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Ships of the Atlantic Ferry.

IN the story of man's struggle with the forces of Nature, there are few more fascinating chapters than that relating to the conquest of the Atlantic by steam. To cross the western ocean is an every-day affair, and except that no ship can be built that will not roll and pitch amidst the great waves of an ocean swept by gales for more than half the year, travellers are carried in comfort and luxury and with regularity and dispatch undreamt of a century ago. The first ever to carry passengers by steamboat, to form a steamboat company, and to advertise his project, was John Fitch, whose experiments were made on the Delaware and who died in 1798. There were many other pioneers, but of them all, Fitch alone envisaged the future of steam on the western ocean, and with prophetic vision wrote of steam navigation that "The Grand and Principle Object must be on the Atlantick, which would soon overspread the wild forests of America with people, and make us the most oppulent Empire on Earth".

Forty years separate Fitch's untimely death and the first voyage of the famous *Great Western*—Brunel's fine ship which definitely established trans-Atlantic steam navigation. Other ships had crossed the ocean before 1838, partly by steam, partly by sail, but the real pioneer ship of the Atlantic ferry was the *Great Western*, the performances of which, from the day she left Bristol on her maiden voyage until she came to the Thames to be broken up, reflected nothing but credit on her designers and constructors. Followed soon by the *Royal William*, the *Liverpool*, the *British Queen*, by Cunard's ships, the *Britannia*, *Acadia*, and *Caledonia*, and by the ill-fated *President*, before the close of 1840, the Atlantic had been crossed and recrossed by steam vessels more than forty times, and ever since, the Atlantic has been the testing ground and the racecourse of the finest ships in the world. Wooden ships have given way to iron ships and steel ships, paddle ships to screw ships; simple expansion engines were replaced by compound engines, and these again have been superseded by triple expansion engines and Parsons' steam turbines; the displacement of ships has risen from 1000 tons to nearly 60,000 tons, passenger lists runs into thousands, and the time of passage has been reduced from the sixteen days of the *Great Western* to the four days of the *Bremen*; and with greater size and greater speed has come vastly increased safety.

During the first years of the Atlantic ferry,

progress was almost entirely due to men trained in the hard school of practical experience, and the designers who possessed more than a passing acquaintance with the scientific principles underlying the work of the naval architect could be counted upon the fingers of one's hands. With the foundation of the Institution of Naval Architects in 1860, the opening of the Royal School of Naval Architecture at South Kensington four years later, and with the work of Woolley, Merrifield, Rankine, Scott Russell, Barnaby, and especially William Froude, the study of the theory of naval architecture became a recognised part of the training of every constructor, and this with immensely important results to our shipbuilding industry.

This aspect of the subject is recalled by the paper on "Atlantic Ships" read to the Institution of Engineers and Shipbuilders in Scotland by Sir John Biles on Oct. 8. A Portsmouth Dockyard apprentice, Sir John Biles was one of the last students of the old school at South Kensington, from which he passed to Greenwich; in 1876 he was employed on the construction of the notable little vessels H.M. ships *Iris* and *Mercury*, and then in 1880, leaving the Admiralty, he joined the firm of J. and G. Thomson of Clydebank and became concerned with the designing of ships for the Atlantic. Beginning with the *Aurania* and the *Pavonia*, he designed the *America*, the *City of Paris*, and *City of New York*, all remarkable ships in their day, and there is probably no one alive to-day with a more intimate knowledge of the history of subsequent developments or indeed of shipbuilding in all its branches. Given a free choice, it was therefore but natural for Sir John Biles to take for his subject "Atlantic Ships", and his paper is not only a valuable historical review of the achievements of the last half-century but also an interesting introduction to the problem of the Atlantic ship of to-day. His own ships, the *City of Paris* and *City of New York*, were soon surpassed by the *Campania* and *Lucania*, and these again by the German vessels the *Kaiser Wilhelm der Gross* (1897), *Deutschland* (1900), *Kronzprinz Wilhelm* (1901), and *Kaiser Wilhelm II.* (1903). With these vessels speeds had increased to 22½ knots and the time of crossing had been reduced to 5½ days. Our reply, as everyone knows, was the construction of the *Mauretania* and *Lusitania*, which began running in 1907. The sinking of the *Lusitania* in 1915 then left the *Mauretania* without a rival, and until the coming this year of the new German ship *Bremen*, she has retained the blue ribbon of the Atlantic.

