 'mistaken associations of ideas.' Crawley treats these simple and often quaint 'savage superstitions' as what they really are: life forces, indispensable moral values which shape the destinies of mankind with a determinism as binding though not as rigid as that which obtains in the physical world. Thus Crawley has given us in the "Mystic Rose," what is, perhaps, the first truly scientific work of comparative anthropology, and he must be regarded as one of the founders of what is now known as the functional method of modern anthropology.

B. MALINOWSKI.

Electrical Research and Development.

The Interaction of Pure Scientific Research and Electrical Engineering Practice: a Course of Advanced Lectures delivered before the University of London, October and November 1926. By Dr. J. A. Fleming. Pp. x + 235. (London: Constable and Co., Ltd., 1927.) 15*s*. net.

THIS book by Dr. Fleming is a delightful record of the research, discovery, and development which has lain behind the infusion of electricity into the life of civilised lands over the last fifty years. It is written with the intimate knowledge and enthusiasm of one who has himself been a worker and a keen contemporary observer through-

out the period, and whose name will always be associated with some of its pioneer achievements. But perhaps of even more importance, Dr. Fleming has been unrivalled in the way in which he has interpreted the results of research to electrical engineers, applying always the latest discovery to the practical everyday technical problems, and expressing results in engineering units and magnitudes. He always sees the romance in every new theory or discovery, and seeks to make others see it too.

The book under review is characteristic. To those who know Dr. Fleming, more cannot be said. The reader is taken rapidly from one subject to another. Insulation, magnetism, thermionics, telephony, arcs, sparks, and glow discharges, radio, surges and pressure rises, electro-chemistry, and many other matters, are passed in review. The main historical features of each are traced, but the author hastens always to the latest development of each subject and leaves with the reader a vignette picture of the art as we know it to-day.

Dealing as he does with so many phases of electrical engineering, Dr. Fleming is careful not to assume on the part of the reader expert knowledge in any. His object is clearly to interest each branch of the profession in the advances of the others, and to show how almost every development has been the result of scientific research ; research, not always with a deliberate objective in view, but always with a keen look-out for the unexpected and the anomalous.

Such a book would be easy to criticise. Where names and origins are mentioned freely, where there are a few pages only for handling each large subject, there must be important omissions and often lack of balance. The part in advances played by Great Britain is certainly not minimised. Electrical machinery and plant is scarcely touched upon, although its evolution has resulted from the same research and investigatory activity as in other branches. Nor is there in the book any effort to analyse the mass of examples with the view of drawing conclusions as to how research can best be encouraged or directed. One can quite believe that the attempt would be baffling. The spirit of research bloweth where it listeth ; and it is the man of imagination and observation who produces results. Such have been found in all walks of life—in the factory as well as in the university—and it would be very difficult to deduce, from the evidence before us, rules for securing results. The few generalisations which Dr. Fleming allows himself are to be found in the concluding pages and are worth special note, for they are the mature conclusions of one who has worked long and hard and has a right to judge. Perhaps we may quote a few sentences :

" Many of the problems which invite inquiry lie on the borderland of two or three sciences. These are best dealt with by carefully organised team work in which specially trained workers in the respective sciences have a share and co-operate and, in any case, call for a scientific education not framed on too specialist lines." And again : " Genius cannot be produced at will. . . . Let us see to it, then, that whenever found, it shall be given adequate opportunity for labours which, even if they seem entirely destitute of practical value at the moment, will certainly yield the fruit at some future time in divers and very unexpected ways."

This book should please all who peruse it. If a reader should feel that he already knows well any part in which he is expert, there will be much with which he is less familiar that will fascinate and instruct.

Our Bookshelf.

New Year's Day : the Story of the Calendar. By S. H. Hooke. (The Beginning of Things Series.) Pp. vi + 89. (London : Gerald Howe, Ltd., 1927.) 2*s.* 6*d.* net.

The Golden Age : the Story of Human Nature. By H. J. Massingham. (The Beginning of Things Series.) Pp. vii + 88. (London : Gerald Howe, Ltd., 1927.) 2*s.* 6*d.* net.

Corn from Egypt : the Beginning of Agriculture. By Dr. Maurice Gompertz. (The Beginning of Things Series.) Pp. vii + 88. (London : Gerald Howe, Ltd., 1927.) 2*s.* 6*d.* net.

THESE three little books form part of an interesting series of popularisation dealing with the early history of civilisation. Mr. Hooke in " New Year's Day " traces the history of the calendar and describes the principal calendrical systems which are or have been in use at different periods and in different parts of the world. Mr. Massingham's " Golden Age " is a book of a more philosophical type. It is a statement of the position in regard to primitive culture with which Mr. Perry has made us familiar, namely, that early man was a pacifist who has degenerated under the influence of advancing civilisation. It seeks to demonstrate that the views of classical writers on the Golden and succeeding ages were substantially correct. Mr. Massingham justifies his theory in the case of palæolithic man by an appeal to the ' faultless artistry ' of the drawings in the French and Spanish caves—a psychological argument which the history of art would perhaps not bear out.

In " Corn from Egypt," Dr. Gompertz describes the development of agriculture. His attractively written and well-reasoned sketch is an exposition of the view that agriculture originated in Egypt.

While the evidence is still too uncertain to admit of any conclusion approaching finality, there are certain considerations in favour of a Mesopotamian origin to which Dr. Gompertz might have given fuller weight, and certain facts which he should have taken into account, such as the wheat discovered by the Weld-Blundell Expedition at Kish. Further, although Mesopotamian dating is not final, agricultural implements from Abu Shahrein may turn out to be as early as any from predynastic Egypt, while the undoubted occurrence of wild wheat and barley in Syria has to be weighed against the inferential attribution of the latter to Abyssinia. The evidence is given in summary in Mr. Harold Peake's presidential address last year to the Royal Anthropological Institute. The argument from the Isis-Osiris cult is no more in favour of an indigenous Egyptian origin than the Ea legend, which the author rejects as in favour of Mesopotamia. Osiris was not Egyptian in origin, but came from the north, while the Isis legend is connected with Byblos.

Memoirs of the Geological Survey of England and Wales. The Geology of the Southern Part of the South Staffordshire Coalfield (South of the Bentley Faults). By Talbot H. Whitehead and T. Eastwood. With contributions by Dr. T. Robertson. Pp. xi + 218 + 13 plates. (London: His Majesty's Stationery Office; Southampton: Ordnance Survey Office, 1927.) 6*s.* 6*d.* net.

WHEN Jukes wrote his classic memoir on the South Staffordshire Coalfield, the Thick Coal was being actively mined. To-day it is almost completely worked out, except in the concealed fields beyond the boundary faults, and the surface geology of much of the coalfield is that of tip-heaps and slag-mounds; nevertheless, the authors of the present memoir, under the scrupulous editorial guidance of Mr. T. C. Cantrill, have compiled a concise, yet detailed, account of the Productive Coal Measures, showing their variations, structures, and probable limits on the south and west. The marshalling of the scattered and often obscure data relating to these measures is very skilfully done. Numerous plates of vertical sections supplement the descriptions.

In view of the importance of a proper understanding of the cover overlying the Productive Series, now that any new coal-ventures must needs take place below them, there is a full treatment of the Upper Coal Measures, in which the authors include not only the Etruria, Halesowen, and Keele Groups, but also provisionally the Enville Beds and even the Clent and Warley Breccias. The Hopwas Breccia is, however, regarded as more closely related to the Trias. These conclusions are reached after a critical review of the data and of the interpretations advanced by other observers.

The re-survey has shown that contemporary movement directly related to pre-existing structural axes was going on during the deposition of the Productive, Etruria, and Halesowen Groups, so that the thicknesses vary considerably from place to place. The detailed mapping appears to have disproved Kay's contention that there is an unconformity below the Etruria Marls; and, on the other hand, it seems to have demonstrated that the Halesowen Group is locally unconformable.

The structure of the sub-Carboniferous floor and of the coalfield itself is fully discussed, and the repetition of movement along some of the structural lines is emphasised. A chapter is devoted to the underground extensions of the coalfield and another to the associated igneous rocks.

An innovation in the index may be noted with approval. The names of authors quoted in the text are printed in capitals, and in this way a separate bibliography is avoided. The whole book is a very careful piece of work that fully maintains the standard set by Jukes. L. J. W.

(1) *Vorlesungen über theoretische Mikrobiologie.* Von Prof. Dr. August Rippel. Pp. viii + 171. (Berlin: Julius Springer, 1927.) 6·90 gold marks.

(2) *The Principles of Practical Bacteriology: for Scientific Workers.* By J. H. Johnston and Dr. R. H. Simpson. Pp. viii + 110. (London: J. and A. Churchill, 1927.) 5*s.*

(3) *An Introduction to Laboratory Technique in Bacteriology.* By Prof. Max Levine. Pp. xii + 149. (New York: The Macmillan Co., 1927.) 5*s.* 6*d.* net.

(1) THIS excellent little book by the professor of agricultural bacteriology at the University of Göttingen is designed chiefly for the use of non-medical students requiring instruction in general bacteriology and particularly in the chemistry of bacterial growth. Of the thirty-four brief lecture-chapters in the book, more than a dozen are devoted to the study of bacterial enzymes and bacterial metabolism generally. Considerable knowledge of organic chemistry is essential for the full appreciation by the student of this portion of the work. The volume closes with a brief sketch of immunity problems and an etymological glossary of biological terms.

(2) It is often desirable that technical workers in fields not primarily bacteriological should have some elementary knowledge of the general characters of bacteria and the principles governing their investigation. It is to meet this demand that Messrs. Johnston and Simpson's small volume has been written. The basic principles of the subject are dealt with in a very simple way, and no attempt is made to give instruction in technique or to acquaint the reader with the different members of the bacterial species.

(3) Prof. Levine's book is based upon a laboratory course in elementary bacteriology at the Iowa State College, U.S.A. It is arranged in the form of a series of exercises covering the commoner phases of the subject. A list of materials required for each exercise is given, together with instructions, and a number of questions at the end designed to test the student's knowledge of what he has just performed. The scope of the book is limited to elementary general bacteriology, and does not extend to special branches of the subject.

Penrose's Annual: the Process Year Book and Review of the Graphic Arts. Edited by Wm. Gamble. Vol. 30. Pp. xvi + 160 + 68 + 59 plates. (London: Percy Lund, Humphries and Co., Ltd., 1928.) 8*s.* net.

THE business of Penrose and Co., with which this *Annual* has been associated from its commencement, has been acquired by the firm of Hunters, Ltd., and will henceforth be known as Hunter-Penrose, Ltd. Mr. Wm. Gamble retires from the business, but will continue to edit the *Annual*, so doubtless its character will be fully maintained. The present volume is on the same lines as those that have preceded it.

The editor in his introductory remarks pleads for a more kindly attitude toward the inventor, for a greater receptiveness of new ideas, and for a bolder enterprise. He finds little that is new to record, but a general if slow progress along the lines that have been indicated in previous years. Perhaps the most striking item is the use of chromium plating for printing surfaces. Chromium is harder than steel, indeed a hardened steel graver will not cut its surface, and it can scarcely be scratched by any form of mechanical abrasion. After 240,000 impressions had been taken, there was no visible deterioration in the prints or in the plate. Another plate was still in use after a run of five million printings.

Mr. Chas. T. Jacobi gives the seventh of his series of descriptions of private presses—The Golden Cockerel Press, which was projected in 1920, and issued its first volume in the following year. Specimens are given. Mr. Paulson Townsend contributes a well-illustrated article on the history of woodcuts and wood engraving. Mr. S. H. Horgan deals with the beginnings of half-tone, and gives a reproduction in facsimile of the first published example in the *New York Daily Graphic* of Mar. 4, 1880. There are many other articles, and a large number of illustrations that show the high standard of present-day process work.

The Principles of Pathology. By Dr. Charles Powell White. (Publications of the University of Manchester: Medical Series, No. 17.) Pp. x + 279. (Manchester: At the University Press; London: Longmans, Green and Co., Ltd., 1927.) 15*s.* net.

PATHOLOGY is a subject to which considerably more attention is paid in the medical curriculum than was the case fifteen years ago. The student, however, still tends to regard it as static rather than dynamic, and this error is not sufficiently corrected in books and in the post-mortem room. Dr. Powel White's "Principles of Pathology" is not a text-book devoted to the description of macroscopic and microscopic appearances; the subject is approached from the biological aspect, and causes and processes are considered rather than nature and appearances. A comparatively small volume, it must be somewhat dogmatic in style, and though this is no disadvantage to the student, it renders the author's views more open to criticism. The term 'diathesis,' which is now rarely used in clinical medicine, is employed to group a number of conditions ranging from hæmophilia to neurasthenia and the tendency to bed-sore formation in paralysed patients. Psycho-pathology is so unsettled that the application of this term to abnormal mental states simply obscures them further; and it seems scarcely advisable to include bed-sore formation, which is as readily explicable as is the severance of the skin by a knife.

Dr. Powell White, however, does not dogmatise in the attitude of a final authority. He writes rather to attract attention and to stimulate thought, and in this his book should be successful. It will certainly assist the student to regard pathology, not as the product of laboratory and microscope, but as a biological science.

The Infancy of Medicine: an Enquiry into the Influence of Folk-Lore upon the Evolution of Scientific Medicine. By Dr. Dan M'Kenzie. Pp. xiv + 421. (London: Macmillan and Co., Ltd., 1927.) 15*s.* net.

THIS work, which emanates from a prominent London otologist with whom the study of folk-lore plays the part of the violin of Ingres, constitutes an attempt to show in what manner and to what extent primitive thought has influenced the evolution of the science and art of medicine. The work, as we learn from the preface, is intended not only for the small section of the medical public interested in medical history, but also for all practitioners of medicine, in that it seeks to explain the more obscure workings of the partially educated lay mind in civilised communities as well as in the savage and semi-civilised races of the world.

The book is divided into two parts. The first consists of three chapters, devoted respectively to the evolution of the medical man, primitive pathology, and primitive treatment; while the second part, which forms the bulk of the work, contains fourteen chapters dealing with the evolution of animal and botanical remedies, astrology in medicine, the evolution of balneology, primitive surgery, and midwifery, various superstitions and practices connected with menstruation, impregnation, and pregnancy, circumcision and other mutilations. An extensive bibliography for each chapter is appended. The work, which shows a characteristic blend of scholarship and humour, will appeal alike to the medical man and the anthropologist.

General Chemistry: Theoretical and Descriptive. By Prof. Thomas P. M'Cutcheon and Prof. Harry Seltz. Pp. x + 415. (London: Chapman and Hall, Ltd., 1927.) 16*s.* net.

"THIS book has been designed for use in a course of General Chemistry based on a series of illustrated lectures and quiz hours, and for a text of reference for the student performing the laboratory work, which usually accompanies such a course." It has probably been of value for this purpose, but it cannot be commended for independent reading, and it is unlikely that it will find any extensive field of usefulness where 'quiz hours' are not the normal method of 'cramming.'

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 Hydrogen Molecule.

RECENT experimental and theoretical work by Richardson, Witmer, Dieke and Hopfield, Hori, Burrau, Condon, Dennison, Sugiura, and others, makes possible a reasonably certain determination of the more important constants of the hydrogen molecule and molecule ion. In order to compare the results of different investigators, it is essential that these be calculated consistently according to some adopted interpretation, and with definite values of the basic constants. I should like especially to emphasise the necessity of distinguishing results in terms of the new wave mechanics from those in terms of the older quantum mechanics. Failure to make such a distinction has already led to a number of errors in the published literature.

In a paper which will appear shortly in the *Proc. Nat. Acad. Sci.*, I have given the more important details concerning such a recalculation and intercomparison of the available data for hydrogen. The purpose of the present communication is to examine critically the results and to consider certain additional facts and conclusions. *All* data and constants are given here in terms of the *old* mechanics. Transformation equations for the two systems are given in the paper just mentioned.

Richardson (*Proc. Roy. Soc.*, A, **115**, 528; 1927) has definitely identified the final (lower) state of his '*A*' and '*B*' bands with the initial '*B*' state of the *A*-*B* ultra-violet bands of Dieke and Hopfield. With an assumed Rydberg formula for the upper levels of these two systems, one obtains 15·34 volts for the ionisation potential of the neutral molecule. This should be accurate to about 0·01 volt. Richardson believes that this value cannot be reconciled with the electrical determination of about 16 volts, but Condon has shown that such an apparent discrepancy is to be expected, and the chief object of the present work is to show that this lower value is entirely satisfactory.

If I_M and I'_M represent the ionisation potentials of the neutral and ionised hydrogen molecule respectively, D the normal heat of dissociation, and I the ionisation potential of the atom, then $I_M + I'_M = D + 2I_A$. Of these four quantities only I_A (= 13·54 volts) is accurately known. For the other three quantities we have the following data. The best value of D is $4{\cdot}34 \pm 0{\cdot}1$ volts from Witmer's extrapolation of the vibrational levels of the normal state. (Dieke and Hopfield's determination of 4·38 volts is based on a probable misinterpretation of the spectrograms, according to later unpublished work by Hopfield.) The best value of I'_M is $16{\cdot}16 \pm 0{\cdot}03$ volts, as calculated by Burrau (*Danske V. S. Math.-fys.*, **7**, No. 14; 1927). His result of 1·402 R (= 16·30 volts) is in terms of the *new* mechanics. Dr. E. U. Condon has directed my attention to the fact that, due to an error in one of Burrau's formulæ, the correcting factor (s^+) should be 0·14 volt, and not 0·07 volt as calculated by Burrau.

With $I_M = 15{\cdot}34$ volts, there is just 0·08 volt discrepancy between the three suggested values. I believe it most probable that I_M and I'_M are correct, as given, and that $D = 4{\cdot}42$ volts. The value of $I_M = 15{\cdot}34$ volts can be checked also by means of the heats of dissociation in the various excited states of the molecule. In the case of every level for which data are available, the agreement, as shown in my longer paper, is remarkably good.

The recent work of Hori gives $0{\cdot}48 \times 10^{-40}$ as a very trustworthy value of I_0, the moment of inertia of H_2 in the normal state, and this checks with Dennison's value from the specific heat curve. For the '*B*' level only B_3 is reliably known, but with a reasonable assumption as to the value of a ($B_n = B_0 - an$), I obtain B_0 and finally $I_0 = 1{\cdot}99 \times 10^{-40}$. This is just twice the value given by Richardson, but is the value to be expected in view of the very small magnitude of ω_0 for this level. The process by which Richardson calculates I_0 from known vibrational data, plus the value of a, but *without* knowing B_0, is most interesting. It is based on Kratzer's expression for the potential function of a *polar* molecule and gives for I_0 a value 5 per cent. too low, as applied to HCl.

So far as I know, Richardson's method has never been tested on a non-polar molecule. I have accordingly carried out such a test for several non-polar molecules for which trustworthy data are available and find that this method gives values of I_0 ranging from 8 per cent. too large for the excited level of the Swan bands to 9 per cent. too small for the excited level of the CN violet bands. Assuming Hori's values of I_0 for the normal and the '*C*' level of H_2, the same method gives results 21 per cent. and 26 per cent. too large respectively. Using my own probable value of a (0·614) for the *B* level, the Richardson method is correct to within 3 per cent. His value of $a = 2{\cdot}22$ is derived from extremely uncertain data and cannot be correct, since even with his own doubled value of B_0 (27·8), it indicates that the mean moment of inertia becomes infinite for only 12·5 quanta of vibrational energy. The vibrational data, on the other hand, show that at least 42 quanta are needed. Richardson's other values of I_0 are probably roughly correct, and the product $I_0\omega_0$ shows the expected rough constancy for *all* levels, including the *B* level, *if* $I_0 = 1{\cdot}99$ is used.

By extrapolating to ionisation the values of ω_0 in a given Rydberg series, one obtains an estimate of ω_0 for the normal state of H_2^+. My own result for this is 2247 cm.$^{-1}$, which corresponds to $s^+ = 0{\cdot}141$ volt, in remarkable agreement with Burrau's value (*as corrected*), calculated directly on the new mechanics. The heat of dissociation of H_2^+ is given by $(D + I_A - I_M)$, and with the values finally adopted equals 2·62 volts. Burrau calculates I_0 for H_2^+ as $0{\cdot}927 \times 10^{-40}$, and the fact that more than *double* this value is found in the *B* level of H_2 is most astonishing, and has interesting consequences.

RAYMOND T. BIRGE.
University of California,
Dec. 22, 1927.

Spatial Distribution of Photoelectrons Produced by X-rays.

JUDGING from recent papers on this subject, there seems to be considerable diversity of opinion concerning the explanation of the *dispersion* or 'spread' of the photoelectrons, whilst there appears to be no disagreement about the cause of the *longitudinal asymmetry*, which is generally assumed to correspond to the transfer to the photoelectrons of the momentum of the absorbed radiation. J. M. Nuttall, H. S. Barlow, and the present writer (hereinafter referred to as N.B.W.) recently investigated the longitudinal distribution of photoelectrons, and the results (not yet published) indicate an average forward component of momentum of the photoelectrons which is appreciably greater than the momentum, $h\nu/c$, of an incident quantum. The writer has also made a closer

quantitative study of the results of other observers, and finds that with the exception of P. Auger's results an 'excess asymmetry' is revealed in each case. As regards dispersion, experimental results seem to prohibit all theories except one, with which there is fair agreement.