Though Sir John Biles begins his paper by remarking that the way to regain the blue ribbon will no doubt be found by the wise young men of the period, he says the problem seems to be much the same as when the *Mauretania* was projected. "Examination of the best information available shows that a ship 1000 feet long by 110 feet beam, if built for Atlantic conditions with geared turbines and water-tube boilers of 500 lb. pressure, would realise a speed of probably 33 knots when fully loaded." But whether such a ship would pay, only the owners could possibly determine. The type of machinery for such a vessel was dealt with by General E. de Vito in a paper at the recent meeting of the Institution of Naval Architects at Rome, but the relative merits of the geared steam turbine, the turbo-electric drive, and the Diesel electric drive for very high speed ships has yet to be determined. It is evident, however, that Sir John Biles does not think that we shall regain the record with a Diesel electric ship.

The Lancashire Witches.

The Trial of the Lancaster Witches, A.D. MDCXII. Edited with an Introduction by G. B. Harrison. Pp. xlvii + 188. (London: Peter Davies, 1929.) 10*s.* 6*d.* net.

IN "The Wonderful Discoverie of Witches in the Countie of Lancaster" we have one of the most authentic documents in the whole literature of witchcraft. It was written as an account of the trial of a number of witches arraigned at an assize held at Lancaster in 1612 by the Clerk to the Court, Thomas Potts, at the request of the two judges before whom the case was tried, and was revised by one of them. It is, therefore, of the highest authority. The book was completed and entered on the Stationers' Register before the end of the same year, and is dated 1613. Not unnaturally it is of great rarity, while the reprint by the Chetham Society, edited by James Crossley in 1845, is not often available. Mr. Harrison's reprint, which follows the original exactly, is therefore cordially to be welcomed in view of the recently revived interest in the subject of witchcraft.

The story of the trial was made familiar to the reading public by Harrison Ainsworth's novel, "The Lancashire Witches"—as a work of fiction perhaps now almost forgotten. The protagonists were two old women of eighty living in the Pendle Forest. One of them, Mother Demdike, had made witches of all her family, her daughter and grandchildren, by name Device. Her rival, Mother

Chattox, had only a daughter who was also a witch. Mother Demdike had been active in witchcraft at least so long before as 1591. She had been joined some five years later by Mother Chattox; but the two families had quarrelled. A number of other witches of both sexes, but mostly women, were associated with them. Twenty, two only being men, were said to have attended the Good Friday feast at Malking Tower in the year 1612 when a plot was hatched to blow up Lancaster gaol, kill the keeper, and liberate Mother Demdike and the other witches then awaiting trial.

With one exception, these witches belonged to the lower stratum of society. The exception was Mistress Alice Nutter, a woman of property and position. Why she should have joined the witches is difficult to see. Perhaps the reason is to be sought in a suggested relationship with that branch of the Nutter family of which three members were said to have lost their lives by witchcraft. In addition to the usual crimes of harming cattle and livestock, the witches were accused of causing at least sixteen deaths, mostly by the familiar method of slowly destroying a clay image of the victim. A local magistrate, Master Robert Nowell, stirred to activity by the state of terror into which the neighbourhood was thrown, had Mother Demdike, Elizabeth Device, her daughter, Mother Chattox and her daughter, Anne Redfearn, brought before him, and after examination and depositions taken, committed them for trial to Lancaster gaol. This was early in 1612. On Good Friday the meeting in Pendle Forest at Malking Tower took place, and as a consequence further arrests were made.

Eleven prisoners—Mother Demdike had by now died in prison—were presented for trial at the August assizes before Sir James Altham and Sir Edward Bromley, justices of assize. These two judges at York in the preceding July had already condemned Jennet Preston, who had been present at the Malking Tower meeting. There were also awaiting trial at Lancaster four witches from Salmesbury, who were accused in particular of bewitching Grace Sowerbutts, a girl of fourteen, on her own evidence.

The trial of the Pendle witches was made the occasion of an expression of the enmity of the Chattox and Demdike families. Accusations and counter-accusations flew from side to side. The principal witnesses were James Device, himself accused, and his sister Jennet, a girl of nine years of age, daughter of Elizabeth Device and granddaughter of Mother Demdike. In passing it may be remarked how with some frequency in witch trials the principal witness is a child of tender years, son or daughter of the accused. Two points of moment in Jennet's evidence were the testimony as to the familiars attending the witches whom she claimed to have seen and the Good Friday feast at Malking Tower. Her brother also stressed these points. The importance of the evidence relating to this feast now lies in the fact that it has been considered by some to have been a ceremonial witches' banquet of the type characteristic of the cult. If this be so, it is the first mention of such a ceremonial in English witchcraft.