According to E. C. Watson (*Proc. Nat. Acad.*, 584, Aug. 1927) the dispersion observed by the Wilson cloud method is entirely due to nuclear scattering of the photoelectrons within the volume represented by the photograph of the first droplet in a Wilson track. The magnitude of this effect depends directly on the diameter of the first droplet, and calculations similar to Watson's show that in the photographs examined by N.B.W. the dispersion due to nuclear scattering in the first droplet is very small compared with the observed dispersion, which is of the same magnitude as that observed by others. We must conclude that the observed dispersion undoubtedly exists when the electrons leave their parent atoms. Attempts have also been made to explain the dispersion by secondary processes *within* the parent atom, such as scattering by the 'parent' nucleus or the effect of the momentum of the electrons in the atoms before absorption. The dispersion afforded by such theories is, however, wholly inadequate, especially in the case of light elements (cf. A. H. Compton, "X-rays and Electrons," p. 247), and the rapid decrease of dispersion with decreasing atomic number which they require receives no corroboration at all from experiment. There remains the "$\cos^2\theta$" law first enunciated by Auger and Perrin and since derived by Wentzel on the wave mechanics. According to this law (provided we overlook longitudinal asymmetry) the probability of emission in a direction making an angle θ with the electric force in the incident wave is proportional to $\cos^2\theta$, and is independent of the atomic number of the atom and the wave-length of the rays. The dispersion is attributed entirely to the dispersion of the 'photoelectric impulses' and no secondary process within the atom is involved. This law represents satisfactorily the lateral distribution observed by Kirchner using polarised rays and the longitudinal dispersion observed by Auger and N.B.W., the experiments involving considerable variation of atomic number and wave-length. Bubb and Loughridge find somewhat less dispersion than is required by the $\cos^2\theta$ law. These, however, are the only discrepancies, and we may say that the $\cos^2\theta$ law leads to distribution functions which are, on the whole, the best representations of the experimental results for dispersion that can be chosen.

The quantities usually considered in measuring the longitudinal asymmetry are the ratio, ρ, of the forward to the backward emission, and the bipartition angle, ϕ_{bi}. The average forward component of momentum, μ, of a photoelectron is also a significant measure of the asymmetry, but up to the present it has not been considered. In order to correlate the asymmetries represented by different quantities, and thereby compare the results of different observers, it is convenient to regard the longitudinal distribution as the result of adding to each vector in a distribution of momentum vectors obeying the $\cos^2\theta$ law, momentum of magnitude $\sigma \cdot (5/4) \cdot (h\nu/c)$ in the forward direction, the magnitude of the initial momenta being such that the resultant momenta are consistent with Einstein's equation. The factor 5/4 is introduced in order that $\sigma = 1$ may correspond to an average forward momentum of the photoelectrons equal to $h\nu/c$. σ can be regarded as a coefficient of asymmetry and its values, which correspond to the results of N.B.W., and other observers are given in the accompanying table. Except in the case of Defoe's results, the values of ρ, ϕ_{bi}, or $\overline{\cos\phi}$ as the case may be, have been deduced from other published data. [It is interesting to note that according to the theory of Perrin and Auger, in which σ is taken equal to 4/5, the average forward momentum of a photoelectron is $(4/5) \cdot (h\nu/c)$.]

The last row in the table gives the results obtained by Nuttall, Barlow, and the writer. These observers made direct observations on the average value of $\cos\phi$ where ϕ is the angle with the forward direction, and the results indicate a forward momentum of the photoelectrons equal to about 1·4 times the momentum of the absorbed radiation. A. H. Compton ("X-rays and Electrons," 251) considers that the "electrons are ejected with an average forward momentum equal within experimental error to the momentum of an incident quantum." This is, however, not in agreement with the above result. Attention should be directed to the agreement in the last row between the values of σ deduced from different quantities, because it justifies, so far as it goes, the scheme up the longitudinal distribution adopted in building.

Gas.	λ(A).	Number Examined.	σ* calculated from ρ.	σ* calculated from ϕ_{bi}.	σ* calculated from $\overline{\cos\phi}$.	Observers.
Air . . .	0·37-1·0	1000	1·5	—	—	C. T. R. Wilson (1923)
Air . . .	0·71	250	2·1	—	—	O. K. Defoe (1924)
O_2, Argon .	0·71	450	2·1	2·3	2·0	D. H. Loughridge (1927)
Argon . .	0·13	300	1·4	1·3†	—	F. Kirchner (1927)
N_2, O_2 . .	0·54-0·71	1000	1·4	1·4	1·4	N. B. W. (1927)

* Denoting $\sqrt{h\nu/mc^2}$ by α, then $\cos\phi_{bi} = (5/4)\sigma\alpha$, $\overline{\cos\phi} = \sigma\alpha$, and $(\rho-1)/(\rho+1) = (15/8)\sigma\alpha \div (15/8)\sigma\alpha/8$ approximately.

† Kirchner gives the distribution of the tracks on the photographic plate and 'works back' to the space distribution, finding $\phi_{bi} = 73°$ which gives $\sigma = 0{\cdot}8$. It seems to the writer that ϕ_{bi} must be close to 60°, giving $\sigma = 1{\cdot}3$ which agrees with σ_ρ.

It is seen from the table that the results of other observers also lead to an 'excess' asymmetry, though the variation in the value of σ is not very satisfying. The experimental results of P. Auger are not included in the table. These lead to a value of σ differing inappreciably from unity and they require special mention for that reason. The differences between the results of various observers is not easy to explain. They may be due to the choosing of tracks or the use of non-homogeneous X-rays. What is desired to emphasise here is that it must not be assumed that *existing* experimental results show that the momentum of the photoelectrons is equal to that of the absorbed radiation. The results rather indicate that the photoelectrons have forward momentum nearly 50 per cent. greater than this.

As possible reasons for the excess asymmetry may be suggested (1) the effect of the nucleus or (2) the effect of the other k electron, both of which have up to the present been neglected. In individual quantum absorptions the nucleus must absorb momentum of magnitude comparable with that of the photoelectron, in order to conserve momentum, and this seems to the writer to invalidate the assumption that the nucleus can be neglected on account of its massiveness. The possibility of the other k electron being involved is suggested by the recent work of Prof. Alexander on the absorption of X-rays (*Phil. Mag.*, Oct. 1927).

E. J. WILLIAMS.

6 North Terrace,
Cambridge.

Differential Response of Barley Varieties to Manuring.

IT is a well-known fact that, by selection or hybridisation, varieties of any one plant can be produced which differ markedly in their yielding capacity. It is generally undecided as to what this difference of yielding capacity is due, and although yielding capacity of plants is controllable by manuring, it is not known whether the increase in yield gained in this way is a function only of the manure added, or whether different varieties respond to varying extents to the manurial combinations given. Interesting results were obtained in an investigation which has been carried out to test the efficiency in the use of manures by five well-known varieties of barley. Eleven manurial combinations consisting of different amounts of phosphate, nitrogen, and potash were used. The experiments were done in pot culture, using pure sand and solutions of pure chemicals. Each manurial combination was replicated seven times, giving in all 385 pots. The manurial scheme is tabulated below. The varieties used were Goldthorpe, Plumage, English Archer, Plumage Archer, and Spratt Archer.

TABLE I.

SCALE OF MANURING EMPLOYED (GM. PER POT).

	Phosphate-deficient Manuring.			Complete Manuring.	Nitrogen-deficient Manuring.			Complete Manuring.	Potash-deficient Manuring.		
	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.
P_2O_5 .	0	0·02	0·10	0·50	0·50	0·50	0·50	0·50	0·50	0·50	0·50
N . .	1·50	1·50	1·50	1·50	0	0·06	0·30	1·50	1·50	1·50	1·50
K_2O . .	1·00	1·00	1·00	1·00	1·00	1·00	1·00	1·00	0	0·04	0·20

Varietal differences in response were apparent in all the types of manuring. The difficulty of separating variations in yield due to experimental error from differences in yield due to manurial treatment, varietal differences in general, and differential varietal response to the various manures, was met by application of R. A. Fisher's 'Analysis of Variance.' By this means it has been possible to separate out the various effects, and to estimate their significance.

The effect of immediate interest here is the differential varietal response with the different manures. This is shown in the table below where the varieties are compared in pairs.

TABLE II.

TOTAL DRY WEIGHT OF TOPS. SIGNIFICANCE OF VARIETAL DIFFERENCES.

Comparison.	P_2O_5 Starved.			N Starved.			K_2O Starved.			Complete.
	A.	B.	C.	E.	F.	G.	I.	J.	K.	
P. with G. .	0	+	0	0	0	+	0	0	−	+
E. A. with G. .	+	+	+	+	+	+	0	0	−	+
P. A. ,, G. .	0	0	0	+	+	+	0	0	−	+
S. A. ,, G. .	0	0	0	+	0	+	0	0	−	+
E. A. ,, P. .	0	0	+	+	+	0	0	0	0	0
P. A. ,, P. .	0	−	0	0	+	+	0	0	0	0
S. A. ,, P. .	−	−	0	+	0	0	0	0	0	0
P. A. ,, E. A.	−	−	−	0	0	0	0	0	+	0
S. A. ,, E. A.	−	−	−	+	−	−	0	0	0	0
S. A. ,, P. A.	0	0	0	+	−	−	0	0	−	0

\+ indicates a significant positive difference.
− indicates a significant negative difference.
0 indicates no significant difference.

The absence of significant differences in Series I and J is almost certainly due to the great variability in these two sets.

A yield significantly greater in favour of the first variety is shown by a +, while a − indicates that the second variety has produced a significantly greater yield; zero indicates no significant difference in yield. It will be seen that for any one pair of varieties the relative magnitude of yield differs in an orderly way with the manuring; thus where a significant increase of the first variety over the second was obtained in the phosphate-deficient combinations, the order is reversed in the potash-deficient sets, and so on. Furthermore, even where no significant differences are found with complete manures, such differences show themselves in the partially deficient sets.

The facts presented in Table II. establish a difference in efficiency in the use of manures by these varieties, and further show that for different varieties tested over the same range of manurial combinations, it is not always the same manurial constituent which in minimum has the most marked effect on relative yield.

The agricultural bearings of the results obtained are twofold: (1) Varietal trials must be combined with manurial trials to be complete, and (2) the lines along which to develop selection and breeding of varieties to meet the requirements of different soil types are indicated.

F. G. GREGORY.
F. CROWTHER.
Imperial College of Science and Technology,
London, Dec. 3, 1927.

The Nebulium Spectrum in New Stars.

IN a recent communication (NATURE, Jan. 7, p. 12) C. T. Elvey has applied the 'expanding shell' theory of novæ to calculate the maximum density at which oxygen can be made to give the nebulium spectrum. In Nova Aquilæ, No. 3 (discovered June 8, 1918), the line λ5007 was first seen on June 27, when its breadth was 55 A.; and the gases are therefore assumed to have been travelling outwards for 19 days with a velocity of 1700 km./sec. before reaching a low enough density to emit this line. If, then, the phenomena are due to the reversing layer of the star being blown off bodily as a shell of gas, we can find the density in the shell at any moment after the outburst, given the initial density and radius. Elvey finds in this way that at the first appearance of the nebulium lines the gas must have a density of the order 10^{-17} gm./c.c.

There is a serious objection to the foregoing reasoning, however, which becomes apparent if we consider the state of ionisation of the gases concerned. The lines λλ5007, 4958, and 4363 are due, according to Bowen, to the O^{++} atom, which has an ionisation potential of about 35 volts. We can, therefore, find at once from the Russell-Saha formula the various pressures and temperatures at which O^{++} atoms will just begin to appear (say 0·1 per cent.); and it follows that at the density given, the lowest admissible temperature is $T = 13{,}000°$ Abs.,

corresponding to a partial electron pressure $p_e = 2 \times 10^{-13}$ atm. (This is about half the total pressure.) Now if we apply Elvey's method to hydrogen, which on June 27 showed bright bands of identical width with that of the nebular ones, it is evident that the hydrogen too must have had a density of the order of 10^{-17} gm./c.c. on that date. The condition that it shall not all be ionised (say

99·9 per cent. only) imposes an upper limit to the temperature; we must have

$$T < 6000° \text{ Abs.}$$

Now it is obvious that at these densities the ionisation is mainly due to the radiation from the star; and so the relevant temperature must be the same for both shells of gas. This, of course, is incompatible with the foregoing conditions.

As time goes on, the density continues to fall, and the discrepancy becomes worse. After three months, hydrogen and nebulium bands are still present together, their widths remaining sensibly constant, though the hydrogen is now relatively much weaker. Thus it appears that the straightforward argument put forward by Elvey yields results which are self-contradictory; and careful consideration is necessary before his figures can be accepted.

Another way of looking at the matter is as follows: The lowest temperature at which two substances with different ionisation potentials I_1, I_2 can coexist at the same partial electron pressure is $T = 840\ (I_2 - I_1)$, where 'coexistence' means that not more than 99·9 per cent. of the one substance is ionised, nor less than 0·1 per cent. of the other. For a mixture of hydrogen and 'nebulium' this gives $T = 18{,}000°$ Abs., corresponding to a minimum pressure $p_e = 2 \times 10^{-3}$ atm. and a density 4×10^{-7} gm./c.c.

If we suppose that these values apply three months after the outbreak, then, working backwards, the critical density at which the nebular lines first appear must be of the order 10^{-5} gm./c.c. at a pressure of about an atmosphere.

This is, of course, directly opposed to the idea that metastable transitions can only occur at very low pressures; but it is conceivable that very high temperatures might also be capable of inducing them. The strength of the ultra-violet continuous spectrum is a well-known feature both of novæ at a certain stage, and of O-type stars, which can also stimulate the nebulium spectrum.

A more probable way out of the difficulty, however, is to suppose that the oxygen and hydrogen shells originate in different layers of the star. There will be hydrogen accompanying the oxygen, of course, and no doubt helping to produce the complicated dark line spectra which appear in the early days; but by the time the nebular stage is reached, this hydrogen will be completely ionised. The hydrogen that is actually seen then must have come from deep down in the star, where the density was much higher than in the reversing layer.

This explanation unfortunately undermines Elvey's argument, for once we admit that the shells of gas come from different regions of the star, we have no means of assigning the initial density of any of them.

S. R. PIKE.

The University, Leeds.

Scientific Terminology and its Annexation.

NATURE has so consistently maintained the purity and accuracy of English scientific nomenclature, and its occasional leading articles on the subject have been of such great interest and assistance, that I venture to point out the insidious annexation of scientific terms to denote a commercial product.

'Ethyl' is the latest offender; the article in question being a petrol or benzol mixture to which is added a small proportion of an anti-knock substance purporting to be lead tetra-ethyl.

I presume there is not a practicable legal remedy, and one would hesitate to adopt the Shylockian tactics of obtaining a stamped agreement to deliver a quantity of substance at the price of the 'commercial' (misnamed) article, and then holding them to their chemical bond; yet one feels that such a lesson would be richly deserved by those who produce 'Radium' tooth powder, 'Ozone' liquids, or even call the impure, evil-smelling napthalene (after deleting the 'albo') by the name of carbon.

One would of course not wish to be arbitrary, but such barbarisms as 'saltrates,' etc., are a deliberate counter to our expensive educational schemes.

As regards scientific terminology, one would wish, *pace* the Oxford Dictionary, that 'revolution' and 'rotation' could be logically distinguished. I have always tried to restrict each term to cases where the centre of movement was either outside or inside the body moving, but there are many borderland cases.

The late Prof. Perry, in his usual pungent way, once rejoiced that there was no name for the time fluxion of acceleration. The term 'crement' (from increment or decrement of force) almost suggests itself.

There seems some doubt as to whether the term 'applement,' denoting the difference between a given angle and four right angles, is suitable to take its place with 'supplement' and 'complement' in their usual connotations. Here, I suppose, the criterion is between the relatively few people who might find the term useful, and the many who would be plagued by it. The same applies to 'cyclon' for a pendular vibration, which is shorter than (or almost an abbreviation of) the late Lord Kelvin's 'cycloidal vibration.'

JOHN L. DUNK.

92 Cheriton Road,
Folkestone, Jan. 11.

Eyeglasses and the Microscope.

MICROSCOPISTS who are hampered by wearing eyeglasses (that is, pince-nez) often find that when their work requires reference to books or other objects on the table, the incessant business of taking their glasses off and putting them on wastes time, and is apt to become wearisome. There is a simple way of getting over the difficulty. When the glasses are taken off in order to make way for the microscope, they should not be laid down but should be kept on the head, in which position, being near the fine adjustment and the hand resting on it, they can at once be replaced when wanted. To attach the eyeglasses in this way nothing more elaborate is necessary than a piece of ordinary elastic, the two ends of which are tied, or fastened with hooks, to the frame, preferably the bridge, of the glasses. With the elastic loop round the head, the eyeglasses can be raised on the forehead out of the microscope's way or brought into position for reading with a minimum expenditure of time and trouble.

T. H. T.

The University, Leeds.

The Sligo Artefacts.

WE, the under-signed, have examined a representative series of the limestone specimens collected by Mr. J. P. T. Burchell in Sligo, Ireland, and, after a study of the type of flaking and of the forms of these specimens, we are of the opinion that they are of human origin. This view is based upon the various criteria applied to universally accepted implements, and has been reached only after the explanation of the Sligo specimens being due to natural forces has been considered and rejected. This statement is without prejudice to their cultural age.

A. LESLIE ARMSTRONG.
M. C. BURKITT.
HENRY DEWEY.
D. A. E. GARROD.
REGINALD A. SMITH.

The Present State of Some Problems in the Theory of Numbers.[1]

By Prof. L. J. MORDELL, F.R.S.

THE theory of numbers, which was called the queen of mathematics by Gauss, the originator of the modern theory, still remains supreme. The present era is pre-eminently one in which she dominates the mathematical world. Her willing, loyal, and devoted subjects include the foremost mathematicians in every land. Their recent achievements bear comparison in difficulty and significance with those of any other period. Their propaganda in the last few years includes a surprisingly large number of thrilling treatises, which deal with most aspects of her conquests, and far exceed in number and importance those dealing with any other advanced mathematical subject. There is no lack of effort to present the most recent developments in as inviting and attractive a form as possible. One need only mention recent books in the last few years by Bachmann, Hecke, Landau, and Feuter. No small part of their subject-matter is closely related to or perhaps had its foundations in one or more of the six problems I have selected for discussion, which are associated with such distinguished names, namely :

1. Euler's Three Biquadrate Problem.
2. Fermat's Last Theorem.
3. The Cubic Indeterminate Equation.
4. Gauss' Class Number Problem.
5. Dirichlet's Divisor Problem.
6. Minkowski's Theorem on the Product of Linear Forms.

Some of these problems are comparatively new, such as (5) and (6), and testify to the wonderful freshness and vitality of the theory of numbers. The age of the others can be measured in centuries, particularly (3), special examples of which have been known for about two thousand years.

Their solutions are in every state of completion or rather incompletion, except perhaps for (3), which I solved a few years ago. Although some progress has been made with most of the others, except (1), they present difficulties which severely tax and seem beyond the powers of present-day mathematics. The slightest advances are made only by the most venturesome and heroic efforts, how much so can be easily appreciated by those who have even the slightest interest in the subject. These advances prove both useful and stimulating in many other fields, and it is difficult to exaggerate their importance and influence in the history of mathematics.

There are many striking features about these problems which have been noticed by all workers in this field. A simplicity of enunciation is combined with the fact that many of its most beautiful and startling results are proved originally in most unexpected and complicated ways. It is generally after many years that the simple and apparently natural method is discovered. It is only then that the proofs can be appreciated by greater numbers, just perhaps as the rough diamond only reveals its beauty after it has been polished and cut.

[1] A lecture given to the Manchester Literary and Philosophical Society on Nov. 15, 1927.

EULER'S THREE BIQUADRATE THEOREM.

This states that the sum of three biquadrates cannot be another biquadrate unless two of them are zero; *i.e.* if integers a, b, c, d satisfy the equation,

$$a^4+b^4+c^4=d^4,$$

then two of a, b, c must be zero.

It is truly remarkable that this simple theorem, the truth of which was conjectured by Euler more than 150 years ago, has neither been proved nor disproved. Further, it has been found absolutely impossible to make any headway with this problem. Indeed, it would be difficult to mention any other which has yielded so little to the efforts of those who have attempted its solution. Hence only some half-dozen references are to be found in the mathematical literature to papers dealing with it. The most important result known is a numerical verification by Aubry, in 1912, that the theorem is true for $|d| \leq 1040$.

The theorem cannot be extended to four fourth powers, as Norrie in 1911 showed that

$$30^4+120^4+272^4+315^4=353^4.$$

The particular case when one of a, b, c is zero, so that the equation is

$$a^4+b^4=c^4,$$

dates back from Fermat. It is proved by his method of infinite descent, *i.e.* if this equation or the less restricted one

$$a^4+b^4=c^2,$$

admits of integer solutions where abc is not equal to zero, then it must have other integer solutions a_1, b_1, c_1 where $a_1b_1c_1$ is not equal to zero, and where c_1 is numerically less than c. By continuing this process we are led to the existence of a solution wherein c is not zero and is numerically less than some definite number (here 1), and it can be easily verified by trial whether this is so. This example is a particular case of the second problem.

FERMAT'S LAST THEOREM.

This states that if integers x, y, z satisfy the equation

$$x^n+y^n=z^n,$$

where n is a given integer greater than 2, then x or y equals zero.

This theorem was discovered about 1637 by Fermat, who wrote upon the margin of his copy of the works of Diophantos, "I have discovered a truly remarkable proof which this margin is too small to contain." The theorem has attained world-wide celebrity because of the Wolfskell prize of 100,000 marks established in 1907 for the first demonstration of its proof. The prize has not yet been won.

The most important results are due to Kummer

who spent a great part of his life upon it. Assuming that n is an odd prime p, which involves no loss of generality, he proved the truth of the theorem for values of n included in certain general classes, *e.g.* when n is not a divisor of the numerator of one of the first $\frac{n-1}{2}$ Bernouillian numbers, B_r being defined as the coefficient of $(-1)^{r-1}x^{2r}/2r!$ in the expansion in ascending power of x of $x/e^x - 1$, and in particular for $3 \leq n \leq 100$, though his proof was not complete for a few values of n. It is not known whether the values of n for which Kummer proved his results are infinite in number. Though his papers were written about the middle of the last century, no further important results were obtained until 1909. Kummer and his successors in the discussion of the problem divided it into two cases, according as xyz is not or is divisible by p. The first case is the easiest, and for the theorem to hold for this one, Wieferich showed in 1909 that $2^{p-1} \equiv 1 \pmod{p^2}$, that is, $2^{p-1} - 1$ is exactly divisible by p^2.

The first value of p for which this is true was shown by Meissner in 1913 to be 1093. But Wieferich's theorem is a particular case of the more general one that if r is any prime less than p, then $r^{p-1} \equiv 1 \pmod{p^2}$ if the equation $x^p + y^p = z^p$ holds with xyz prime to p. This was proved for $r = 3$ by Mirimanoff, for $r = 5$ by Vandiver, and by Frobenius for $r = 11$, 17, and when $p \equiv 1 \pmod 6$, for $r = 7$, 13, 19. The proofs except when $r = 2$ or 3 are very complicated and suggest that the real source of these results is still to be found.

Fermat's last theorem is the most important of all the problems that I shall mention, as the efforts made in attempting its solution led Kummer to discoveries that marked the beginning of the theory of algebraic numbers. This discovery later revealed wonderful and beautiful relations between the theory of numbers, elliptic functions, automorphic functions, and many other parts of the theory of functions of a complex variable.

In no other part of the theory of numbers as in Fermat's last theorem are the investigator and reader called upon to deal with such abstract conceptions, such involved results, many of which are arrived at by a long chain of reasoning; and such general theories, *e.g.* laws of reciprocity, which have their foundations deep in the arithmetical theory. No other problem has been attempted by so many distinguished mathematicians, and very few can have led to such remarkable developments.

Cubic Indeterminate Equations.

This problem is to find the rational values of x, y, satisfying the general equation of the third degree in x, y with rational coefficients, namely,

$$ax^3 + bx^2y + cxy^2 + dy^3 + ex^2 + fxy + gy^2 + hx + ky + i = 0,$$

i.e. to find the rational points on this cubic curve which it is supposed has no double point, as then the problem is comparatively simple.

It is the oldest of those with which I am dealing, and particular cases of this question have been considered so long as two thousand years ago. Its solution proved intractable until six years ago, when I discovered the general solution, which is now so obvious that it is given in lectures at some universities.

A great deal of what was done on this question for many years can be explained in a few sentences. Any straight line meets the curve in three points. If two of these points are rational, the third is found from a simple equation, so that its co-ordinates will certainly be rational. In particular the tangent to the cubic at a rational point will meet it in another rational point.

Now suppose we have already found, perhaps by trial, n rational points on the curve say P_1, P_2 . . . P_n, *e.g.* if $x^3 + y^3 = 9$, $x = 2$, $y = 1$ is an obvious point. The tangent to the curve at P_1 will meet it again in another rational point P'_1, distinct from P_1 unless P_1 is a point of inflexion. So the tangent at P'_1 meets the curve in general in another point P''_1, etc., and we may expect to find an infinite number of rational points starting from P_1, though it is conceivable that we may find only a finite number of points forming a closed polygon. Similarly, we may expect to find an infinite number starting from P_2 if P_2 is not included in the group arising from P_1, and so for P_3, etc. But we can find another rational point, $Q_{1,2}$ from the intersection of the line $P_1 P_2$ . . . and the curve. We may now either draw a tangent to the curve at $Q_{1,2}$, or draw the secants joining $Q_{1,2}$ and the points P_2, P_3, etc., and find their intersections with the curve.

Clearly, in this way, we can find in general an infinite number of other rational points by starting from n known rational points, say primary points for short. From the time of Fermat onwards, mathematicians had to content themselves with doing little more than deriving for special equations explicit formulæ for the co-ordinates of the points found from one or more given ones, *e.g.*: for

$$ax^3 + by^3 = c, \quad y^2 = px^3 + q.$$

Even prizes established by learned societies led to no solution.

Finally, I showed that all the rational solutions of the general equation could be found from a finite number of primary ones by drawing tangents and secants as above. In other words, the method of infinite descent gives all the solutions; and there is now no theoretical difficulty in finding them.

Gauss' Class Number Problem.

Let $-D$ be a given negative number and let $ax^2 + bxy + cy^2$ be any quadratic form of determinant $-D$, *i.e.*, a, b, c are any integers for which $b^2 - 4ac = -D$. This requires that $D \equiv 0, 1 \pmod 4$, and then an infinity of integers a, b, c, can be found, and so an infinite number of quadratic forms of given determinant $-D$. It is a classic and elementary theorem that all these quadratic forms can be derived from a finite number, $H(D)$ say, by means of a linear transformation with integer coefficients and determinant unity. It was conjectured by Gauss more than 125 years ago that there are only a finite number of values of D for a given $H(D)$. This

has not yet been proved, though a formula and many recurring formulæ are known for $H(D)$. Hecke, making use of an unproved hypothesis about the zeros of a function analogous to the Riemann Zeta function, has given a simple proof. But I wish to deal more particularly with what would appear to be the very simple case when $H(D)=1$. This is so for $D=3, 4, 7, 8, 11, 12, 16, 19, 27, 28, 43, 67, 163$. It is easily verified that for any others, D must be a prime of the form $8n+3$. It was shown in 1911 by Dickson that there is no other value of D less than 1,500,000.

It may seem surprising that the truth of the conjecture about $H(D)=1$, is equivalent to the fact that the formula $z^2+z+2n+1$ gives only prime numbers for the integers z satisfying $0 \leq z \leq 2n-1$ as was proved by Rabinovitch (Rainich), and this is easily verified for $D=43, 67, 163$, when $n=5, 8, 20$.

It is also equivalent to the statement that the only solutions in non-negative integers of

$$yz+zx+xy=D=8n+3$$

are given by

$$(x, y, z)=(0, 1, 8n+3), (1, 3, 2n), (1, 1, 4n+1),$$

and those derived from these by permuting x, y, z.

Neither of these simple facts has, however, proved of use in proving the theorem.

Dirichlet's Divisor Problem.

The number of divisors $d(n)$ of a given integer n is a function of n which changes very irregularly with n, and is really the number of positive integer solutions of $xy=n$. If n is a prime number $d(n)=2$, while if $n=p^aq^br^c \ldots$ where $p, q, r \ldots$ are different primes

$$d(n)=(a+1)(b+1)(c+1) \ldots .$$

But though $d(n)$ does not depend so much upon the magnitude of n as upon its form, it is different with

$$d(1)+d(2)+ \ldots d(n).$$

This really represents the number of positive integer solutions of $xy \leq n$, *i.e.* the number of points with positive integral co-ordinates lying in the area bounded by the rectangular hyperbola $xy=n$ and the lines $x=1$, $y=1$, including the boundary in the area. The irregularities are smoothed out as it were, in the sum. Dirichlet showed in 1849 that $d(1)+d(2)+ \ldots d(n)=n \log n+(2\gamma-1)n+R(n)$ where $\gamma=0{\cdot}577 \ldots$ is Euler's constant, and $R(n)$ the remainder or error term is less numerically than a constant multiple of $\sqrt{n}$. This is expressed by $R(n)=O(\sqrt{n})$. For many years this was thought to be the best approximation to $R(n)$. Voronoi proved, however, in 1903, that $R(n)=O(\sqrt[3]{n} \log n)$. Van der Corput showed next that $R(n)=O(n^a)$ with $a=\frac{1}{3}$. This result was arrived at in many different ways, arithmetical, geometrical, by the real variable, and by the complex variable. These all led to $a=\frac{1}{3}$ and seemed to suggest that $O(\sqrt[3]{n})$ was the best approximation to the error term; though it was known from Hardy's work of 1915 that in the error term, the index $a \geq \frac{1}{4}$. Wonderful to relate, Van der Corput showed in 1922 by an exceedingly difficult and complicated method that $a<33/100$. Simpler proofs have since been given by Littlewood, Walfisz, and Landau for the slightly less precise result $a \leq 37/112$.

This extraordinary result appears not to be final; but to have arrived at it is one of the most startling achievements of the present day. The problem is one which has made the greatest demands upon many branches of mathematics. The most delicate questions of convergence, of the theory of functions, and the most adept manipulation of inequalities are all required.

In this problem, as opposed to the others, it is the methods of the analytical theory of numbers which have proved most successful. The most important stage in the proof depends upon Weyl's method of finding upper limits for large values of n to sums such as

$$\cos(f(1))+\cos(f(2))+ \ldots \cos(f(n)).$$

These approximations have also played a vital part in Waring's problem and in the recent theory of the Riemann Zeta function.

Minkowski's Theorem on the Product of Linear Forms.

This is the most recent of these problems, but it has features that mark it out as a worthy companion to those that have preceded it.

Let

$$\begin{aligned} L_1 &= a_{11}x_1+a_{12}x_2+ \ldots a_{1n}x_n-c_1, \\ L_2 &= a_{21}x_1+a_{22}x_2+ \ldots a_{2n}x_n-c_2, \\ &\ldots\ldots \\ L_n &= a_{n1}x_1+a_{n2}x_2+ \ldots a_{nn}x_n-c_n, \end{aligned}$$

be n linear non-homogeneous forms where the a's and c's are any real constants subject to the restriction that the determinant $|a_{rs}|=1$, which it may be noted in no wise detracts from the generality of the following theorem. Then it is supposed that there are integer values for $x_1, x_2, \ldots x_n$, for which the product $|L_1L_2 \ldots L_n| \leq 2^{-n}$.

The proof for $n=2$ was first given by Minkowski. Remak has given another, and I am now publishing one which proves it in a very simple way. But a different state of affairs arises for $n=3$. Remak gave in 1921 an extraordinarily complicated and intricate proof in fifty pages. It depends upon the arithmetic theory of the definite ternary quadratic, and involves ideas closely allied to those occurring in the problem of the closest packing of spheres. Unfortunately, it appears to be exceedingly difficult to extend the proof to the case $n=4$, and it is not known whether the theorem is true for $n \geq 4$, although it seems very likely. It is very rarely that the proof of the generalisation of a question to n dimensions proves so unattainable, especially when in similar questions, for example, in dealing with linear forms in which $c_1=c_2=. \ldots c_n=0$, the results for n variables are proved as easily as for two.

It is fairly certain that in due course a very simple general proof will be found, making the truth of the theorem almost intuitive. Such a one could be found by generalising to n variables the simple theorem that if $|a| \leq 1$, $|b| \leq 1$, there is a range of values of width at least two for x for which

$$|ax^2+bx| \leq 1.$$

Neanderthal Man a Distinct Species.[1]

THE fossil crania of the extinct members of the human family have been described and measured by many investigators; but it has long been recognised that there were important lacunæ in our information that had to be made good, and a lack of uniformity in the methods of measurement. Dr. Morant has rendered a very useful service to anthropology by himself measuring all the available crania and providing a complete and uniform treatment of the series in accordance with the refined mathematical methods of Prof. Karl Pearson.

How valuable and important such statistical investigations can be was shown in Dr. Morant's first memoir in this series, in which he provided a mathematical confirmation of Testut's opinion that the Chancelade skull (found in the Magdalenian deposits in the Dordogne thirty-eight years ago) conformed to the racial type of the modern Eskimo, a view that has been so vigorously championed in recent years by Prof. Sollas, and many years ago, in the face of vigorous opposition, by Sir William Boyd-Dawkins.

The second memoir, dealing with the series of Neanderthaloid skulls, is particularly valuable—for providing exact data and the careful investigation of the measurements and interpretation of their meaning. At the present moment, when doubt is once more being cast on the validity of the species *neanderthalensis*, it is important to get Dr. Morant's emphatic corroboration of our morphological conclusions. He informs us that the available measurements of the skulls associated with the Mousterian phase of culture in Europe and Palestine indicate a remarkable homogeneity of type, between which and all modern racial types there is a distinct hiatus, which may be taken to indicate a specific difference. "Some modern races resemble the Neanderthaloid type more closely than others do, but there is no race, or group of races, which is particularly distinguished in that way." "The working hypothesis that Mousterian man is equally related to all races of *H. sapiens* would seem to be the safest to adopt in the present state of our knowledge. In that case it is impossible to decide whether *H. neanderthalensis* has been a stage in the direct line of descent or not."

With these conclusions most anatomists would agree, with the qualification that the many signs of specialisation in the skull and teeth as well as in the limb bones are fatal to the suggestion that *H. neanderthalensis* could have been in the direct line of descent.

In his recent Huxley lecture, however, Dr. Aleš Hrdlička has questioned (NATURE, Nov. 19, p. 750) the validity of the specific distinction of Neanderthal man, an issue which most anatomists imagined to have been definitely settled by the investigation of Schwalbe in 1899, and the corroboration afforded by the work of Boule and a host of other anatomists. It will be remembered that when the original Neanderthal skull was found, Prof. William King (in 1864) suggested it was a distinct species, if not even a distinct genus, but Huxley opposed this claim and got his way. Thirty-five years later Schwalbe, with ampler material and modern criteria, made out a good case for the reality of the specific distinction, which the discoveries of the skeletons at La Chapelle-aux-Saints, La Quina, La Ferrassie, and elsewhere in 1908 and the succeeding years seemed to put beyond all question.

It is the way of true science constantly to submit to scrutiny the foundations of its theoretical views—a discipline to which a restive anthropology is not always willing to submit. The only justification for re-opening the problem of the status of Neanderthal man would be afforded by new evidence or new views, either of a destructive or constructive nature. I do not think Dr. Hrdlička has given any valid reasons for rejecting the view that *Homo neanderthalensis* is a species distinct from *H. sapiens*. Dr. Morant's important memoir comes at a very appropriate time to buttress the generally accepted view against such criticisms as Dr. Hrdlička's.

G. ELLIOT SMITH.

[1] "Studies of Palæolithic Man. By G. M. Morant. II. A Biometric Study of Neanderthaloid Skulls and of their Relationships to Modern Racial Types." *Annals of Eugenics*, vol. 2, Parts III. and IV., October 1927. Issued by the Francis Galton Laboratory for National Eugenics, University of London. 35*s*. net.

Obituary.

MR. LEON GASTER.

WE record with great regret the death of Mr. Leon Gaster, who passed away after a brief illness on Jan. 7. Mr. Gaster's chief work was the founding of the Illuminating Engineering Society, of which he had been honorary secretary since its birth in 1909. A year earlier he had founded the *Illuminating Engineer*, the official organ of the Society, which he edited up to the date of his death. A very sad feature was the fact that his death occurred shortly before the issue of a special number of his journal, celebrating its twentieth anniversary.

Mr. Gaster was a member of many scientific and technical committees, amongst which may be mentioned the Home Office Departmental Committee on Lighting in Factories and Workshops, the Illuminating Research Committee working under the Department of Scientific and Industrial Research, and various committees of the British Engineering Standards Association concerned with illumination. But his wide interests and enthusiasm led him into many other fields of work. He was keenly interested in the National Safety First Association and in the Association of Special Libraries and Information Bureaux. He was a fellow of the Institute of Journalists, and was in turn honorary secretary and chairman of its Scientific, Trade, and Technical Circle. He was also the honorary secretary of the British

International Association of Journalists, and as such was mainly responsible for the organisation of the International Press Conference in London last year.

Even this list does not exhaust the record of Mr. Gaster's activities. He used to affirm that he was a member of no less than thirty different scientific and technical committees. To every piece of work he undertook he brought boundless enthusiasm and indomitable perseverance. He delighted in meeting and disarming opposition, and few could resist his diplomacy and personal charm. It was, perhaps, in international activities that his special gifts found their chief application. Born in Rumania, educated in Switzerland, and with a wide knowledge of foreign countries, he was at once at home in any international gathering. This knowledge stood him in good stead in connexion with his work on the International Commission on Illumination, and in his conduct of the affairs of the British International Association of Journalists.

Mr. Gaster's foresight and sagacity, especially displayed in connexion with illuminating engineering, were remarkable. He had a genius for the correlation of different fields of scientific work and for discovering opportunities for joint effort which few would have perceived. He used to describe his occupation humorously as a 'committee promoter,' but he also found time for a considerable consulting engineering practice, where his knowledge of the world and powers of diplomacy proved quite as valuable as his technical skill. He was a man who made friends by instinct, and was equally well known in journalistic and scientific circles. It is no exaggeration to say that his name was known all over the world. His early death—in spite of his achievements he was only fifty-five years of age—will be widely regretted and his loss severely felt.

We regret to announce the following deaths:

Dr. Emil Böse, formerly of the Geological Survey of Mexico and the author of numerous contributions on the Mesozoic of Mexico and the Permian of western Texas, on Nov. 8, aged fifty-nine years.

Prof. C. Diener, professor of palæontology in the University of Vienna, and a foreign correspondent of the Geological Society of London, well known as the editor of the "Fossilium Catalogus," on Jan. 6, aged sixty-five years.

Sir Dyce Duckworth, Bart., president of the Clinical Society of London from 1891 until 1893 and *correspondant étranger* of the Paris Academy of Medicine, on Jan. 20, aged eighty-seven years.

Mr. E. Kay Robinson, well known as a writer and lecturer on natural history topics, on Jan. 20, aged seventy-two years.

Prof. F. L. Washburn, professor of entomology at the University of Minnesota, and State entomologist from 1902 until 1918, on Oct. 15, aged sixty-seven years.

Dr. Israel C. White, State geologist for West Virginia since 1897, in which year he was a vice-president of the American Association for the Advancement of Science, on Nov. 24, aged seventy-nine years.

News and Views.

Prof. Arthur Hutchinson, who has been elected Master of Pembroke College, Cambridge, to fill the vacancy caused by the sudden death of Dr. Hadley, shares with Prof. Seward the honour of combining the offices of Master of his College and professor of a department of science in the University. Prof. Hutchinson was educated at Clifton (1879) and Christ's College, Cambridge (1884), graduating in 1888 with a first class in both parts of the Natural Sciences Tripos, having taken chemistry as his subject in Part 2. His first paper, published in 1889, was the result of work in collaboration with M. M. Pattison Muir "On a Cubical Form of Bismuthous Oxide." He next studied in Germany at Munich and at Würzburg, taking his Ph.D. at the latter University and carrying out research under Emil Fischer on the reduction of aromatic amides. Returning to Cambridge, he worked with W. Pollard on "Lead Tetra-Acetate and the Plumbic Salts," publishing the results in 1893 and 1896. In 1895, the professor of mineralogy appointed him demonstrator of mineralogy, and under this title for many years he gave almost all the lectures for the first year course in mineralogy and crystallography. It was not until 1923 that the University appointed him lecturer in crystallography. He eventually succeeded to the professorship after the death of Prof. Lewis in 1926.

Prof. Hutchinson's connexion with Pembroke College dates from his election to a fellowship in 1893. He held the office of assistant-tutor from 1900 until his election as president of the College in 1926. In the meantime he had served the University on many boards, and was secretary of the General Board of Studies from 1920 until 1925. During the War, he carried out tests for the Admiralty on gas helmets, and for this and other services was awarded the O.B.E. He was president of the Mineralogical Society from 1921 until 1924, and was elected a fellow of the Royal Society in 1922. Lectures and college work left little time for scientific research, yet from 1900 to 1910 no year passed without his making some notable contribution to mineralogy, and in addition he prepared the section on mineralogical chemistry for the *Annual Reports of the Chemical Society* from 1905 until 1913. His first purely mineralogical paper, "On Stokesite, a New Mineral Containing Tin, from Cornwall," was a remarkable example of a complete chemical and physical determination made on a minute amount of material. This was followed by papers on the chemical composition and optical characters of chalybite, a study of the diathermancy and optical characters of antimonite, and on the composition of lengenbachite. More recent important contributions are on the stereographic and gnomonic projections and on

various graphical methods for solving problems which arise in the course of mineralogical determinations. The stereographic protractor and the 'universal' goniometer, both of which Prof. Hutchinson designed, have proved of very great utility in the many laboratories in which they have been introduced.

AT the recent meeting of Council of the Royal College of Veterinary Surgeons, a signal honour was conferred on Sir John McFadyean, late Principal of the Royal Veterinary College, London, when he was awarded the diploma of honorary associate of the Royal College of Veterinary Surgeons, an honour only once before conferred on a British veterinary surgeon. In making the presentation, the president, Lieut.-Colonel J. W. Brittlebank, referred to the fact that Sir John, who qualified as a member of the College in 1876, and had taken the degrees in medicine and science at Edinburgh shortly afterwards, had been Principal of the Royal Veterinary College since 1892, and a member of the Council of the Royal College of Veterinary Surgeons since 1893, being now the 'father' of the Council. He was a member of the Royal Commission on Tuberculosis appointed in 1901, which refuted Koch's contention that bovine tuberculosis was rarely if ever communicable to man to any serious degree. He also served on the departmental committee appointed to inquire into contagious abortion, 1905, and on many similar inquiries. Specialising at first in veterinary anatomy, McFadyean turned to the study of pathology, and his reputation as a veterinary pathologist and bacteriologist is now world-wide. His special method of staining blood films for the diagnosis of anthrax came into universal application, and his contributions into the elucidation of the problems raised by such diseases as tuberculosis, blackquarter, contagious abortion, and Johne's disease have made his name famous. He is the editor of the *Journal of Comparative Pathology and Therapeutics*, and the author of text-books on the anatomy of the horse and comparative anatomy. In 1905 he was knighted for his outstanding services to veterinary science and was also made an honorary LL.D. of the University of Aberdeen. He was president of the Royal College of Veterinary Surgeons from 1906 until 1910, and of the tenth International Veterinary Congress held in London in 1914.