In the result, the accused were convicted and hanged with one exception. The fate of the Salmesbury witches differed. They were acquitted. The witness in chief, Grace Sowerbutts, broke down when the trial was practically completed, and in response to a question from the judge, put at the despairing request of the prisoners, confessed to imposture. She admitted that she had been instructed in her evidence by a Roman Catholic priest, who turned out to be a grandson of one and nephew of another of the prisoners.

The confession of Grace Sowerbutts throws a lurid light on the conditions of the times and locality. Panic reigned throughout the district—an atmosphere most tellingly re-created by Harrison Ainsworth in his novel. Lancashire was a hotbed of Roman Catholicism. Feeling was inflamed in both religious parties by recent events. The Gunpowder Plot was fresh in every mind. The action of the priest was said to have been dictated by the fact that the accused had recently left the Roman for the English Church. It is significant that, apart from a form of possession of Grace Sowerbutts and the killing of a small child, the heads of the indictment against the four Salmesbury witches were that they had eaten the flesh of the child, which they had exhumed, and from its fat had made an ointment for the purpose of changing their form, and that with others they had attended an assembly at which dancing and sexual indulgence had taken place with certain strange beings. It is worth while recalling that such accusations as these were the commonplaces of the trials on the Continent under the Papal Bulls against witchcraft and heresy.

Potts is almost violent in his comments on the imposture in the Salmesbury trial, notwithstanding his instructions to confine himself throughout to the facts of the cases, while he accepts the statements in the Pendle trial with equanimity and

approbation. His first editor, Crossley, suggests, but without any grounds whatsoever, that Jennet Device had also received instruction in her evidence. It is certainly curious that she should have dwelt so persistently on the feast at Malking Tower. Her brother James, though himself accused, was responsible almost equally with her for the result of the trial. He consistently emphasised the fact that the guests at the banquet "went out of the house in their own shapes and likenesses", and when they had "gotten on horseback, like unto foales, some of one colour some of another . . . they all presently vanished out of this Examinates sight". It was also James who, according to his own account, was instructed to attend Communion and "not to eate the bread the Minister gave him, but to bring it and deliver it to such a thing as should meet him on his way homewards". For refraining "the said thing threatened to pull him to pieces".

Is this the result of instruction, or was there something real but half understood and imperfectly described which underlay the statements of the two witnesses? Was there in this instance a real witch cult such as was alleged in Scotland and on the Continent, but for which there is little evidence in England? If it were not for the Salmesbury case, opinion might well incline to the latter view. Mr. Harrison, to whom we are indebted for this scholarly edition of Potts's work, holds that "on its face value the Lancaster trial reveals the practice of the witch cult in its full horror".

Mr. Harrison has written an excellent introduction to the trial, in which he reviews the more important English contributions to the discussion of witchcraft and some of the leading cases before 1612, incidentally doing justice to the too often neglected "Daemonologie" of King James I. The book is beautifully produced and does credit to its publisher.

Foraminifera.

Foraminifera: their Classification and Economic Use. By Dr. Joseph A. Cushman. (Cushman Laboratory for Foraminiferal Research: Special Publication, No. 1.) Pp. iii + 401. (Sharon, Mass.: Cushman Laboratory for Foraminiferal Research; London: Thomas Murby and Co., 1928.) 22*s.* 6*d.* net.

THAT the time has come when an exhaustive work upon the classification of the Foraminifera fills a want which has grown yearly more persistent since Frederick Chapman's book[1] went out-of-print, there can be no question. Dr. J. A. Cushman, whose persevering energy, amazing industry, and colossal output cannot but fill older students of the group with mingled admiration and alarm, has made a noteworthy effort to satisfy this want, but whether his revolutionary methods in the matter of classification, his resurrection of long abandoned, if ever adopted, nomenclature, and the overwhelming avalanche of new genera and species with which he and the workers in his "Laboratory of Foraminiferal Research" have swollen the already overburdened catalogue, will be received with equanimity by workers on the eastern side of the Atlantic, is open to doubt. In C. Davies Sherborn's colossal and epoch-marking "Index", more than twenty thousand named species and varieties of Foraminifera are recorded with an accuracy which is final; these are extracted from the two thousand books and papers listed in his "Bibliography" of the group, and these two works, which must ever remain the fundamental 'tools' of all systematic researches upon the subject, were published respectively in 1888 and 1893–96. Since then many hundreds of papers great and small have been published, and the catalogue has necessarily been vastly extended by the establishment of new genera and several hundred new species. Now comes Dr. Cushman with a work in which the index of genera alone cites more than seven hundred and fifty genera, of which less than one hundred and fifty may be regarded as synonyms. It causes the brain of the beginner to reel and his senses to gape.