THE Council of the Institution of Electrical Engineers has made the seventh award of the Faraday Medal to Prof. J. A. Fleming, who has recently retired from the chair of electrical engineering in the University of London. This Medal is awarded by the Council of the Institution not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution. Prof. Fleming is well known as the inventor of the first thermionic valve, and has played a notable part in the development of many applications of electrical science.

Two distinguished octogenarian men of science—Sir Robert Elliott-Cooper, K.C.B., and Sir John Isaac Thornycroft, F.R.S., on the civil and marine sides of engineering respectively, celebrate their birthdays next week. The former enters on his eighty-fourth year, having been born at Leeds on Jan. 29, 1845. Many railway and allied projects have engaged his activities both at home and overseas, establishing notable progress in the Victorian era. Sir Robert succeeded Prof. Unwin in 1912 as president of the Institution of Civil Engineers, and a portrait of him hangs there.

SIR JOHN THORNYCROFT, the eldest son of Thomas and Mary Thornycroft, was born in the Via Felice, Rome, on Feb. 1, 1843, and thus enters on his eighty-sixth year. Educated in early life at private schools, he derived much mechanical training at home, as well as skill in the drawing arts. When eighteen years old he constructed a small steam launch, the *Nautilus*, the first steam craft on the Thames that attained enough speed to keep up with racing crews. A period of intensive training and study followed at Jarrow-on-Tyne, in the engineering department of the University of Glasgow, and at Govan. In business at Chiswick, he became a builder of torpedo-boats, and is justly regarded as the pioneer in the construction of that form of high-speed craft. In 1903 Messrs. Thornycroft and Co. transferred their shipbuilding yards to Southampton, whilst later, important motor works were set going at Basingstoke. Experiments with hydroplanes were begun in 1908, culminating in the remarkable craft known as coastal motor-boats, well remembered in the Navy for their service during the War. Sir John was elected a fellow of the Royal Society in 1893.

ON the occasion of his visit to London to receive the Symons Gold Medal of the Royal Meteorological Society, Dr. Hugo Hergesell, the Director of the Prussian Aerological Observatory at Lindenberg, delivered a brief address, selecting as his subject the observation of cloud with special reference to the safeguarding of aviation. Lindenberg Observatory is not only the central observatory in Germany for the scientific investigation of the upper air, but is also the headquarters of that branch of the meteorological service which is charged with the issue of weather reports and forecasts for aviation. Soundings of the lower 3000 metres are made at the Observatory twice a day as a matter of routine, kites, captive balloons, or kite balloons being used to lift the reading instruments, according to the wind conditions prevailing at the time. These three different methods of levitation make it practicable to obtain soundings under almost all meteorological conditions. From the records of temperature and humidity so obtained, the heights and thicknesses of the various cloud layers can be determined, and information on this point is regularly included in the reports broadcast from the Observatory for the guidance of aviators. The difficulties encountered in interpreting the records of the hair hygrometer, in consequence of the deposition of a coating of ice on the hair, were briefly discussed.

DR. HERGESELL then gave some account of the work of the meteorological flight at Tempelhof, which works under the direction of the Observatory at Lindenberg.

This flight is equipped with a Junkers A 20 machine, and ascents are made as frequently as circumstances permit. The pilots attached to the flight have received special scientific training, and a professional meteorologist is carried on each flight as observer. The aeroplane is equipped with a so-called 'gyrorector' or horizontal gyroscope to enable the pilot to determine the direction of the vertical when flying through cloud, as it is well known that in such circumstances the unaided human sense of equilibrium may be entirely at fault. Whenever possible flights are made through the cloud layers, and the flight already has to its credit a large number of ascents made under these difficult conditions. In conclusion, Dr. Hergesell described the use of the inverting range-finder having a base of six metres for the measurement of the heights and movements of clouds, and showed a number of slides exhibiting cloud waves, on which the heights and wave-lengths as determined by such observations were marked.

JUDGING from reports in the daily press on Jan. 24 of the experiments carried out by the engineers of the Bell Telephone Co. on a new loud speaker, it seems clear that their new instrument has a much greater range than any existing loud speaker. Standing on a hill overlooking Hoboken, the engineers of the Company spoke in ordinary tones into a field telephone which was connected with a loud speaker placed on the top of their laboratories in New York, more than a mile distant. After a few seconds their words came back to them as clearly as they had spoken them. They also spoke in this way to the crews of vessels in the River Hudson, which lay between them and the loud speaker. A lady twenty miles away sang a song into a transmitter connected with the loud speaker, and we are told that every tone was clearly reproduced and transmitted. None of the sounds made by the speaker or singer was in the least distorted. The loud speaker reproduces, with no appreciable distortion, tones having vibrations of from 40 to 8000 cycles per second. The excellence of the results obtained is attributed mainly to the high efficiency of the new arrangement of apparatus. It is claimed that more than 50 per cent. of the electrical energy supplied is converted into wave-energy. The diaphragm used in this loud speaker is thinner than a sheet of gold leaf and is little larger than a watch dial. For broadcasting it has many advantages, and it can fill an auditorium with the same volume of sound that sixty men playing instruments would produce. Doubtless a vast crowd can be addressed by its use, and as 'gigantophone,' 'stentorphone,' 'magnavox,' etc., already describe other loud speakers, it will be difficult to find a suitable word to designate it.

THE increasing use of alternating current for supplying electric energy for light and power in Great Britain has led some engineers to think that in the future there will be a diminishing demand for storage batteries. In a paper read to the Institution of Electrical Engineers on Jan. 5, however, Mr. E. C. M'Kinnon gives several reasons for thinking that the demand will increase. New and novel applications for storage batteries are continually arising. They are used for motor-cars and for industrial electric vehicles, and are of great value for helping supply stations to maintain their pressures during peak loads. They are a necessity for submarine vessels. They are also most useful for alternating current automatic plants, for radio beacon equipments, and for broadcasting. The Post Office, however, is the largest user of storage batteries. The gradual adoption of automatic telephones is rapidly increasing the electric power required for the exchanges. It is estimated that this year the ampere-hour capacities of the batteries in the London area alone will be 627,000, with an estimated discharge rate for a nine-hour day of 2000 kilowatts. An official estimate is that by 1936 the capacity of the batteries installed in Great Britain will have increased from the present value of 28,000 kilowatt hours in nine hours to 100,000 kilowatt hours in nine hours. In thirteen or fourteen years there will be about 120 automatic exchanges in London alone, requiring some 21,000 horse-power for six hours to operate them. A very large quantity of lead is used annually in Great Britain for making accumulators. In 1926 it amounted to 247,000 tons, or nearly one-sixth of the total world production of 1,600,000 tons. There is practically no lead in South America and, if we exclude Burmâ, in Asia. The United States produces 500,000 tons per annum. The combined total annual output of Spain, Mexico, and Canada is about 340,000 tons. Production, however, is largely controlled by demand, and so it is unsafe to assume that the price of lead will rise in the future.

SENSATIONAL claims have recently been made in the *Daily Express* with regard to the possibility of increasing the normal yield of cereal crops from three to five times by means of transplanting the seedlings at a very early stage in development. A machine, invented in Germany, is said to distribute 12,000 seedlings per hour at the rate of about one per square foot, the resulting plants tillering very freely, each producing thirty to forty stems or more. The quantity of seed needed is one-thirtieth or less of that generally used, and the grain is said to be superior in quality to that usually obtained. The method of transplanting has been in use in China for thousands of years, but there hand labour is extremely cheap and circumstances have demanded the most intensive cultivation possible. Under European conditions, labour is so expensive that the saving in cost of seed is negligible compared with the increased labour costs.

THE two main principles underlying this transplanting method are increased root development due to transplanting, and increased tillering allowed by the extra space per individual plant. The former result can be obtained less expensively by the adoption of special methods of surface drilling with machines adapted for the purpose. As regards the second point, it is generally accepted that too thin seeding fails to give maximum crops per acre, and very careful

comparative tests would be necessary to prove whether this is also the case after transplantation or not. One great danger under field conditions in the uncertain climate of England would be in that of drought after transplanting, as a few days of fine weather in the early autumn might be sufficient to ruin acres of plants. As to the effect on the yield, it is quite possible to get a heavy increase on a small area under special conditions of cultivation and soil preparation, but it is far more difficult to maintain the same level of increase over large areas which cannot receive such particular treatment. While it is to be hoped that the method will receive full investigation, it would be unwise to raise the hopes of agriculturists until the experimental results are known.

THE next International Mathematical Congress will be held at Bologna on Sept. 3-10. Since the War, previous congresses have been held at Strasbourg in 1920 and Toronto in 1924, but the Bologna meeting will be the first since the War that will be strictly international in character, its two predecessors having been restricted as to membership to subjects of allied or neutral nations. The Italian Prime Minister takes great interest in the Congress and has accepted the office of honorary president. Arrangements are actively proceeding for the various sections of pure mathematics and applications of mathematics to economics and to scientific and technical problems. In addition, excursions are being proposed for visiting the art treasures of Florence and Ravenna and some of the principal hydro-electric plants of Italy. Prof. Pasquale Sfameni, rector of the University of Bologna, is organising president, Prof. S. Pincherle is president of the executive committee, and the general secretary is Prof. Ettore Bortolotti, Via Zamboni 33, Bologna. This is the second congress held in Italy, the previous one being at Rome in 1908.

THE fifteenth International Geological Congress will be held in South Africa in 1929, and the date of the inaugural meeting in Pretoria is to be during the fortnight following July 29. The special subjects provisionally proposed for discussion are: (*a*) magmatic differentiation; (*b*) pre-Pleistocene glacial periods; and (*c*) the stratigraphy, palæontology, and world distribution of the Karroo system. In the past the Congress has published several economic studies of great value, and on this occasion the subject suggested, "The Gold Resources of the World," is particularly appropriate. It is proposed to organise two long excursions before the session opens: one to illustrate the more attractive features of the geology of the Cape, concluding with a visit to the diamond mines and to the Dwyka glacial deposits near Kimberley; and the other to provide an opportunity of making a detailed study of the diamond pipes and of the Witwatersrand goldfield. During the session itself there will be excursions around Pretoria, to Johannesburg, and to the platinum field of Rustenburg. Three alternative excursions are provisionally proposed to follow the session: (*a*) to the Vredefort granite dome; (*b*) to the Drakensberg escarpment and the asbestos deposits of Barberton; and (*c*) to the Stormberg, for the study of the Karroo system. After the first two of these a long excursion to the Bushveld Complex is to be held, and, if it be possible, an alternative tour will be arranged, bringing in the Victoria Falls, the Wankie coalfield, and the Bulawayo district. Communications should be addressed to The General Secretary, XV. International Geological Congress, P.O. Box 391, Pretoria.

AN International Geographical Congress, under the auspices of the International Geographical Union, will open in London on July 14 and transfer to Cambridge on July 17, where the scientific and business transactions will continue until July 25. General Vacchelli, president of the Union, will preside over the Congress. The meetings in London will be mainly ceremonial, and will include receptions at the Royal Geographical Society, the Science Museum, and, by the Lord Mayor and Corporation of the City, at the Guildhall. At Cambridge there will be a reception by the Vice-Chancellor of the University and a dinner and reception offered by the Government. The work of the Congress is to be divided into six sections: (*A*) mathematical, (*B*) physical, (*C*) biological, (*D*) human, (*E*) historical, and (*F*) regional. Three subjects have been specially selected for discussion: (1) The problem of rural occupation, including the origin and causes of the agglomeration or dispersion of rural habitation, and the influence of natural conditions and racial traditions. (2) The International map on a scale of one to a million, which is making steady progress in many countries. (3) The study of pliocene and pleistocene coast and river terraces with the object of determining the existence of constant levels, if they exist, and of fixing their succession. The Committee will also welcome communications on any subject, and particularly the following: (4) Variation of climates, (5) flora and fauna of high mountains, (6) the map of internal drainage areas on which M. E. de Martonne is preparing a memoir for the basis of a discussion.

FIVE mornings will be devoted to meetings of the sections of the Congress, and several afternoons to more general geographical topics. Exhibitions are being arranged of the Carte du Monde Internationale au Millionème, the maps of the Ordnance Survey, and the Geographical Section of the War Office. At the end of the Congress a number of excursions, of two to five days' duration, will be arranged. These will be by motor coach, and will enable foreign visitors to see various parts of England and Wales. Arrangements have been made for reduced fares for members travelling to London and Cambridge to attend the Congress. The chairman of the executive committee is Sir Charles Close and the secretary is Mr. F. Debenham. Applications for membership (£1) and all inquiries should be addressed to The Secretary, International Geographical Congress, Caius College, Cambridge.

IN 1600 the reindeer was to be found in all parts of the Scandinavian peninsula. Now it is extinct as a wild animal in Sweden and Finland. In *Naturen* for for November, Carl Schulz tells the melancholy tale of the war of extermination that has been waged

against it in Norway. Successive "inventions of the devil," as various true sportsmen have called them, from the flint-lock to the latest long-distance rifle, have gradually diminished the numbers of this interesting creature. At the beginning of this century a complete close time was enacted from 1902 to 1906. The herds increased and the slaughter began again, so that to-day the situation is as in 1901. There is no economic reason for this destruction: 72 per cent. of Norway is uninhabitable fell. Surely there is room enough for the wild deer. New laws, says the author, are useless so long as they are neither obeyed nor enforced.

COMMDR. R. E. BYRD, U.S.N., who in 1926 flew from Spitsbergen to the Pole, is planning an expedition to the Antarctic. The *Geographical Journal* for January states that he proposes to enter the Ross Sea in December this year and to make his base at the Bay of Whales on the Ross Barrier, where relatively calm weather may be expected. Dog teams will be used to lay out four or five bases 100 miles apart towards the Pole. These will be used in case of mishap on a polar flight which is to be one of the main features of the expedition. Ten scientific workers will accompany the expedition, and the remainder of the party will consist of men with previous Arctic experience. Eskimo dogs, aeroplanes, and snow tractors will be taken. The flying machines will include one large tri-motor monoplane, similar to that used in Com. Byrd's recent trans-Atlantic flight, and one or two single-engine monoplanes. The hope of taking off from the open sea off the Barrier is a doubtful project since ice will almost certainly form on the floats. A trans-Continental flight to the Weddell Sea will probably not be attempted on this expedition, but aerial photography is proposed in the region of Edward Land and in the unknown region to the east of it, where no ship has been able to penetrate.

THE Galton Anniversary Dinner will be held at the Rembrandt Hotel, Brompton Road, on Thursday, Feb. 16, at 7.15 P.M. The Galton Lecture will be delivered by Mr. C. J. Bond, who will take as his subject, "The Distribution of Natural Capacity in the Population and the Need for National Stock-taking."

AT the ordinary meeting of the Institution of Electrical Engineers to be held on Thursday, Feb. 2, at 6 P.M., a portrait in oils of Mr. Ll. B. Atkinson, past president of the Institution, will be formally presented to the Institution by the Cable Makers' Association. The portrait was painted by Mr. G. Harcourt, R.A.

IT is announced in *Science* that Dr. H. J. Muller, professor of zoology at the University of Texas, has been awarded the 1000 dollars prize of the American Association for the Advancement of Science for his paper on "The Effects of X-radiation on Genes and Chromosomes," read at the recent Nashville meeting of the Association.

THE King has conferred the rank of Honorary Knight Commander of the Order of St. Michael and St. George on Dr. A. Castellani, Director of Tropical Medicine at the Ross Institute and Hospital for Tropical Diseases, Putney Heath. Dr. Castellani is well known for his discoveries in connexion with sleeping sickness, yaws, and other tropical diseases, and is at present in the United States at Tulane University, New Orleans. He is also to be congratulated on the announcement made last week that the King of Spain had conferred on him the Grand Cross of the Order of Civil Merit.

THE following have been elected officers of the Royal Meteorological Society: *President*, Sir Richard Gregory: *Vice-Presidents*, Sir Gilbert T. Walker, Col. A. J. H. Maclean, Mr. R. Arnison, Mr. I. D. Margary; *Treasurer*, Mr. F. Druce; *Secretaries*, Dr. C. E. P. Brooks, Commander L. G. Garbett, Dr. A. Crichton Mitchell; *Foreign Secretary*, Mr. R. G. K. Lempfert; *New Members of Council*, Mrs. C. J. P. Cave, Mr. F. Entwistle, Lieut.-Col. Ernest Gold, Dr. J. S. Owens, Mr. W. M. Witchell.

THE following have been elected officers of the Royal Microscopical Society for the ensuing year: *President*, Mr. J. E. Barnard; *Vice-Presidents*, Dr. R. S. Clay, Dr. W. E. Cooke, Dr. J. W. H. Eyre, Dr. James A. Murray; *Treasurer*, Mr. Cyril F. Hill; *Secretaries*, Prof. R. Ruggles Gates, Dr. Clarence Tierney; *New Members of Council*, Dr. J. D. Coales, Dr. G. M. Findlay, Mr. J. Rheinberg, Mr. E. J. Sheppard; *Librarian*, Mr. S. C. Akehurst; *Curator of Instruments*, Mr. W. E. Watson Baker; *Curator of Slides*, Mr. E. J. Sheppard.

THE Report of the Council of the Zoological Society of London states that the number of visitors to the Society's Gardens during the past year reached the record total of 2,158,208, an increase of 101,062 as compared with the previous record in 1924 (the year of the British Empire Exhibition at Wembley). The receipts for admission for the year amounted to £68,433, actually showing a decrease of £793 as compared with the receipts for 1924. This is partly due to the increased number of fellows, who were responsible for the admission of 39,964 visitors by their signatures and the distribution of their tickets; also 40,192 children were admitted free under an arrangement with the *Daily Sketch*. The number of visitors to the Society's Aquarium during the year was 458,936, and the receipts amounted to £18,293, an increase of £1050 as compared with the previous year.

PROF. HENRY FAIRFIELD OSBORN, president of the American Museum of Natural History, has been elected president of the American Association for the Advancement of Science for the present year. Vice-presidents of the various sections have been elected as follow: Section A (mathematics), Dr. K. C. Archibald, of Brown University; Section B (physics), Dr. P. W. Bridgman, of Harvard; Section C (chemistry), Dr. C. E. K. Mees, of the Eastman Kodak Laboratory; Section D (astronomy), Dr. J. S. Plaskett, of the Dominion Astrophysical Observatory, Canada; Section E (geology and geography), Dr. Frank Leverett, University of Michigan; Section F (zoology), Dr.

M. F. Guyer, University of Wisconsin; Section G (botany), Dr. C. E. Allen, University of Wisconsin; Section H (anthropology), Dr. Fay-Cooper Cole, University of Chicago; Section I (psychology), Dr. H. C. Warren, Princeton; Section M (engineering), Dr. R. L. Sackett, Pennsylvania State College; Section N (medicine), Dr. A. J. Goldfarb, College of the City of New York; Section O (agriculture), Dr. C. A. Mooers, University of Tennessee; and Section Q (education), Dr. Truman L. Kelley, Stanford University. The 1928 meeting of the Association will be held in New York City.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A research student in the department of protozoology of the London School of Hygiene and Tropical Medicine—The Secretary, London School of Hygiene and Tropical Medicine, 23 Endsleigh Gardens, W.C.1 (Feb. 11). A professor of physiology at Presidency College, Calcutta—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Feb. 11). An assistant on the higher technical staff of the library of the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S.W.7 (Feb. 18). Three assistant lecturers in mathematics in the University of Manchester—The Registrar, University, Manchester (Mar. 1). The Radcliffe Crocker travelling scholarship in dermatology at University College Hospital Medical School—The Dean, University College Hospital Medical School, Gower Street, W.C.1 (Mar. 31). An engineer in charge of workshops in the Research Department, Woolwich Arsenal—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

SKJELLERUP'S COMET.—Science Service, of Washington, has distributed with a recent *Daily Science News Bulletin* a remarkable photograph of this comet taken at the Lowell Observatory, Flagstaff, in daylight. According to *Popular Astronomy*, it was taken in infra-red light. The coma is very conspicuous, being large and bright, and a fan-shaped tail may be traced for some distance. Dr. C. Hoffmeister at Sonneberg was able to trace the tail to a length of 40° on several mornings at the end of December. The head was invisible, being too near the sun (*Beobach. Zirk.*, No. 2). Mr. R. A. McIntosh, of Auckland, N.Z., sends some interesting drawings of the telescopic aspect of the comet on the morning of Dec. 6. They closely resemble those of Coggia's comet of 1874. There is the same dark space in the middle of the tail, and intersecting paraboloid envelopes. These combine to give the aspect of a bright fan opening out on the sunward side of the head. Stars being shown in the picture, it is possible to deduce a position. This comes out R.A. $16^h\ 26^m\ 51^s$, S. Decl. 51° 9′, at U.T. Dec. 5·646.

BRIGHT METEORS.—Mr. W. F. Denning writes: "Between Jan. 16 and 20, several bright meteors were observed at Bristol by an assistant. It is desirable to obtain duplicate records, as the objects were of decidedly interesting character. The particulars were as follow :

Date.			
Jan. 16,	$10^h\ 3^m$	P.M. :	equal to Jupiter. Path from 61° + 72½° to 38° + 44°, slow motion, bright streak.
Jan. 19,	6 14	P.M. :	equal to Sirius. Path from 353° + 63° to 10½° + 50°. Slow. Probable radiant at 314° + 48°.
Jan. 19,	6 48	P.M. :	equal to Jupiter. Path from 26° + 44° to 31° − 4°. Slow, bright train. Probable radiant, 195° + 58°.
Jan. 20,	6 40	P.M. :	equal to Venus. Path from 300° + 76° to 300° + 36½°. Slow. Long flight. Probable radiant, 120° + 0°."

PHOTOGRAPHIC STELLAR PHOTOMETRY AT ALLEGHENY.—The 31-inch Thaw refractor of Allegheny observatory was designed principally for the purpose of parallax observations, but as it was possible to undertake this work during only a part of each night, the remaining hours of darkness have been utilised for other purposes in order to make the best use of this fine instrument. The most important work which has been carried out is photographic photometry by the extra-focal method. This is especially interesting in view of the fact that hitherto no large telescope has been devoted to this work, since reflectors can conveniently utilise only sharp focus images for this purpose, and extra-focal work has mainly been performed by small refractors uncorrected for photographic rays. The large aperture of the photographic telescope at Allegheny renders it especially useful for photometric work on short period variables, where great speed in exposure is essential. An account of the instrument and methods of work is given in the *Publications of the Allegheny Observatory*, vol. 7, No. 1, together with the results so far obtained for 29 faint Cepheid variables. Details of all the observations are given in each case, as well as light curves based on normal places.

THE ANCIENT ASTRONOMY OF THE MAYAS.—The attempts that have long been made to gain some insight into the scientific knowledge of the Mayas are beginning to bear fruit. Dr. H. J. Spinden contributes an article to the *Scientific American* for January on their system of astronomy, which presumably was derived independently of any systems hitherto known. The zodiac was for them also an 'Animal Circle,' but the animals were quite different from ours; the Pleiades were in the Rattlesnake; the Turtle occupied part of Gemini; they had a Scorpion, but it was adjacent to Gemini.

The Maya gained a considerable knowledge of the planetary movements, and obtained useful cycles, after which configurations repeated themselves. They found the 8-year Venus cycle so far back as the sixth century B.C., and later found the very exact 243-year cycle. Their zodiac is stated to have contained 13 signs, and their year 13 months of 28 days each, a device which many calendar reformers wish to adopt now. It is not stated how they arranged the odd day.

The article states that the Maya adopted in their astronomical records a continued count of days, starting with 613 B.C., similar to the system of Julian days; such a count is of great utility in tracing cycles of recurrence, which were much more difficult to detect among nations that used a lunar calendar. Their instruments for pointing on the stars had V-shaped sights like those used on rifles. Further contributions are promised, and it is evident that these records are of a character likely to repay all the trouble that has been taken in their decipherment.

Research Items.

HESPEROPITHECUS.—The attention of our readers is directed to an interesting statement on this animal published by Dr. W. K. Gregory in a recent number of *Science* (Dec. 16, 1927). As is well known, the specimen is a much worn tooth and therefore very difficult to decipher. Its original description as being a primate was received in many quarters with considerable scepticism. The authorities of the American Museum of Natural History, not content to leave the question in doubt, have made every effort to set it at rest by careful search for further material. As a result it now appears practically certain that the animal is not primate at all and that the tooth in question belongs to a peccary, Prosthenops. Dr. Gregory has paid great attention to the problem, and his considered opinion carries the greatest weight.

STONE CELTS FROM INDIA.—Two recent finds of stone implements are recorded in vol. 22, N.S. No. 3 of the *Journ. and Proc. of the Asiatic Soc., Bengal*. The first is a celt from the Naga Hills which is described by Mr. J. H. Hutton. It is remarkable in that the material, instead of being 'Indian jade,' olivine, serpentine, or similar material, as is almost always the case, is made of fossilised wood. It was found by Mr. G. Heseldin early in 1926 when making a road at Nichuguard at the foot of the Naga Hills. Its measurements are: maximum length $4\frac{3}{8}$ in., max. breadth $2\frac{3}{8}$ in., max. thickness $\frac{5}{8}$ in. It is slightly shouldered—the usual form. As this silicified wood is abundant a few miles north-west of Dimapur, it may fairly be inferred that it was made locally. The second find consisted of two neolithic implements discovered when a tank was being dug at Jamalpur (Monghyr). They are described by Upendra Nath Brahmachari and Shyama Charan Brahmachari. The first implement was found at a depth of ten feet. It is an unpolished celt with sharp, round, cutting edge, both sides of the edge being ground and polished up to a depth of one inch. There is a prominent ridge on one side on the unpolished portion. The second specimen was found at a depth of 15 ft. It is an unfinished celt with a cutting edge slightly curved. One side has been hammered into shape and there is a groove for hafting broken at the top. Both implements are made from the same rock, a fine grained schistose phyllite which occurs about two miles away.

CANCER.—Cancer of the uterus is one of the chief causes of death in middle-aged and elderly women, and the Departmental Committee of the Ministry of Health has issued a useful memorandum (Circular 826) which summarises the present position in respect of diagnosis and treatment. The natural duration of the disease from the first symptom to death is on the average rather less than 2 years. About half the cases when first seen by medical men have already advanced beyond the stage at which surgical operation is possible. Of these inoperable cases, some 10 per cent. can gain some considerable prolongation of life and perhaps be cured by the local application of radium. Of those in whom it is possible to attempt the removal of the growth by operation, at least 10 per cent. die from the necessary severity of the procedure, and about 40 per cent. survive for at least 5 years, most of whom may be looked upon as cured. Cases which are operable can also be treated with radium, which gives no operation mortality and presumptive cure in 40 per cent. On the average, therefore, about 1 woman in 5 who comes to a doctor with symptoms of uterine cancer has a fair prospect of being cured—a position bad enough, but a good deal better than it used to be. The natural progress of the disease being so rapid, it is imperative that the slightest sign of irregular uterine hæmorrhage should be taken seriously and expert advice obtained.

THE FOOD-FISHES OF ST. ANDREWS BAY.—Prof. W. C. M'Intosh ("The Food-Fishes of St. Andrews Bay") has brought together his notes which were published in the *Fishing News* from Aug. 13 to Oct. 29, 1927. These notes were made by the author at intervals over a period of about forty years, and, as he states in the preface, the Bay and its fisheries have been familiar to him for more than eighty years. The actual records begin in 1885 and extend to 1922, but few are made in each year, even at times only a single entry. It is interesting to follow these casual notes, which show the nature and magnitude of the catches at various times. These include plaice, herrings and sprats, cod, haddock, skate and young dabs, lemon-dabs and flounders. Often the contents of the fishes' stomachs were examined. At times sharks, porpoises, and large numbers of sea-birds were caught and duly noted. Apparently there are still many young fishes in St. Andrews Bay, and it is to be hoped that the writer is not too optimistic in his confidence in the permanent abundance of food-fishes in that area.

NORTH AMERICAN DIATOMS.—The second part of "A Synopsis of the North American Diatomaceæ," by Charles Boyer (*Proc. Acad. Nat. Sci. Philadephia*, vol. 79, 1927, Supplement), is now published, the first part having appeared in 1926 in the same publication (vol. 78). This first part contained, in addition to the introduction and classification, the Centricæ and the first division of the Pennatæ (Fragilariatæ). The present part contains the remainder of the Pennatæ (Naviculatæ and Surirellatæ), and as in this group are included the majority of the fresh-water and littoral forms which are more easily collected and more frequently studied than those from the open sea, it is much more complete than the first part. Welcome additions are a good index, and an appendix recording several of those planktonic marine species omitted before. Most of these latter are recorded from La Jolla, California, and from the Gulf of Maine. The two parts together form a valuable guide to North American diatoms, and the author is to be congratulated on the completion of his arduous task, the number of species and varieties in the synopsis being upwards of nineteen hundred.

THE GOLGI APPARATUS OF PROTOZOA.—At least five different types of supposed Golgi bodies have been described in Protozoa and a useful review of them is given by Dr. S. D. King (*Jour. R. Micr. Soc.*, **47**, part 4, 1927). Hirschler (1914) first recorded a Golgi apparatus in Protozoa in the form of osmiophile rings and crescents in the cytoplasm of *Monocystis ascidiae*, and Golgi elements have since been described in other gregarines and coccidia. In all these Sporozoa the Golgi apparatus is in the form of discrete rods and granules, often clumped near the nucleus in the early stages but later spreading through the cytoplasm. Its function is probably secretory, there being evidence to indicate that the lipoid granules of the gametocyte are derived from the Golgi elements. The work of Duboscq and Grassé (1924–27) points to the homology of the Golgi apparatus of herpetomonads and other flagellates with the parabasal apparatus (kinetonucleus). It is suggested that the clear 'space' around the kinetonucleus, which can

be stained *intra-vitam* and is therefore not an artefact, may correspond to the chromophobe substance. Grassé considers that the stigma of the euglenoids, which may or may not be coloured, represents the parabasal apparatus. After reference to lipoid cell constituents believed to represent the Golgi apparatus in Opalina and Anoplophrya, a résumé is given of Nassonov's work (1924–25) on the contractile vacuole of ciliates. Nassonov assumes that the permanent osmiophile membrane which surrounds the vacuole secretes the osmotically active substance necessary to the working of the vacuole and pours it into the latter after each successive systole—a secretory activity which is compared with that of Golgi bodies in the gland cells of Metazoa. He figures a ring-shaped Golgi apparatus in relation to the contractile vacuole. Dr. King points out that investigations are required on flagellates such as Bodo and Euglena in which both parabasals and contractile vacuoles are present.

PRAIRIES AND TREE GROWTH.—Various theories have been advanced to explain the lack of tree growth on the prairies. Prof. J. E. Weaver, of the University of Nebraska, has re-examined the problem, and the results of his experiments, as communicated to the American Association for the Advancement of Science, are summarised in a *Daily Science News Bulletin* issued by Science Service, Washington, D.C. His work in tree planting on densely vegetated prairie confirms the observations of other workers in the same field (see Ewing, *Jour. of Ecology*, vol. 12, No. 2, p. 238). The climatic prairie is overcrowded, and there is never enough water and soil nutrients for all species, and consequently the dense mat of vegetation makes the chances of the newcomer very poor. Even when planted in a strip 12 inches wide from which the sod has been removed, trees make little headway. After three years, Weaver found that the trees were only 18 inches high, but with roots 7 feet deep and widely branched. None of the roots extended into the grass sod. In a second row the sod was unbroken, but the grasses were kept cut back, giving the tree seedlings full sunshine but not enough water. Here again most of them were greatly dwarfed. In other rows the trees were left unaided in their struggle with the grasses, and only a few sickly specimens survived. Watering made conditions even worse for the trees, for the resulting vigorous growth of the grasses caused greater overshadowing of the tree seedlings.

THE MISSISSIPPI FLOODS.—A study of the floods of 1927 in the Mississippi basin is the subject of a recent memoir by Mr. H. C. Frankenfield (*Monthly Weather Review*, Supplement No. 29). The lower Mississippi floods, which were disastrous in the spring of 1927, are caused by a wide distribution of rains over the central plains. The waters of the Missouri River above the mouth of the Platte, and of the Mississippi above the mouth of the Wisconsin, do not materially add to the strength of the floods. In comparison with 1922, the previous year of great floods, there was little difference in the rainfall during January and February, but in 1927 there were heavy falls in April in the lower Arkansas valley, while a heavy fall in the Ohio basin in the previous December contributed a good deal to the floods. The probability of such high waters occurring in the near future is not great, although the last great flood was only five years ago. At the same time, Mr. Frankenfield believes that last year's floods did not attain the possible maximum. He calculates the maximum levels as follows, compared with the 1927 level: Cairo, 58 ft. (1927), possible 66 ft.; Memphis, 47 ft. (1927), possible 55 ft.; New Orleans, 27·5 ft. (1927), possible 30 ft. At New Orleans the effect of tides and winds may also be felt. The monograph contains full statistical data and is illustrated with rainfall and other maps.

THE DIFFRACTION OF ELECTRONS.—The experiments of C. Davisson and L. H. Germer on the elastic reflections of electrons from a single crystal of nickel, which were the subject of correspondence in NATURE last year (April 27), are described in detail in the December number of the *Physical Review*. They are remarkable both for the complicated nature of the apparatus and for the significance of the results. The experimental tube contained an elaborate piece of metal-work, consisting essentially of an 'electron gun,' a nickel target, and a Faraday cylinder to collect the reflected electrons, and although the whole was maintained at a pressure which was probably less than 10^{-8} mm. mercury, the constituent parts were capable of movement which allowed the scattered electrons to be examined for distribution both in latitude and azimuth. Those electrons which lost little energy in the process behaved as if they were equivalent to pencils of radiation, except that it was necessary to suppose that the crystal was effectively contracted normal to its surface by an amount depending on the speed of the particles. The corresponding wave-lengths agreed with those required by wave mechanics. It has also been found possible to deduce the structure of the adsorbed films of gas which are present when the crystal is not scrupulously clean, from the additional diffracted pencils to which they give rise, but it appears from a subsequent paper read by the authors at the December meeting of the American Physical Society that there is here some uncertainty in the interpretation of the results.

GAMMA-RAYS FROM POTASSIUM SALTS.—In determinations of the residual radiation of his instruments in the Berlepsch shaft at Stassfurt, Prof. Werner Kolhörster has found an appreciable γ-radiation from 'Hartsalz' (NaCl, $MgSO_4.H_2O$, KCl) (*Die Naturwissenschaften*, **16**, 28; 1928). Preliminary measurements with iron of mean thickness 3·75 cm. gave a value of $\mu_{Fe} = 0{\cdot}19$ cm.$^{-1}$, so that the rays are harder than those from radium C after filtering through 4 cm. lead, in which case $\mu_{Fe} = 0{\cdot}356$ cm.$^{-1}$ (Kohlrausch). Further measurements with large quantities of sylvine yielded the following values of μ_{Fe} for the thicknesses of iron given in brackets: $\mu_{Fe} = 1$ cm.$^{-1}$ (up to 8 mm.), $= 0{\cdot}35$ cm.$^{-1}$ (8 to 16 mm.), $= 0{\cdot}19$ cm.$^{-1}$ (16 to 60 mm.). The intensity of the radiation per gram of sylvine was equivalent to that from at least 10^{-11} gm. of radium, but separate measurements of the amount of radium in the sylvine showed that the radiation could not be attributed to radium contamination. The investigation of the thorium content of sylvine is being carried out, but there seems little doubt that the γ-radiation is due to potassium. The radiation is proportional to the potassium content, and its hardness suggests the existence also of a very penetrating β-radiation, hitherto unknown, from potassium. The work is being continued, and rubidium and cæsium are also being investigated. There appears to be also a γ-radiation emitted by rubidium.

ACTIVE NITROGEN.—The November issue of the *Journal of the Chemical Society* contains a further account by E. J. B. Willey of his investigations of active nitrogen. This modification of the element has been considered to be atomic, molecular and metastable, and triatomic by various workers, and a brief summary is given in the above paper of each of these views. It was suggested that the luminous phenomena observed with active nitrogen are due, not to the chemically active constituent, but to the

recombination of a small proportion of nitrogen atoms produced simultaneously, and Willey has carried out four series of experiments which support this view. The luminosity was destroyed both by heat and by an auxiliary electrical discharge, and it was found that chemically active nitrogen was still present. Willey considers that the non-luminous form of active nitrogen is probably a metastable diatomic or acetylenic molecule with a heat of formation of approximately 45,000 cal./gm.-mol., while the heat of formation of the atomic form is 200,000 to 250,000 cal./gm.-mol. These new views explain satisfactorily various observations which previously appeared to be contradictory.

THE SURFACE TENSION OF LIQUID CARBON DIOXIDE.—The surface tension of liquid carbon dioxide has been determined by E. L. Quinn over the temperature range 25° to − 52·2°, and the results are given in the *Journal of the American Chemical Society* for November. The capillary rise method was the only one that could be employed owing to the very high vapour pressure of carbon dioxide at ordinary temperatures. The capillary tube was enclosed in a Pyrex tube of 1 cm. diameter, the carbon dioxide being distilled in before sealing off. The observations were corrected for the quantity of liquid in the meniscus and for the capillary effect of the narrow outer jacket. The surface tension was then calculated, using density values for the liquid obtained by Behn and Jenkin, and extrapolations of Amagat's values for the vapour, an equation being derived for calculation of the density of the saturated vapour between 25° and 0°. From the surface tension results the internal pressure of liquid carbon dioxide was calculated and found to be about the same as that of carbon tetrachloride, toluene, and chloroform, and hence, according to Hildebrand's view of solubility, carbon dioxide probably resembles these liquids in its solvent properties.

ELECTRICAL DISTURBANCES IN CABLES.—Very little progress has been made since Kelvin's time in explaining the curious effects produced by sudden electrical and magnetic storms in the working of submarine cables. All these cables are worked by an earth return circuit. Hence external disturbances can enter the circuit directly from the earth connexions. Some of these disturbances are doubtless due to currents in the earth caused by natural phenomena. Others are artificial and due to the working of other cables and to the earth currents caused by electric railways, tramways, and power stations. The cable companies give much more thought to methods of alleviating these disturbances in their lines than to detecting the causes of them. They have found that the best remedy is to make the earth connexion in deep water at a depth of about 100 fathoms. This is done by taking the earth connexion to a special core insulated inside the cable and connected with the sheath at the desired earthing point. All the high speed Atlantic cables now use sea 'earths' at a suitable distance from the end of the cable. The remaining disturbances, when troublesome, can be swamped by increasing the current. Magnetic storms, however, seem to act on the cable directly by induction. Very h gh voltages have been observed during these storms between the cable end and the earth. Work is quite impossible during a bad magnetic storm and the cable is earthed at both ends for protection. Fortunately, such storms are rare, and seldom last for more than a few hours. Not infrequently, however, after a severe storm, they recur for several days in succession. Kelvin thought that these storms would give splendid opportunities for scientific observation. But as Mr. Hughes in his paper on submarine cable design, published in the January number of the *Journal of the Institution of Electrical Engineers*, points out, the cable engineers are then very busy and have no time to take observations and make measurements of the disturbances.

ARC TYPE ELECTRO-STEEL FURNACES.—A large number of electro-steel furnaces of the arc type are used in industry. The discovery of stainless iron and steel has given a large and rapidly extending use for electric steel furnaces. One of the difficulties that has to be overcome is to maintain the electrodes at a constant distance apart, notwithstanding the continuous alterations which occur in the circuit. These are mainly due to the alterations that occur during the melting period in the position of the iron and scraps. The liquid charge also bubbles and the electrodes continually burn away. To compensate for these changes the electrodes have to be continually moved. The efficiency of these furnaces and the time required for each charge depends largely on the electrode regulating devices. In *A.E.G. Progress* for November, two types of regulator are described. The first method is the Leonard-Tirrel System. As these furnaces generally employ a three-phase arc, three direct current lifting motors are used to move the electrodes. These motors are controlled in a way similar to that used to keep the voltage of an ordinary alternator constant by means of a voltage regulator. In the second method hydraulic cylinders are employed, the pressure being controlled by means of valves. A water supply under a pressure of about four atmospheres is required and, if necessary, this can be obtained from a special plant. Both these methods are found satisfactory in practice. The position of the electrodes can be controlled by hand at any distance from the furnace; they produce a constant current automatically, and in the event of a failure of the supply voltage both electrodes remain in a fixed position.

HARMONIC CURVES.—Donkin's harmonograph, designed and constructed in wood by Mr. A. E. Donkin in 1873, was presented by him in 1925 to the Science Museum, where it is exhibited with the mathematical instruments. It is described in the *Proceedings of the Royal Society*, 1874, vol. 22, pp. 196-199. Prof. Tyndall was much interested in the instrument, and at his suggestion Mr. Donkin had a similar instrument constructed by Messrs. Tisley and Spiller. This was exhibited at the Special Loan Collection at South Kensington in 1876. The harmonic curves are drawn by a pen on a paper secured round the surface of a cylinder. By means of two eccentrics, simple harmonic motions are given to the pen and cylinder respectively, the relative number of vibrations being variable by the use of change wheels. Since both pen and cylinder move at once, the curve drawn shows the combination of the two motions. In the second edition (1884) of the book on acoustics written by his father, Prof. W. F. Donkin, previously Savilian professor of astronomy at Oxford, Mr. Donkin added an article on compound harmonic curves (pp. 50-54), illustrated by 21 examples of the curves drawn by his instrument. Some of these curves are included in a printed sheet of 15 curves now issued by him. Expressed in terms of musical intervals, the curves represent: simple tone, octave above, the two combined, fifth, fourth, major third, minor third, major tone, minor tone, sixth, semitone, twelfth, comma, octave out of tune, twelfth out of tune. Copies of the sheet may be obtained at 2*s*. 6*d*. per dozen, post free, from Mr. A. E. Donkin, 5 Sion Hill Place, Bath.

The N.P.L. Primary Standard of Mutual Inductance.

UNDER the heading "British Scientific Gift to Japan," the *Times* recently gave a brief account of a ceremony some fuller details of which may be of interest to readers of NATURE. An absolute standard of mutual inductance was constructed at the National Physical Laboratory in 1907–8 from the designs of Mr. Albert Campbell. The standard was described by Mr. Campbell in 1912, and the value of the coefficient of mutual inductance as found by calculation was given by him as 10017·83 microhenries.

In the early part of 1914, Dr. Giebe, of the Reichsanstalt, visited the National Physical Laboratory in order to make an inter-comparison of various standards. The paraffin wax was dissolved off the standard inductance and the coils remeasured. Some slight variations from the original dimensions were observed, and the value of the mutual inductance coefficient when recalculated was found to be 10017·78 microhenries. The coils were not rewaxed.