The question must at once arise: What is the *raison d'être* of this magnificent volume of four hundred pages and fifty-nine plates—without counting tables and text-figures? The answer is to be found in the opening paragraph of the Introduction: "The Foraminifera have come to have a place of economic importance as well as of general scientific interest. Their use in geological correlation, especially as an aid in determining sub-surface structures in connection with petroleum investigations, has become wide-spread." This is the key-note of the book, or, as the author's fellow-countryman might say, "the nigger in the woodpile". Deposits of Foraminifera have taken their place side by side with metalliferous strata as determining factors in swaying the stock exchanges of the New World if not of the Old. As Dr. Cushman has put it in a 'broadcast lecturette', "All industry is run by oil, and oil comes from fossils".[2]

The present reviewer neither contests nor deplores

[1] "The Foraminifera." London, 1902.

[2] "Fossils: what they are." (Nat. Hist. Radio.) *Scientific Monthly*, vol. 27, p. 346. October 1928.

this condition of things: he merely records it. The paramount value of this exhaustive work lies in the fact that out of his intensive and ubiquitous study of the literature, Dr. Cushman has recorded practically everything that has ever been written upon the group—life-history, bionomics, fabric, and protoplasmic body. From this he passes to the collection and treatment of Foraminiferous material, both recent and fossil; technique (that is, methods of study, mounting, and preserving); identification and diagnosis of species. No student embarking upon the study of the group can dispense with this admirable résumé of hitherto recorded knowledge and experience.

The thirty pages of analytical bibliography form an invaluable supplement to that of Sherborn. It is when we reach the sections dealing with economic use, geographical and geological distribution, and classification, that we begin to be assailed by doubt. The case was stated shortly by J. J. Galloway in 1926[3] as follows: There are certain 'Index fossils' that connote strata (for example, *Fusulina* for the Permian, *Lepidocyclina* for the Oligocene, and so on up to Recent), and 'guide fossils', of which "those of restricted range and frequent occurrence are the *ne plus ultra* of criteria for the correlation and identification of horizons. Every worker will decide upon his own, and Foraminifera are vastly superior than [*sic*] Mollusca, being far more numerous and less liable to damage and destruction." In a later paper, Schenck[4] directs attention to the value of Foraminifera as an indication of the temperature-conditions under which the deposits were formed. Dr. Cushman himself, in the 'lecturette' already quoted, likens the strata to floors in an apartment-house with their inhabitants; "each 'floor' has its own fossils, so, if you see what are upon the surface, you know how many 'floors' you have to go down, to reach the 'floor' whose fossils connote oil". It will be observed that a strict geological 'conformity' is assumed—it may be suggested that uncharted un-conformities or 'faults' may seriously embarrass the 'petroleum geologist'. It is also self-evident that the pelagic Foraminifera must be useless as stratigraphical indications, whilst no one will contest the fact that an assemblage of Foraminifera often forms a definite facies in a horizon.

The reviewer's most serious quarrel with the author is his resurrection of names never adopted, or long ago abandoned, in accordance with the strict rules of priority in nomenclature. He was on the spot and should have strenuously stood out for the placing of such works as that of Denis de Montfort (1808),[5] whose only recognised and adopted genera are *Reophax* and *Peneroplis*, upon an Index Expurgatorius. In accordance with the strict rules of priority, we are ordered to abandon *Polystomella* (Defrance, 1822) in favour of *Elphidium* (Montfort, 1808), and *Nonionina* (d'Orbigny, 1826) in favour of *Nonion* (Montfort, 1808), the latter, curiously enough, in spite of the fact that *Nautilus* (*Nonionina*) *asterizans* (Fichtel & Moll) and *Nautilus* (*Nonionina*) *pompilioides* (F. & M.) appear as *Florilus* and *Melonis* several pages earlier in Montfort's work than *Nonion*, which is the 'new' name for *Nautilus incrassatus* (F. & M.), which, excepting in Wood's "Index" (1825), has never been heard of again, whilst, until resuscitated by Dr. Cushman, *Florilus*, *Melonis*, and *Nonion* have not been heard of for more than a hundred years. It would be interesting to know whether Dr. Cushman has examined de Montfort's types and fixed their determination. So far as the present reviewer is aware, they are non-existent.