In 1913 a similar standard, ordered by the Japanese Government, was under construction by Mr. R. W. Paul. This was sent to the Laboratory to be wound and measured with the view of the calculation of its coefficient. The work was delayed by the War, and in 1920 the grooves to hold the wire were recut in the Engineering Department and the standard completed and sent to Japan. It had only just arrived when it was destroyed by the earthquake of 1923. Soon afterwards the Japanese Government placed an order for a new standard. It was then suggested, and the suggestion was welcomed by the Lord President of the Council, Lord Balfour, that the new standard should be constructed at the National Physical Laboratory, and presented by the Lord President to the Japanese Government as a token of sympathy for the losses sustained by the earthquake; this standard is the scientific gift referred to in the *Times* notice.

A full description of the standard will appear shortly in the Collected Researches of the N.P.L. in a paper by Messrs. Dye and Hartshorn of the Electricity Department of the Laboratory. Fig. 1 is a reproduction of a photograph of the standard. The interest for physicists, however, lies in the fact that its construction has enabled a very careful comparison to be made of the values of the N.P.L. standard since 1914. The recent results are given in the accompanying table taken from the paper in which the method of comparison is described.

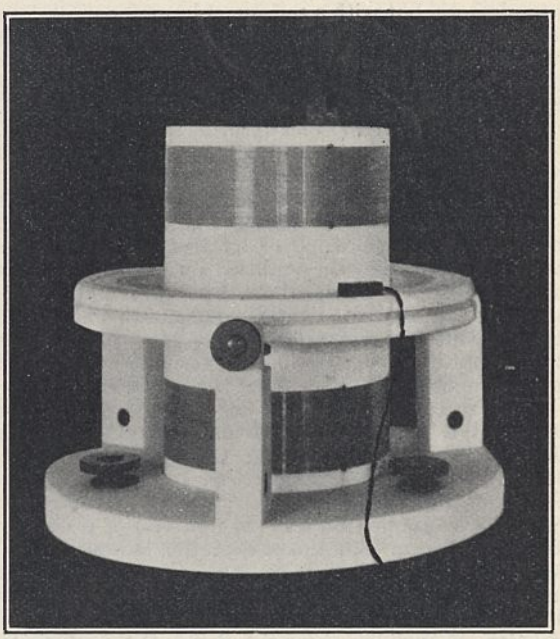

FIG. 1.—Photograph of the Japanese standard mutual inductance, consisting of the inner marble cylinder upon which are the upper and lower single layer primary windings and the outer ring-shaped secondary winding in the channel turned in the ring. The ring is supported on levelling and centring screws attached to the three marble pillars fixed to the base.

COMPARISON OF NEW JAPANESE STANDARD WITH NATIONAL PHYSICAL LABORATORY STANDARD.

Temp. Jap. Standard.	M_J. Calculated.	$M_{N.P.L.} - M_J$. Observed.	$M_{N.P.L.}$ by Difference.	Temp. N.P.L. Stan.	$M_{N.P.L.}$ at 15°.	Deviation from Mean.
	μH.	μH.	μH.		μH.	μH.
15·6	10010·03	7·81	10017·84	15·2	10017·84	0·02
15·0	10010·02	7·86	10017·88	14·3	10017·90	0·04
15·5	10010·03	7·84	10017·87	15·0	10017·87	0·01
15·0	10010·02	7·79	10017·81	14·2	10017·84	0·02
16·2	10010·04	7·83	10017·87	15·4	10017·86	0·00
16·2	10010·04	7·86	10017·90	15·9	10017·87	0·01

Mean Value of N.P.L. Standard at 15° C., 10017·86 μH.

It thus appears that the value of the N.P.L. standard in terms of the new Japanese standard of 1927 is 10017·86 microhenries. In 1921 its value was found by Dr. Dye by comparison with the first Japanese standard to be 10017·83 microhenries. As already stated, its calculated value found in 1914 was 10017·78 microhenries.

Insulin and Synthalin.

TO elucidate the chemical constitution of a compound of the nature of insulin, two main lines of approach may be followed; methods may be devised for the isolation of the substance in a state of chemical purity, preferably, if possible, in crystalline form, or the problem may be tackled from the opposite direction, by the synthesis of bodies possessing an insulin-like action, one of which may ultimately be found to be identical with insulin itself. In the following account, brief reference is made to certain of the investigations recently carried out with the view of determining the properties and constitution of insulin.

PURIFICATION OF INSULIN: CRYSTALLINE INSULIN.

In a series of publications, Abel and his collaborators have described methods by means of which solutions of insulin may be made to yield crystals of the active principle. The original method was first described by J. J. Abel in the *Proc. Nat. Acad. Sci.*, vol. 12, p. 132; 1926, and involved the use of a purified insulin as a starting-point. To obtain this purified insulin, material of a unitage of about 10-15 units per mgm. was dissolved in weak acetic acid and precipitated by means of pyridine, the whole process being repeated a number of times: by this means, 35-40 per cent. of

inactive matter was removed. The material was then extracted in 90 per cent. phenol, the insulin passing into solution, from which it was precipitated by the addition of a large excess of water. The pyridine precipitation in acetic acid solution was then repeated several times, but with a sodium chloride precipitation between the first and second pyridine treatment. The material thus obtained contained 40 units or more per mgm., and was used as the starting-point for preparing crystalline insulin (J. J. Abel and E. M. K. Geiling, *Jour. Pharmacol. and Exper. Therap.*, vol. 25, p. 423; 1925).

To a solution of the purified material in acetic acid was added an acidified solution of brucine, by means of which impurities were precipitated. By the addition of pyridine to the clear solution of insulin, the compound was precipitated, largely in a crystalline form, and could be recrystallised by the same means or by dissolving in disodium hydrogen phosphate, adding acetic acid to slight permanent turbidity and setting aside for crystallisation to take place. The crystals obtained were doubly refracting, and belonged to the rhombohedral division of the hexagonal system.

More recently Abel and his collaborators have described a simpler method of obtaining crystals (J. J. Abel, E. M. K. Geiling, C. A. Rouiller, F. K. Bell, and O. Wintersteiner, *Jour. Pharmacol. and Exper. Therap.*, vol. 31, p. 65; 1927). The brucine method was applied directly to material of a unitage of 13 per mgm., and the use of the tedious phenol purification was found to be unnecessary. The material now used gave only a slight precipitate on the addition of the acidified brucine solution, but the addition of pyridine brought down the impurities, together with some of the insulin, provided the reaction was kept well to the acid side of the isoelectric point of the latter. The addition of ammonia to the clear filtrate now brought down crystals, or more usually, they appeared on setting aside to crystallise. The crystals were either rhombohedral and doubly refractive or rhombic dodecahedrons. Tested against the international standard of insulin, the crystalline material showed a unitage of 40 per mgm., and the activity was unchanged on recrystallisation.

Before discussing the chemical properties of the purified material, reference may be made to the work of Dodds and his collaborators (F. Dickens, E. C. Dodds, W. Lawson, and N. F. Maclagan, *Biochem. Jour.*, vol. 21, p. 560; 1927). By entirely different methods from those used by Abel, these workers have succeeded in obtaining an insulin of a unitage of about sixty to the milligram, but they were unable to crystallise their product, using Abel's first method. The steps in the purification were as follows: the insulin, in aqueous solution, was precipitated by the addition of trichloracetic acid to 2 per cent., leaving some of the impurities in solution. The precipitate was dissolved in dilute hydrochloric acid and the potency again precipitated, this time by means of one-third saturation with sodium chloride. The precipitate was again dissolved, in slightly acid water at *p*H 4·0, and an oxalate-oxalic acid mixture of similar reaction added. After standing, the precipitate was centrifuged off, re-dissolved in dilute acid, precipitated as the picrate, and regenerated as the hydrochloride by Dudley's process, which consists in precipitating the hydrochloride from an alcoholic hydrochloric acid solution of the picrate by means of acetone. The purest material was prepared by the use of five oxalate precipitations.

Examination of the chemical properties of the products obtained by these two groups of workers shows that they are of protein nature, thus confirming the conclusions of other investigators. The biuret, Millon's, Pauly's and ninhydrin tests are positive and the tests for tryptophane negative: Molisch's test is also negative. The nitrogen content is about 15 per cent. or somewhat less. Abel suggests the formula $C_{45}H_{69}O_{14}N_{11}S$. Dodds finds that the arginine, histidine, and especially the lysine fractions are lower in the more purified specimens of his material. The results obtained agree in general with those published by other workers, although there are discrepancies as regards the percentages of the various fractions found on hydrolysis, and in some cases also as to the presence or absence of a particular amino-acid.

Abel has raised the question as to the relationship between the sulphur of the molecule and the physiological activity. He found that boiling the insulin with $N/10$ sodium carbonate for a short time resulted in loss of potency together with a change in the condition of a portion of the sulphur, such that subsequent treatment with dilute acid led to the liberation of hydrogen sulphide. His experiments suggested that the amount of this 'labile' sulphur present was directly proportional to the potency of the particular sample under examination, the proportion of both total and 'labile' sulphur increasing with increase in potency. About one-third of the sulphur of the molecule appears to be liberated by the dilute alkali in the case of the crystalline preparation. Dodds, however, states that there is no relationship between the sulphur content and the physiological activity, the former being the same in the purest as in relatively impure material. Whether the sulphur in the molecule plays a dominant rôle in relation to the physiological activity, must, then, be left to future work to decide.

The investigations into the chemistry of insulin appear to indicate that it is either itself of the nature of a protein or, as extracted from the pancreas, is always associated with protein material. The fact that products of varying physiological activity can be obtained seems to suggest that the insulin molecule is of a simpler nature than that of any of the compounds hitherto prepared, but is associated with protein material of varying amount and composition, depending upon the particular processes of extraction and purification adopted.

Synthalin.

The synthesis of certain compounds with an insulin-like action has been described by Frank, Nothmann, and Wagner, one of which, 'synthalin,' has been subjected to extensive clinical trial in cases of diabetes mellitus. The starting-point of this work was the well-known observation that guanidine and its compounds produce, on injection into animals, symptoms resembling tetany in human beings, and even convulsions. The authors found that a dose of 0·3 gm. per kgm. body weight, injected subcutaneously into a fasting rabbit, produces convulsions, accompanied by a fall in the blood sugar to 0·035-0·05 per cent. (E. Frank, *Naturwissenschaften*, vol. 15, p. 213; 1927): the administration of sugar or adrenalin can postpone the onset of the hypoglycæmia, given with the guanidine; but once the convulsions have commenced, sugar cannot relieve them. Smaller doses producing no symptoms also cause no fall in blood sugar. Methyl and dimethylguanidine produce convulsions independently of the blood sugar level: the authors therefore turned to a different type of guanidine compound, namely, agmatine, which was first extracted from herring-sperm by Kossel, but can now be prepared synthetically by a process devised by Heyn. Agmatine is amino-butylene-guanidine, and has the formula

$$HN=C\begin{matrix}NH_2\\ \diagdown\\ NH\end{matrix}.CH_2.CH_2.CH_2.CH_2NH_2.$$

In doses of 0·08 to 0·1 gm. per kgm. body-weight, this compound produces a fall in the blood-sugar of 30 per cent. without any obnoxious symptoms: larger doses cause a primary hyperglycæmia, followed by a fall in the blood-sugar and convulsions. The next higher homologue of agmatine, amino-pentylene-guanidine, has a more powerful hypoglycæmic action than the former compound: 0·2 gm. per kgm. body-weight is a convulsive dose, and the symptoms are similar to those produced by insulin, which was not the case with the other compounds investigated. Further, both substances resemble insulin in that the symptoms can be relieved by administering glucose.

Synthalin is closely related to the last two guanidine derivatives, being a diguanidyl derivative of a long chain aliphatic hydrocarbon, but the exact constitution has not yet been published. The toxic effects have been still further dissociated from the hypoglycæmic, doses as low as 0·003 gm. per kgm. body-weight producing a definite decrease in the blood-sugar. In applying these results to cases of human diabetes, Frank found that 20-25 mgm. constituted a suitable dose, and that up to 150 mgm. could be given in the course of four days. Such a dosage resulted in the utilisation of 40-50 gm. of glucose, which would otherwise have been excreted in the urine. If 125 mgm. cause the utilisation of 160 gm. of glucose in four days, 1 mgm. is equivalent to 1·24 gm. glucose, or, roughly, to one unit of insulin. Weight for weight, synthalin is therefore considerably less potent in causing a fall in the blood-sugar than the best samples of insulin.

The use of synthalin has in its favour the facts that it can exert its action after oral administration, and that this action, although slower in onset than that of insulin, is much more prolonged: to its disadvantage is the fact that unpleasant symptoms may be produced by it in many patients. The probable mode of action of the drug throws some light on the origin of these symptoms. Workers at the National Institute for Medical Research in London have found that synthalin only produces a decided fall in the blood-sugar in the normal animal in doses which also exert a definitely toxic action on the liver (*Lancet*, vol. 2, p. 517; 1927). This effect on the liver presumably results in a depression of the new formation of glucose which occurs in that organ, and also explains in part the unpleasant symptoms of nausea, anorexia, etc., frequently encountered in patients taking the drug: these symptoms have been found by Continental observers to be mitigated by the administration of a bile salt derivative, sodium dehydrocholate, to stimulate bile secretion, during the period of action of the synthalin: the toxic effect of the latter on the liver is believed to be counteracted by the simultaneous increase in the activity of the organ.

Apart from its action on the liver, synthalin also accelerates the disappearance of glucose from the circulation in the eviscerated spinal preparation, although the sugar vanishing is not laid down as glycogen in the muscles as is the case with insulin: moreover, large toxic doses of synthalin are necessary to demonstrate this effect. It therefore appears that the two main actions of insulin, depression of new formation of glucose in the liver and accelerated metabolism of sugar present in the blood, are represented in the effect of synthalin, but the fate of the sugar disappearing, which, in the case of insulin action, is partly laid down in the muscles as glycogen and partly burnt to carbon dioxide and water, is not absolutely similar in the two cases.

The clinical usefulness of the compound appears then to depend on how far its insulin-like action can be dissociated from its toxic effects: and this seems to occur to a different degree in different people. In Great Britain, the Medical Research Council has set on foot clinical investigations in a number of different centres, preliminary reports of which have recently been published (*Lancet*, vol. 2, p. 517; 1927): the same journal also contains a paper by E. G. B. Calvert on the treatment of diabetes by the drug (*ibid.*, p. 649). The results of these investigations show conclusively that synthalin is not a complete substitute for insulin. In certain patients, roughly one-third of the cases so far treated, it exerts a definitely toxic effect, the symptoms suggesting intestinal irritation, although a hepatic element may also be present. In a certain number it appears to be without action, but in others it enables the dosage of insulin to be reduced, although very rarely can its use be abandoned altogether. It has more effect in reducing the glycosuria than in reducing the blood-sugar.

The difficulties of estimating the value of synthalin, or that of any similar therapeutic agent, are considerable: thus, in a case in which synthalin has exerted a favourable influence, the patient may remain well, after withdrawal of the drug, on simple dieting alone; or if symptoms of gastro-intestinal irritation supervene, the accompanying loss of appetite, by reducing the food intake, may suffice to reduce the glycosuria and ameliorate some of the symptoms of the disease. Finally, since synthalin has a toxic action on the liver, it is possible that apparently good results may be due to a mild degree of this toxic action, in which case only time can disclose its real value even in the cases which appear to react successfully to it at the present moment.

Synthalin, then, is not a substitute for insulin: its real usefulness lies rather in the encouragement its discovery brings to the further investigation of synthetic compounds having an insulin-like action.

The Control of Plant Diseases.

"*Be ye ashamed, oh ye husbandmen; howl, oh ye vinedressers, for the wheat and for the barley; because the harvest of the field is perished. I have smitten you with blasting and mildew.*"—JOEL i. 11 and AMOS iv. 9.

IN opening the discussion between Sections K and M on the control of plant diseases, at the Leeds meeting of the British Association, Mrs. N. L. Alcock chose the above text, and passing lightly over the superstitions of the past regarding disease, she turned to the problem of control as seen to-day by the pathologist and agriculturalist. From the practical point of view, the first full recognition of the importance of plant diseases came with the epidemic of American gooseberry mildew. In 1905, Prof. Salmon, of Wye Agricultural College, while Ireland alone of the British Isles was definitely affected by the disease, gave a clear warning of the need of legislative control of both American gooseberry mildew and of potato wart disease. In another direction the warning was spread in 1909 by Prof. Sommerville in his references to the white pine blister rust, *Cronartium ribicola*, which he stated was still unknown in America, though it was to be feared that the day was not far distant when its footing in North America would be secured. To-day the losses in America due to this disease are credibly reckoned as enormous.

Neither the spread of American gooseberry mildew in Britain, however, nor the ravages in American

forests by pine blister rust, served to awaken fully the British people to the need of strict control. The full awakening came with the spread of wart disease, which, though described as a new malady of the potato in England by Prof. Potter and Mr. Massee in 1902, was not recognised as a menace to our food supplies until some years later. Happily, the lesson had been partly learned from the spread and havoc of mildew and blister rust, and legislation was initiated, at first haltingly, in an effort to devise rules for disease control, and later, as experience widened, amendments followed and mildew was lessened generally. The credit for the decline of mildew may be given to legislation, but it must not be forgotten that as in human infectious diseases, so also in plant diseases, there is probably an ebb and flow, not yet fully understood.

At first little was heard of wart disease, though a further warning of the dangers which it created was given by Prof. Salmon, but its spread led in 1907 to the Destructive Insects and Diseases Act, which may be considered the first important step in legislation for the control of plant diseases, and served to bring the subject of control into prominence. The establishment of inspectors to administer the control, and of mycologists and entomologists to recognise and to teach others to recognise plant pests, followed naturally.

In 1909 a further landmark was reached with the discovery that certain varieties of potato were immune to wart disease. With the work on this discovery the names of Mr. Gough and Mr. Snell will always be associated. Little is yet known as to the nature or degree of permanence of this immunity, but so far the latter has generally been maintained. Here geneticists have helped greatly, since there is cause for the belief that immunity may be a Mendelian character which, through breeding, may yield increasing crops of disease-resisting plants. But in this field of research there is still much to do before our crops are immune to disease, mature quickly, are hardy and produce acceptable fruit in abundance, and until the possibilities of success on these lines are assured, effort must be centred largely on the control of existing disease. At the present moment the English Phytopathological Service consists of three sections—official, inspectorate, and advisory respectively—and comprises entomologists, mycologists, an administrative unit forming part of the Horticultural Division of the Ministry of Agriculture, the Ministry's inspectorate—all members of which have received training in pathology—a corps of advisers—consisting of an entomologist and a mycologist in each agricultural province—and research workers on both entomology and mycology, who are stationed at Rothamsted Experimental Station, Long Ashton Fruit Station, Bristol, the Imperial College of Science, London, the Fruit Station at East Malling, the Lee Valley Station, Cheshunt, the London School of Tropical Medicine, and other institutions.

For the full effectiveness of such a service the convinced and willing co-operation of the grower is an essential factor, for not only must the grower play his part in an advisory council, but he must also take his part in the framing and enactment of agricultural legislation. The business value of measures of control must never be forgotten. The knowledge of those who are to administer control must be accurate and wide, and above all practical. Thus, for example, in some parts of Scotland the spraying of gooseberries against American gooseberry mildew with washing soda is cheap and effective; in other parts of Scotland such spraying is harmful and destroys all hope of a crop. The use of weights and measures familiar to the grower, the need of clear and simple language in the exposition of the facts of the grower's problems, and moderation in policy in the framing of rules and regulations for the guidance of the grower, are vital to the successful co-operation of the administrative body and the producer.

There is to-day great need of a full investigation of common seed-borne diseases; for wheat may bear bunt spores, flax-seed may carry the resting mycelium of *Colletotrichum linicolum*, and both the pycnidia of *Phoma betæ* and the sori of the rust *Uromyces betæ* may be transmitted by the seed of the sugar-beet. At least some seventy common diseases are thus carried. On this aspect of control there is much need for chemical research with the view of the elimination of disease before the seed is sown.

It may be considered fortunate that Great Britain has not yet been faced by a disastrous plant-disease epidemic, but in America the loss by wheat-rust alone is reckoned at not less than 100,000,000 dollars. Nevertheless, the constant and steady toll taken from our food resources is formidable and must amount annually to tens of thousands of pounds. It may, however, be held that the greatest available field for the exercise of control of disease lies in horticulture, for here the margin of profit is relatively broad, labour is adequate, there is no lack of interest on the part of the grower, and much good can be done. Here also is wide scope for the exercise of plant sanitation, for clean cultivation, the destruction of diseased plants, the removal of weeds and moribund tissues, and the destruction of refuse by fire. The incidence of disease may also be lessened by careful selection of site, while much may be gained by closer co-operation between growers and the staffs of our botanic gardens. Both for horticulture and forestry the importance of nurseries calls for fuller recognition, for while in horticulture many diseases may be fought with reasonable hope of success in adult plants, to avoid disease in the nursery is better than to control it in later life. With forestry the matter of nursery control is more urgent, for in many cases there is little hope of disease control other than by the elimination of the cause in the nursery itself.

Dr. W. B. Brierley, who spoke from the point of view of agriculture, dealt at length with the training and supply of workers, the financing and staffing of laboratories, and the field and administrative services for research on disease control, and strongly urged the need for careful gradation from pure to applied research, without which the full integration of investigation could not be realised. In urging the claim for extended research foundations in our universities and for crop stations, he held that by the enlargement of such foundations and stations the work of control could now be best advanced. There is still great need for the popularisation of knowledge regarding the nature and dangers of plant diseases, and he held that by oral instruction to the grower, and by the wider use of clear and concise printed matter, disease control would be materially promoted. In his opinion there was, however, a danger that the training of plant pathologists might remain a function of pure botany rather than become one of agriculture, and this he considered a matter for regret and correction.

Miss E. Welsford, who followed, spoke from her experience of the control of the diseases of the clove in Zanzibar, and urged the need for improvements in the methods of cultivation and plant hygiene for all crops. In her experience the practical sides of healthy plant physiology were of greater importance in the battling of disease than cure; for while the latter would ever be essential, the primary duty of the plant

pathologist must increasingly become the avoidance of disease by assuring healthy growth for crops as a whole.

Some of the difficulties in control were referred to by Sir Daniel Hall, who discussed the breeding of plant varieties immune to disease. In his opinion such breeding must be slow in securing satisfactory results, since the starting-point is immunity to known diseases in a few varieties which may still be prone to, and may be even more prone to, other diseases than they were before immunisation to one. He warned all who must deal with the practice of agriculture that progress in one line of control would not assure immunity for crops as a whole, and that step by step the problem must be probed until a sound knowledge of the effects of environment on immune varieties has been attained. With a widened understanding of the advantages and defects of a known environment for a known crop would come a surer foundation on which all could co-operate in the elimination of disease.

Dr. Malcolm Wilson strengthened the plea of Sir Daniel Hall for the extended study of environment, and while laying emphasis on the need for fuller knowledge of the condition of individual crops at the time of infection, he held that the plant pathologist could best be fitted for the practical work of agriculture relating to the cure of disease by the fullest possible training in both healthy physiology and pathology.

Mr. W. A. Millard discussed the processes of green manuring as preventive of scab on potatoes, and described experiments which threw light on the beneficial effects of such treatment.

Dr. W. G. Smith discussed the differences between the work of the adviser and that of the agricultural inspector, and while admitting that the present system of administration was advanced and enlightened, he urged the need for the fuller study of plant diseases on the spot, for by such study the complications of the problem of disease could often be more fully appreciated and approached than by other means.

Prof. Link spoke of the close parallelism between the problems of disease control in Britain and the United States of America, and stated that the work of control in America was still hampered by the inadequate training of plant pathologists in pure botany. On the other hand, there are other directions in which improvements are indicated, and in particular it must be assured that a closer relation is established between the research worker and the grower. By such a relation the work of both the investigator and the grower would be accelerated.

In conclusion, Mr. Stoughton discussed the methods of propaganda against plant disease, and emphasised the importance of the personal factor for both the investigator and the grower, by which investigation could be stimulated on one hand and knowledge accepted on the other, to the benefit of all concerned and the assurance of unbroken progress.

J. McL. T.

University and Educational Intelligence.

CAMBRIDGE.—Prof. A. Hutchinson, professor of mineralogy, has been elected Master of Pembroke College.

Sir Arthur Shipley, late Master of Christ's College, left £5500 to Christ's College for the endowment of a fellowship, along with various other bequests, including some relics of Darwin. As we announced in our issue of Oct. 29, p. 640, parts of his library are going to the Molteno Institute of Parasitology, the Balfour Library, and the Cambridge Philosophical Society.

THE Education Committee of the West Riding of Yorkshire announces in its report for 1926–27 a new departure in regard to provision of education for the adolescent: the inauguration at Castleford of a "centre for social and physical training" at an estimated cost of £500. Nine other similar centres are to be established in the course of the years 1927–1930, under the direction of a juvenile organisations committee, representative of all the local organisations engaged in social work amongst the young. Fifty-one scholarships tenable in universities were awarded in 1926–27, the average value being £78 a year. The field of selection of candidates (now 250 annually) has been widened by the grant of 'continuation' scholarships covering tuition, travelling, and maintenance expenses of preparation for the Higher School Certificate examination. Eighty per cent. of the pupils above sixteen are scholarship holders. Secondary school entrance scholarships were awarded to 2030 out of 5·5 times that number of candidates. Technical exhibitions numbered 3291.

THE Rockefeller Foundation has issued another, the eighth, series of "Methods and Problems of Medical Education." Of the 37 articles in this series, 7 deal with British practice and institutions. Sir Lenthal Cheatle discusses "English Surgery: Practice, Teaching, and Research," and Sir Archibald Garrod the "Teaching of Clinical Medicine in England." The medical and surgical 'units' of St. Bartholomew's Hospital are described by Prof. Fraser and Prof. Gask respectively. Details are given of the Electrocardiograph Department, Edinburgh Royal Infirmary, by Dr. W. T. Ritchie, and of the Department of Surgery, University of Edinburgh, by Prof. Wilkie. The new obstetric hospital, University College Hospital, is described by Sir George Blacker and Prof. Browne. The remaining articles mostly deal with special medical departments of institutions in America and Europe, including a useful one on medical postgraduate work in Germany, by Prof. Curt Adam. The volume is profusely illustrated with photographs and plans and contains useful information on staffing and finance.

THE appointments to Ramsay fellowships in chemical science for this session, British, Dominion, and foreign, are practically completed. At the present time ten fellowships are being held in the universities and colleges of Great Britain. The list of awards for the present session is as follows, the institution selected by the fellow for his research being given: *British Fellowships*: Dr. R. F. Hunter, Imperial College of Science and Technology, London; Mr. A. M. Taylor, University of Cambridge; *Glasgow Fellowship*: Mr. James D. Fulton, University of Manchester; *Canadian Fellowship*: Dr. W. H. Barnes, Royal Institution, London; *Danish Fellowship*: Miss Augusta M. Unmack, University of Oxford; *French Fellowship*: M. Robert le Guyon, University College, London; *Italian Fellowship*: Dr. Gastone Guzzoni, Royal School of Mines, London; *Japanese Fellowship*: Dr. Yohei Yamaguchi, University College, London; *Spanish Fellowship*: Senor Fernando Calvet, University of Oxford; *Swedish Fellowship*: Mr. H. Liander, University College, London. The total value of the annual amount of the fellowships that is awarded is approximately £4000, of which about £3000 is provided by grants from Dominion and foreign sources.

Calendar of Customs and Festivals.

February 1.

ST. BRIDGET.—Next to St. Patrick the most important of the Irish saints, the patroness of arts and culture. She, with seven virgin companions, the first nuns in Ireland, founded a church which stood under an ancient oak on what is now the site of the city of Kildare. The popularity of the saint, as indicated by the frequent use of Bridget as a Christian name, together with the survival of many pagan elements in relation to her, point to the pre-existence of a widely diffused and important cult. Her shrines are frequently associated with oak or ash groves, and she herself is connected with fire. This is shown by the story told by Giraldus Cambrensis of an ashless undying fire sacred to her, which was tended by twenty virgins in an enclosure taboo to men, as well by other of her attributes.

Popular custom points to a connexion of St. Bridget with fertility. On Jan. 31, the eve of her feast, it was the custom in the Isle of Man to cut green rushes and, standing at the door, to invite the saint to enter as the rushes were strewn on the floor to make a bed or carpet. The meaning of this practice is made clearer in the Western Isles of Scotland, where on the night of Feb. 1 a sheaf of oats was dressed in woman's clothes by the mistress and her maids, and placed in a basket with a stick beside it while saying, "Bri'id is come, Bri'id is welcome." In the morning, if the mark of the stick was found in the ashes, it portended a prosperous year. The custom of making rush crosses in honour of St. Bridget in association with a more or less solemn feast, widespread in Ireland, has suggested a connexion with sun-worship.

Like St. Agnes, St. Bridget, a virgin saint, has come to be associated with fertility by a process of synthesis. Her cult has absorbed that of the pagan goddess Brigid, goddess of fertility, of fire and of the arts of civilisation, who is identified with the goddess Dann (Welsh Dón) of the Tuatha de Danaan. She was the most important of the Celtic goddesses and belongs to that stage of Celtic religion when goddesses were more important than gods. In Gaul, Cæsar equates her with Minerva. In Britain she was the eponymous goddess of the Brigantes. One of her shrines was situated at Bath.

February 2.

CANDLEMAS.—"The Purification of the Virgin Mary," also called "Christ's Presentation" and the "Holiday of St. Simeon." It is also known in the north of England as the "Wives' Feast."

The ceremony of purification after childbirth, perpetuated in the modern 'churching of women,' now, of course, a service of thanksgiving, is a necessary accompaniment of the idea of taboo involved in the great crises of life, such as birth and death, in primitive thought. Among most primitive peoples, women after childbirth are regarded as unclean and dangerous, and as such are subject to certain prohibitions. In Korea, for example, they must veil themselves from the sun for a period of varying length according to their rank. The uncleanness may be removed by various means; in the New Hebrides by washing in new coconut milk or by stroking the limbs with branches which remove the pollution. In the Malay Peninsula mother and child are laid on a platform under which a brisk fire is lit, sometimes with fatal results.

The Church celebrated the feast by a solemn procession, in which candles were borne in procession. According to some authorities, all candles for use during the year should have been blessed on that day. The observance was continued in England up to the Reformation and was forbidden by statute in the reign of Edward VI.

The custom and name have been derived from Simeon's naming of Christ as "the Light of the World"; but ecclesiastical tradition is probably nearer the truth when it states that the ceremony was instituted because the pagans on that day carried lighted candles in honour of Pluto and Proserpine or, according to another account, Mars and his mother Februa—a function of Juno as presiding over the purification of women. In order to divert the Christian from these pagan practices, it was enjoined on all to carry candles in honour of the Virgin and Christ. The feast therefore perpetuated the cult of male and female chthonic or fertility deities and was connected with the purification of women. It is significant that in Britain St. Bridget has come to be associated with Candlemas.

In popular lore "on Candlemas Day throw candle and candle-stick away," said to mean that the use of tapers at Vespers and Litanies which had continued through winter, now ceased until All Hallow Mass. It certainly marks a period in a tradition older than the ecclesiastical. On Candlemas Eve the Yule brand was kindled and allowed to burn until sunset, when it was quenched and set aside to light the Yule log in the next season. The distinctively Christmas decorative foliage, the rosemary, bay, ivy, holly, and mistletoe were taken down and replaced by the box. In the Scottish Highlands St. Bridget's Day (Feb. 1, O.S.) was the first day of spring. It was the custom in Scotland for school children to make a present to the schoolmaster on Candlemas Day, the boy and girl giving the most becoming king and queen with certain privileges, such as asking for a weekly half-holiday and the remission of punishments over a certain period. It was also customary in some towns for a football match to be played. Both customs are significant in this connexion.

February 3.

ST. BLAISE.—Bishop and Martyr, born at Sebaste, Armenia, martyred by Agricola, A.D. 316. His legend records his fondness for and control over animals. At his command a wolf gave up a pig stolen from a poor woman. The woman brought the head and feet and a candle made of the pig's fat to the saint when he was in prison. Hence the custom of burning a candle to him for the animals of the household. He healed a youth dying through having swallowed a bone. Anyone in a similar state invoking the saint and commanding the bone to pass down or up in his name would be healed. Several Christian women were martyred with St. Blaise. When ordered to sacrifice to the heathen gods, they asked to be allowed to wash the idols that their offering might be the purer; but they threw them into the lake. This suggests a customary ritual, otherwise consent would scarcely have been given so readily.

St. Blaise was tortured with a sharp comb like that of the wool-comber, and is credited with having invented wool-combing. He was, therefore, the principal figure in the procession of the wool-combers of Bradford, which took place on this day, Jason with the Golden Fleece being the next in importance. By folk etymology he is associated with a custom whereby country women making a holiday on his festival burnt the flax and distaff of any woman found working, and also with the hill-top fires it was customary to light in some parts of the country on this date.

Societies and Academies.

LONDON.

Royal Society, Jan. 19.—**E. S. Horning** and **A. H. K. Petrie**: Enzymatic function of mitochondria in the germination of cereals. In the resting stage of maize, wheat, and barley, mitochondria occur in the scutellum and endosperm. During germination they become numerous in the scutellum, and are secreted in large numbers from epithelial cells into adjacent starch-containing cells of endosperm. These secreted mitochondria aggregate round starch grains prior to their corrosion; as corrosion commences the associated mitochondria seem to disappear. Throughout the period of endosperm depletion, mitochondria are thus secreted and migrate through the emptied cells to the zone of active hydrolysis, where they become associated with the starch grains. In isolated endosperms, mitochondria of intracellular origin effect starch hydrolysis and depletion at a slower rate corresponding to their lesser numbers. There is no evidence for secretion of mitochondria from the aleurone layer or of depletion being affected by secretion of an enzyme therefrom.

S. Dickinson: Experiments on the physiology and genetics of the smut fungi. No infection of oat or barley seedlings by pure cultures of smut fungi occurs when one gender (sex) is present; but when two genders are present, 90 per cent. infection is obtained.

P. H. H. Gray: Formation of indigotin from indol by soil bacteria. Oxidation of indol to indigotin can be effected by bacteria. Two new species have been isolated from soil. *Pseudomonas indoloxidans* oxidises in solution cultures and on agar media; *Mycobacterium globerulum* produces very small amounts, on agar media only. A new species of Micrococcus can also produce crystals on indol agar. Indol does not act as a source of energy; of the carbon compounds tested, glycerol appears most readily to act as energy-source to the oxidation. Bacterial numbers and amount of indigotin produced increase with higher ratios of carbon to nitrogen. Indol is oxidised only by young growing cultures, and can be oxidised in the absence of other nitrogen compounds; it depresses multiplication of bacteria.

R. A. Fisher: Triplet children in Great Britain and Ireland. Results of measurements, and of genealogical inquiries on three years' data from recipients of the Royal Bounty, are given. Six physical measurements taken on 117 children show correlation between pairs of unlike sex conformable with that obtained by the author from Lauterbach's measurements on twins, and with that between adult brothers and sisters. Pairs of like sex are more highly correlated, the results being well fitted by the supposition that about 54 per cent. of the surviving like-sex pairs are monozygotic in origin, and that these have a correlation 0·94. Relationship data confirm paternal influence, and sex distribution of related twins strongly suggests that this is confined to causation of di-embryony. If maternal influence conditions both dizygotism and di-embryony, the slightly higher values obtained from these and other data for maternal influence indicate that di-embryony is the more strongly inherited phenomenon.

J. W. H. Harrison: A further induction of melanism in the lepidopterous insect, *Selenia bilunaria* Esp. and its inheritance. By administering food containing manganese chloride to a strain of *Selenia bilunaria*, known by the use of adequate controls to be free from heritable melanism, melanic insects have been developed. This melanism is inherited as a Mendelian recessive. Certain mosaics were obtained in the critical treated brood, but these, from experimental tests, seem to represent cases of somatic induction, the germ plasm being apparently unaffected. The effect is not of the Lamarckian type, but rather illustrates a new evolutionary principle, that heritable variations may be induced by means of the food supplied. The metal seems to be the active agent.

J. W. H. Harrison: Induced changes in the pigmentation of the pupæ of the butterfly, *Pieris napi* L. and their inheritance. The pupæ of *Pieris napi*, when developed from larvæ exposed at the critical time to lights of different colours, are influenced in their pigmentation, like those of their congeners *Pieris brassicæ* and *P. rapæ*. As Dürken and Brecher found in the case of *P. brassicæ*, the green pupal colour, acquired under the influence of orange light, is inherited.

F. G. Gregory: The differential effect of the ions of three-salt solutions on the growth of potato plants in sand culture. A method of statistical analysis is developed enabling assessment of the effect of single ions on growth of plants in culture solution consisting of a mixture of salts, and has been applied to data published by E. S. Johnston. The kations in the solution have for each relative ionic concentration (ionic proportion) a greater effect than any of the anions used.

Sir Kenneth Goadby: Bacterial proteins: presence of alcohol-soluble proteins in bacteria. By a method, shown to produce minimum change on protein constituents, an alcohol-soluble protein, having many of the characters of the similar proteins of cereal seeds, has been extracted from Streptococci, Staphylococci, *Bacilli Hoffmann, typhosus, coli com., paracoloides*, and *Micrococcus catarrhalis*. The Molisch-reacting substance seems to form an important constituent of bacterial structure.

F. W. R. Brambell: Development and morphology of the gonads of the mouse. (Part 2.) The paper deals with 64 animals irradiated during pregnancy or lactation. Degenerative changes in corpora lutea start at the same age in the sterile as in the normal ovary. They proceed slowly, and the old corpora lutea become practically permanent components of the sterile ovary. This is attributed to absence of competition with maturing follicles and new corpora lutea.

R. C. Punnett: Linkage groups and chromosome number in Lathyrus. A fundamental requirement of the chromosome heredity-theory is that the number of linkage groups and characters showing independent assortment in a species should not exceed the haploid number of chromosomes. This holds good for the only species—Drosophila—hitherto tested adequately. Experiments over twenty years and involving 19 characters have shown that in a plant also (*Lathyrus odoratus*) the number of linkage groups and characters showing independent assortment is 7, the same as the haploid number of chromosomes in this species.

S. Ochoa: Action of guanidins on the melanophores of the skin of *Rana temporaria*. The guanidin hydrochlorides cause contraction of skin melanophores in frogs. This is a direct action, either on the melanophores or the nerve endings in them. Calcium salts antagonise the effect, as they do many of the other effects. It is probable that Collip's parathyroid hormone also antagonises the action of guanidins.

E. J. Maskell: Experimental researches on vegetable assimilation and respiration. (Parts 17 and 18.) In cherry-laurel leaves, at limiting concentrations but under *constant* lighting, there is marked diurnal rhythm of apparent assimilation, falling to

very low values at night and rising in morning. At any point in the diurnal march, assimilation can be increased by increasing carbon dioxide up to the limit set by the light-intensity used. Diurnal rhythm of assimilation is due to a rhythm of stomatal opening. At small opening, assimilation rate is approximately proportional to porometer rate; as the stomata open and the porometer rate increases, the assimilation rate approaches asymptotically to a level determined by non-stomatal resistances in the diffusion path of the carbon dioxide.

PARIS.

Academy of Sciences, Dec. 19.—**A. Lacroix**: The hyperalkaline quartziferous rhyolites and trachytes, with reference to those of Korea.—**P. Villard**: The law of absorption of the X-rays by matter. The total absorption coefficient is regarded as the sum of two terms, a diffusion coefficient taken as independent of the wave-length and the true absorption coefficient, $C\lambda^3$ (Bragg and Pierce). C is considered as a function of the wave-length $C_0\phi(\lambda)$, and from a study of the experimental curve $C = C_0\phi(\lambda)$ it is recognised as a Bjerknes resonance curve, and a formula is developed based on this view. The calculated and experimental figures for zinc are compared.—**Gabriel Bertrand** and **Jules Labarre**: The acetolysis of mannocellulose. The preparation of new sugars, tetramannoholoside and pentamannoholoside. These sugars were produced by the controlled acetylation of mannocellulose by a mixture of sulphuric acid and acetic anhydride, the acetates being afterwards saponified by alcoholic potash and the potassium removed as perchlorate. Details of their chemical and physical properties are given.—**E. Mathias**: Magnetic measurements in the Hautes-Pyrénées, Gers, and Haute-Garonne.—Sir Ernest Rutherford was elected a foreign associate in the place of the late C. Walcott, and Joseph Auclair, *correspondant* for the section of mechanics in succession to Torres Quevedo, elected foreign associate.—**André Weil**: Arithmetic on an algebraic curve.—**Paul Mentré**: The projective displacements of two plane pencils with a common right line.—**Lainé**: The equations $s = f(x, y, z, p, q)$ which are of the first class.—**Paul Flamant**: The development of a linear transmutation in series of powers of the finite differentiation.—**J. Favard**: The normal meromorph functions of the group of translations.—**Henri Milloux**: The theory of integral functions of finite order.—**Georges Valiron**: Some properties of integral functions.—**A. Véronnet**: The evolution of the figures of equilibrium of a heterogeneous fluid mass. The impossibility of a breaking up.—**Belzecki**: A case of critical velocities in the movements of a locomotive on rails.—**G. Rougier**: Observations of the third satellite of Jupiter. A drawing of the spot on the third satellite, previously seen by Antoniadi, is given. From observations of this spot it is concluded that the period of rotation of the satellite equals its time of revolution round Jupiter.—**A. Levêque**: An attempt at an approximate theory of the transmission of heat by convection in a circular cylindrical tube through which is flowing a real fluid in turbulent motion.—**Cordonnier** and **Guinchant**: Inductive capacity in the gaseous state. The results of measurements of thirty-three gases and vapours are given, and their relationship with the refractive indices and chemical constitution discussed.—**Rouelle**: The demultiplier of ferromagnetic frequency.—**Georges Déjardin**: Spectra of phosphorus for different degrees of ionisation. The study of the variations observed in the electrodeless discharge leads to the separation of the spectra characteristic of the different degrees of ionisation of the phosphorus atom. The whole of the results obtained may serve as a starting-point for the development of the classification outlined by Millikan and Bowen. The presence in the photographs of a large number of new lines shows that the spectrum of phosphorus is still imperfectly known, particularly in the ultra-violet, below 2700 A.—**Georges Simon**: Superposition fringes between two half-silvered plates formed by media of different refractive indices.—**Pierre Leroux**: Study of the pleochroism of tourmaline.—**E. Brylinski**: The velocity of the earth. The author holds that the results obtained by A. Piccard and E. Stahel on the Rigi in September 1927, do not disprove Miller's results.—**Edmond Bayle**, **Henri George**, **Augustin Mache**: The identification of works of art. The finger-print of the artist placed on some part of the work has been proposed as a remedy against a forged signature on pictures and other works of art; but it is pointed out that this would be insufficient, since the finger-print could be copied by photomechanical methods. The method suggested as more trustworthy is a combination of photography and radiography.—**A. Dauvillier**: An X-ray tube with an effective wave-length of 8 Angström units. The important feature of the tube proposed, a detailed description of which is given, is a window of very thin cellophane, 0·02 mm. thick, 20 sq. cm. surface, with a support of metallic gauze.—**Henri Belliot**: An attempt at the interpretation of the phenomena of photographic inversion and solarisation.—**W. H. Keesom** and **M. Wolfke**: Two different liquid states of helium. In a series of measurements of the dielectric constant of liquid helium, with diminishing temperatures, at a certain temperature this constant undergoes a sudden change. Earlier observations have given similar indications based on the variation with the temperature of density, specific heat, latent heat of evaporation and surface tension. The change from one state to the other takes place when the pressure of saturated helium vapour is about 38 mm. of mercury.—**B. Bogitch**: Some properties of electrolytic nickel. Measurements of hardness, density, and velocity of solution in hydrochloric acid are given for specimens of nickel of varying degrees of purity. Analyses of the samples are appended: nickel bought as electrolytic is not necessarily pure.—**René Delaplace**: Study of the gas, obtained by cracking oil, for lighting for coast beacons. Analyses of original gas, liquefied gas and residue after rectification of liquid are given.—**I. N. Longinescu**: A new additive property of liquids.—**A. Colani**: Study of the systems uranyl nitrate—alkaline nitrate—water at 25° C.—**R. Locquin** and **R. Heilmann**: The mechanism of the oxidation of the pyrazolines. The basic compounds isolated included the pyrazol corresponding to the pyrazoline oxidised, azines and pyrazoline compounds of the same molecular weight as the azines.—**L. Palfray** and **Mlle. Th. Duboc**: 1, 3, 4, Metaxylenol and some of its derivatives.—**Albert Kirrmann**: The reactions of the α-bromaldehydes. Besides normal aldehyde reactions, other reactions are obtained suggesting an acid bromide. It is shown that with α-bromœnanthol there is no tautomerism, and a probable explanation of the abnormal reactions is suggested.—**W. Ipatief** and **B. Dolgof**: The catalytic hydrogenation of *p*-oxytriphenylcarbinol and *p*-oxydiphenylmethane under pressure. The first step in the reduction of *p*-oxytriphenylcarbinol (catalyst nickel, pressure 80 to 100 atmospheres) is *p*-oxytriphenylmethane and 50 per cent. of this decomposes into phenol and diphenylmethane at 220° C., and pressure 100 atmospheres. The remainder is converted nearly quantitatively into tricyclohexylmethane.—**James Chappuis** and **A. Pignot**:

The compression of town gas. Town gas may contain from 1 to 4 per cent. of oxygen, and at ordinary atmospheric pressure this is outside the limit of inflammability. Experiments are described showing that mixtures of coal gas and oxygen, compressed to 150 to 200 kgm., are not inflammable if they contain less than 10 per cent. of oxygen.—**R. Lantz** and **A. Wahl**: The action of the primary amines on nitroso-β-naphthol.—**Robert Gibrat**: The focal structure of smectic bodies.—**M. E. Denaeyer** and **Jacques Bourcart**: The chemical composition of the lavas of Ahaggar, Central Sahara (Jacques Bourcat Expedition, 1922–1923).—**Pierre Bonnet**: The characters of the south Transcaucasian geosynclinal.—**Henri Schoeller**: The Embrunais layer and the outside edge of the Briançonnais layer, traced from France into Switzerland.—**Paul Fallot**: The geology of the region of Antequera (Andalusia).—**J. Thoulet**: The double oceanic circulation and the abyssal volcanic columns.—**M.** and **Mme. A. Chauchard**: The variations in salinity of estuaries measured *in situ* by the electrical conductivity.—**Marcel Mascré**: The action of some fixing reagents on the nucleus of the plant cell.—**A. Maige**: Observations on the phenomena of chloroplastogenesis and plastidal regression in the cotyledons of various Leguminoseæ.—**A. Guilliermond**: The cytology of the Nematospora.—**A. de Puymaly**: A fixed Spirogyra, perennial and multiplying by layering.—**M. Bridel** and **Mlle. M. Desmarest**: A method permitting the extraction from the oil cake of bitter almonds of amygdaloside (amygdalin) and emulsin.—**E. Carrière** and **Brunet**: Contribution to the study of grape pip oil.—**G. Guittonneau**: The influence of sulphur and the products of its solvation in the soil on nitrification.—**J. Legendre**: The battle between mosquitoes by the larval concurrence between zoophiles and androphiles.—**Maurice Azéma**: The excretion *in vitro* of methylene blue by the renal vescicles of an ascidian.—**Edouard Fischer**: The relation between the reducing power of sea water and the distribution of the organisms of the coast line.—**Chevey, L. Roule,** and **Mlle. Verrier**: The interruption of the movement of salmon up rivers by the reduction of the amount of dissolved oxygen in the water course. If the dissolved oxygen in a river falls below 6 c.c. per litre, salmon will not ascend. Salmon appear to be more sensitive in this respect than other fish.—**René Fabre** and **Henri Simonnet**: Contribution to the physiological study of glutathione by the method of perfusion.—**P. Delauney**: The biochemical synthesis of β-5, bromosalicylglucoside. An attempt at the synthesis of β-3-5-dichlorosalicylglucoside.—**Marcel Labbé, Roubeau,** and **F. Nepreux**: The influence of nickel and cobalt on the hypoglycæmic action of insulin in the rabbit.—**G. Lavier**: The structure of the parabasal body in trypanosomes.—**Mme. Phisalix**: Properties of the serum of snakes belonging to the genus Coluber.—**Daniel Florentin**: The composition of the air of the streets of Paris. A series of determinations of the proportions of carbon monoxide and dioxide. The amount of impurity diminishes rapidly as the height above the ground increases.—**P. Lassablière**: The biological and therapeutic effects of the serosity of blisters.—**Jules Amar**: Mass action and vital defence.

Official Publications Received.

BRITISH.

The Association of Special Libraries and Information Bureaux. Report of Proceedings of the Fourth Conference held at Trinity College, Cambridge, September 23rd-26th, 1927. Pp. xiv+170. (London.)

The Quarterly Journal of the Geological Society. Vol. 83, Part 4, No. 332, December 15th. Pp. 551-652. (London: Longmans, Green and Co., Ltd.) 7*s.* 6*d.*

Madras Fisheries Department. Administration Report for the Year 1925-26. By Dr. B. Sundara Raj. (Report No. 1 of 1927, Madras Fisheries Bulletin, Vol. 21.) Pp. v+94+6 plates. (Madras: Government Press.) 2.4 rupees.

The Physical Society Proceedings. Vol. 40, Part 1, December 15. Pp. 36. (London: The Fleetway Press, Ltd.) 7*s.* net.

Aeronautical Research Committee: Reports and Memoranda. No. 1059 (Ae. 241): Experiments on a Model of a Fokker (F. VII) Monoplane Wing. By A. S. Batson, D. H. Williams and A. S. Halliday. (A.3.*a.* Aerofoils-General, 167.—T. 2324 and a.) Pp. 21+19 plates. 1*s.* 3*d.* net. No. 1106 (Ae. 283): The Theoretical Pressure Distribution around Joukowski Aerofoils. By W. G. A. Perring. (A.3.a. Aerofoils-General, 178.—T. 2498.) Pp. 13+11 plates. 9*d.* net. (London: H.M. Stationery Office.)

Proceedings of the Malacological Society of London. Edited by G. C. Robson. Vol. 17, Parts 5 and 6, December. Pp. 175-254+plates 15-35. (London: Dulau and Co., Ltd.) 20*s.* net.

Royal Botanic Gardens, Kew. Picture Postcards. Nos. 85-91, Ornamental Geese. (Set 13.) 1*d.* each; 6*d.* per set of 7. Nos. 97-102, Ornamental Waterfowl. (Set 17.) 2*d.* each; 1*s.* per set of 6. Nos. 103-108. 2*d.* each; 1*s.* per set of 6. (Kew.)

Chemists and Dividends. By S. M. Gluckstein. Pp. 24. (London: Institute of Chemistry of Great Britain and Ireland.)

Indian Central Cotton Committee, Bombay. Annual Report for the Year ending 31st August 1924. Pp. iv+73. 2 rupees. Annual Report for 1926. Pp. iv+169. 2 rupees. Annual Report for the Year ending August 31st, 1927. Pp. ii+116+14 plates. 2 rupees. (Bombay.)

Memoirs of the Department of Agriculture in India. Botanical Series, Vol. 14, No. 8: Pennisetum Typhoideum, Studies on the Bajri Crop. i: The Morphology of Pennisetum Typhoideum. By S. V. Godbole. Pp. 247-268+10 plates. (Calcutta: Government of India Central Publication Branch.) 12 annas; 1*s.* 3*d.*

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twentieth Annual Report, 1926-27, presented by the Council to the Court of Governors on the 27th October 1927. Pp. 54+11 plates. (Cardiff.)

Guide to the Seventh Congress of the Far Eastern Association of Tropical Medicine, Calcutta, December 5th to 24th, 1927. Pp. vi+115. Seventh Congress of the Far Eastern Association of Tropical Medicine: Abstracts of Papers and Programme of Scientific Sessions. Pp. iv+176. (Calcutta.)

FOREIGN.

Department of the Interior: Bureau of Education. Bulletin, 1927 No. 28: Nursery-Kindergarten-Primary Education in 1924-1926. By Mary Dabney Davis. Pp. 46. (Washington, D.C.: Government Printing Office.) 10 cents.

Mitteilungen des Geologischen Instituts der Landbouwhoogeschool, Wageningen (Holland). No. 11: Düne und Moor bei Vogelenzang; Beiträge zur Frage der quartären Niveauveränderungen an der holländischen Nordseeküste. Von Prof. J. van Baren. Pp. 39+10 Tafeln. (Wageningen: H. Veenman en Zonen.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 79, 1927, Supplement. Synopsis of North American Diatomaceae. Part 2: Naviculatae, Surirellatae. By Charles S. Boyer. Pp. 229-583. (Philadelphia, Pa.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 19, Part 2: On the Difference in Physico-Chemical Properties of various Proteins in Plant Seeds. Second Report: On the Differences in the Physico-Chemical Properties of the Four Kinds of Rice Proteins which vary in their Iso-Electric Points, by Tetsutaro Tadokoro, Taro Tsuji and Shukichi Watanabe; Chemical Studies on Sex Differences of Proteins in Animals and Plants. First Report: Sex Differences of Muscle and Serum-Proteins, by Tetsutaro Tadokoro, Makoto Abe and Shukichi Watanabe. Pp. 93-134. Vol. 21, Part 2: On the Alcohol-Soluble Proteins of Naked Barley. By Eiji Takahashi and Kiyoshi Shirahara. Pp. 43-62. (Tokyo: Maruzen Co., Ltd.)

Bulletin of the National Research Council. No. 59: Chemiluminescence. Report of the Subcommittee on Chemiluminescence. Pp. 62. (Washington, D.C.: National Academy of Sciences.) 1 dollar.

Proceedings of the American Academy of Arts and Sciences. Vol. 62, No. 5: Ionization in Nebular Matter. By B. P. Gerasimovič. Pp. 155-171. 45 cents. Vol. 62, No. 6: Astrophysical Aspects of the General Field of Penetrating Radiation. By B. P. Gerasimovič. Pp. 173-185. 45 cents. (Boston, Mass.)

Proceedings of the Imperial Academy. Vol. 3, No. 8, October. Pp. xix-xx+477-578. (Tokyo.)

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademi i Oslo. Vol. 5, No. 3: On Periodic Variations in Terrestrial Magnetism; Studies based upon Photographic Records from the Polar Station Gjøahavn. By K. F. Wasserfall. Pp. 33. (Oslo: A. W. Brøggers Boktrykkeri A.-S.) 4.00 kr.

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 20, Part 3: Studies on the Inheritance of Sterility in Rice. By Junichi Ishikawa. Pp. 79-201+plates 5-8. (Tokyo: Maruzen Co., Ltd.)

Instituts scientifiques de Buitenzorg, "'s Lands Plantentuin." Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 9, Livraison 4, Août. Pp. 293-472. (Buitenzorg.) 2.50 f.

Bulletin of the American Museum of Natural History. Vol. 57, Art. 3: The Fishes of the Rio Chucunaque Drainage, Eastern Panama. By C. M. Breder, Jr. Pp. 91-176+5 plates. Vol. 56, Art. 5: A Study of the Crystallography of the Calcites of the New Jersey Diabase Region. By Herbert P. Whitlock. Pp. 351-377. (New York City.)

Bulletin of the National Research Council. No. 60: Industrial Research Laboratories of the United States, including Consulting Research Laboratories. Third edition, revised and enlarged. Compiled by Clarence J. West and Ervye L. Risher. Pp. 153. 1 dollar. No. 61: Transactions of the American Geophysical Union, Eighth Annual Meeting, April 28 and 29, 1927, Washington, D.C. Pp. 297. 3 dollars. (Washington, D.C.: National Academy of Sciences.)

Methods and Problems of Medical Education (Eighth Series). Pp. iv+372. (New York City: The Rockefeller Foundation.)

Ministero dell' Aeronautica, Aviazione Civile e Traffico Aereo: Ufficio Presagi. Sondaggi aerologici eseguiti nei giorni stabiliti dalla Commissione per la esplorazione dell' alta atmosfera. 1: Gennaio 1926, maggio 1926, settembre 1926. Pp. ii+30. 2: Febbraio 1927. Pp. ii+11. Annali dell' Ufficio Presagi. Vol. 1. Pp. 104. (Roma.)

Bernice P. Bishop Museum. Bulletin 41: Report of the Director for 1926. By Herbert E. Gregory. Pp. 45. (Honolulu, Hawaii.)

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 34: Higher Education, Biennial Survey, 1924–1926. By Arthur J. Klein. Pp. ii+46. (Washington, D.C.: Government Printing Office.) 10 cents.

Catalogues.

Verlagskatalog 1811–1927. Pp. xxx+86. (Leipzig: Wilhelm Engelmann.)

Apparatus for Ultra-Violet Polarimetry as used by Prof. T. M. Lowry, F.R.S. Pp. 4. Testing Outfit for Precision Work. (Catalogue No. N.31.) Pp. 4. (London: Adam Hilger, Ltd.)

The New Propaganda in Industry: its Nature and Practice. By J. Bertram Ward and W. K. Crampton Chalk. Pp. 28. (London: The Technical Advertising Service, Ltd.)

Diary of Societies.

SATURDAY, JANUARY 28.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—D. W. Baron: Machine Mining at Ashington Colliery.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. R. W. Chambers: Some Tudor Biographers (2).

INSTITUTE OF BRITISH FOUNDRYMEN (Newcastle and District Branch) (at Neville Hall, Newcastle-upon-Tyne), at 6.15.—D. Sharpe: Ramming Moulds by Sand-slinger.

MONDAY, JANUARY 30.

INSTITUTE OF ACTUARIES, at 5.—J. M. Laing: New National Life Tables (1921 Census).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. W. E. M. Wardill: Certain Aspects of Cleft Palate, with Observations on the Causes of Defective Speech and the Remedies proposed for their Treatment.

SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (at Great Northern Hotel, Leeds), at 7.15.—Dr. F. L. Usher and others: Discussion on The Phenomenon of Wetting and its Industrial Significance.

ROYAL SOCIETY OF ARTS, at 8.—Dr. A. E. Dunstan: The Scientific Foundation of the Refining of Petroleum (Cantor Lectures) (III.).

TUESDAY, JANUARY 31.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—Lord Lovat: Migration in the Empire.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. A. P. Newton: The Mercantile Empire, 1606–1783 (I.).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group), at 7.—L. J. Hibbert: Light, Colour, and Colour Filters.

INSTITUTE OF CHEMICAL ENGINEERS.

WEDNESDAY, FEBRUARY 1.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.30—Dr. N. Raw: Medico Legal Problems of Lunacy.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. G. A. Auden: (*a*) The Gild of the Barber Surgeons of the City of York; (*b*) Note on an Ancient Medical Manuscript in the Library of York Minister.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. H. S. Souttar: New Methods of Surgical Access to the Brain.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Capt. P. P. Eckersley: The Design and Distribution of Wireless Broadcasting Stations for a National Service.

INSTITUTION OF ELECTRICAL ENGINEERS (Tees-Side Sub-Centre) (at Cleveland Technical Institute, Middlesbrough), at 7.—G. S. Evans: The Decorative Value of Electric Light.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.—Dr. S. Z. de Ferranti: Electricity in the Service of Man (Faraday Lecture).

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 7.30.—C. H. B. Quennell: House Building through the Centuries.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS, at 8.—L. V. Cocks and E. Nightingale: The Determination of Butter in Margarine.—The Deposition of Metals on Copper from Cyanide Solution:—Dr. B. S. Evans: I. A New Method for the Separation and Determination of Small Amounts of Lead.—Investigations into the Analytical Chemistry of Tantalum, Niobium, and their Mineral Associates:—Dr. W. R. Schoeller and A. R. Powell: X. The Separation of Silica from the Earth Acids. XI. The Precipitation of Titanium by Tannin.—Prof. J. Reilly: The Determination of Carvone in Dill Oil.

ROYAL SOCIETY OF ARTS, at 8.—C. H. Wright: Modern Aspects of Rubber Cultivation.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—Pathological Evening.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

THURSDAY, FEBRUARY 2.

ROYAL SOCIETY, at 4.30.—Prof. A. V. Hill: The Air Resistance to a Runner.—S. M. Manton: On the Embryology of a Mysid Crustacean *Hemimysis lamornæ*.—Dr. R. J. Ludford: (*a*) Studies in the Microchemistry of the Cell (I.); (*b*) Cytological Studies on the Viruses of Fowl-pox and Vaccinia.—G. M. Findlay: Immunological and Serological Studies on the Viruses of Fowl-pox and Vaccinia.—G. E. Briggs: A Consideration of some Attempts to Analyse Growth Curves.—Dr. H. M. Leake: Agricultural Value of Rainfall in the Tropics.—C. Forster Cooper: On the Ear Region of Certain of the Chrysochloridæ.—Marion Hines: The Brain of Ornithorhynchus.—F. H. Edgeworth: The Development of some of the Cranial Muscles of Ganoid Fishes.—Dr. F. W. R. Brambell, Una Fielding, and Dr. A. S. Parkes: Changes in the Ovary of the Mouse following Exposure to X-Rays. Part IV.

LINNEAN SOCIETY OF LONDON, at 5.—Major R. W. G. Hingston: Animal Life on Mount Everest.—W. T. Saxton: The Life-History of Lunularia, with special reference to the Archegoniophore and the Sporophyte.—R. S. Adamson: Notes on the Vegetation of Southern Rhodesia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir William Bragg: From Faraday's Note Books (I.): Ice and Regelation.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. B. Poynder: Some Practical Considerations in the Design of the Automatic Equipments for Heavy Traction Substations.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Major H. N. Wylie: The Design and Production of Steel Aircraft.

CHEMICAL SOCIETY, at 8.—J. W. Jenkin and Prof. C. H. Desch: Some Experiments on Diffusion in Solid Metals.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch).—Fifth Report of the Steam Nozzles Research Committee.

INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Branch).—Prof. C. J. Hawkes: The Marine Oil-Engine (Thomas Lowe Gray Lecture).

FRIDAY, FEBRUARY 3.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—Longitude Observations and 'Shortt' Free Pendulum Clocks. Chairman: Sir Henry Lyons. Speakers: Dr. Jackson, Mr. Shortt, A. R. Hinks, and others.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. E. Miles Atkinson: The Pathology, Diagnosis, and Treatment of Abscess of the Brain.

GEOLOGISTS' ASSOCIATION (at University College) (Annual General Meeting), at 7.—Presidential Address: Further Aspects of the Mountain Building Problem.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Informal Meeting.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—D. Kingsbury: Automatic Substations.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. E. Weekley: Philological Notes.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—A. D. Cowburn: Death Occurring under Operation or Before Recovery from Anæsthesia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. C. C. Baly: Photosynthesis.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institution of the Rubber Industry) (at Engineers' Club, Manchester).—S. A. Brazier and Dr. L. R. Ridgway: The Influence of Zinc Oxide on the Coefficient of Vulcanisation.

SATURDAY, FEBRUARY 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. C. Colles: Musical London from the Restoration to Handel (1660–1759) (I.).

ASSOCIATION OF WOMEN SCIENCE TEACHERS (Annual General Meeting) (at St. Paul's Girls' School), at 4.30.—Sir John Russell: The Growth of Crops: Applications of Botany and Chemistry to Country Life (Lecture).

PUBLIC LECTURES.

SATURDAY, JANUARY 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Proofs of Evolution in Animals and Man.

MONDAY, JANUARY 30.

UNIVERSITY COLLEGE, at 5.—Dr. A. S. Parkes: The Internal Secretions of the Gonads. (Succeeding Lectures on Feb. 6, 13, 20, 27, and Mar. 5.)

UNIVERSITY OF LEEDS, at 5.15.—Prof. E. V. Appleton: Wireless Methods of Investigating the Upper Atmosphere.

GRESHAM COLLEGE, at 6.—G. P. Bailey: Modern Science and Daily Life: Mineral Oils.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—P. Francis: The Poultry Industry: Developments and Prospects.

TUESDAY, JANUARY 31.

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. E. B. Poulton: Recent Discoveries throwing New Light on some of the Commonest Insects.

WEDNESDAY, FEBRUARY 1.

UNIVERSITY COLLEGE, at 5.30.—C. Nowell: The Provision of Commercial and Technical Literature in the Smaller Public Libraries.—At 6.—Prof. A. L. Bowley: Measurement by Index Numbers—Theory and Application to Recent Economic History (Newmarch Lectures). (Succeeding Lectures on Feb. 8, 15, 22, 29, and Mar. 7.)

SATURDAY, FEBRUARY 4.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Mrs. R. Aitken: Village Life in High Castile.