All these 'words' were duly recorded in 1893 by Sherborn, who signified what they appeared to represent but wisely regarded them as of no systematic value. The irony of the situation is increased by the fact that these generic names have no zoological value *per se*, and their present resuscitation and acceptance is entirely owing to their precedence in printed order in Montfort's treatise. We should be grateful that Dr. Cushman is precluded by the 'Rules' from asking us (following the late Prof. Rupert Jones) to abandon *Vaginulina* (d'Orbigny, 1826) in favour of *Strombites* (Gesner, 1565),[6] which Rupert Jones identified as *Vaginulina lævigata* Roemer! It is probably too late now to protest and plead for a reaction, but it seems to the present reviewer that these cases are covered by the recently published "Opinion No. 107" (NATURE, Aug. 17, 1929) of the International Committee on "the principle that a name in current use is not to be supplanted by an earlier but rarely adopted or an unadopted name unless the argument is unambiguous", etc. The Committee should be urged to establish the records set forth in Sherborn's "Index" as the basis of departure for Foraminiferal nomenclature, and to let the hitherto universally adopted names there recorded stand, notwithstanding any later or future discoveries in forgotten or abandoned works.

[3] "Methods of Correlation by means of Foraminifera", *Bull. Amer. Assoc. of Petroleum Geologists*, vol. 10, p. 562, June 1926.
[4] "The Biostratigraphical Aspect of Micro-palæontology", *Jour. of Palæont.*, vol. 2, p. 158, June 1928.

[5] "Conchyliologie systématique." 2 vols. Paris, 1808–10.
[6] "De omni rerum fossilium genere", Tiguri, 1565, fol. 165 of the concluding part.

Lastly, one can but deplore the splitting up of established genera into an infinity of sub-genera. A single instance will suffice. We are invited to split up the genus *Polymorphina*,[7] starting from d'Orbigny's *Guttulina*, into A-forms, which are split up into *Globulina*, *Pyrulina*, and *Guttulina*—d'Orbignyan names long since abandoned—with sub-genera *Pyrulinella*, *Pseudomorphina*, and *Dimorphina*; and B-forms, which are split up into *Sigmoidella* and *Sigmomorpha*, with sub-genera *Sigmoidina* and *Sigmomorphina*, whilst *Polymorphina* is restricted to a small group coming between the sub-genera of the A- and B-forms.

The present reviewer has so seriously respected Dr. Cushman's invaluable work as "to nothing extenuate", but he equally seriously deplores the overloading and confusion of the already unwieldy nomenclature of the Foraminifera in this care-free and distracting manner. E. H.-A.

Transmission and Distribution of Electrical Energy.

Electrical Transmission and Distribution: a Complete Work by Practical Specialists describing Modern Practice in the Transmission and Distribution of Electricity Supply. Edited by R. O. Kapp. Vol. 1: *Overhead Lines*. Pp. viii + 239. Vol. 2: *Power Cables*. Pp. viii + 241-476. Vol. 3: *Switchgear, Part 1*. Pp. viii + 477-764. Vol. 4: *Switchgear, Part 2*. Pp. viii + 765-1003. Vol. 5: *Sub-Station Work, Part 1*. Pp. viii + 1005-1276. Vol. 6: *Sub-Station Work, Part 2*. Pp. viii + 1277-1563. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 6*s*. net each.

THIS work, which is published in six volumes, describes modern practice in the transmission and distribution of electrical energy. It contains much novel matter and is written by practical specialists. The first volume is divided into four sections. The first three deal with the construction, erection, and maintenance of overhead lines, and the last deals with distribution in rural areas. In the first section good descriptions are given of the poles, steel tubes, and lattice towers that are employed to support the overhead wires, and of the various types of conductors and insulators that are used. The latest data about steel cored aluminium are given, so that they can be substituted in the catenary formulæ. We were interested in the various forms of bird guards described. Incidentally, the insulated perches save the lives of the birds, but that is not the reason why they are erected.

[7] "A Revision of Polymorphinidæ", *Jap. Jour. Geol. and Geog.*, vol. 6, p. 79, 1929 (with Y. Ozawa).

The maintenance of the line necessitates having a staff of patrol men. Each patrol should have No. xii. binoculars and a self-contained focusing spot light so that incipient faults can be early detected. The section on distribution in rural areas is well written and will be a real help in solving a difficult and pressing problem.

In the second volume, the manufacture of power cables, cable-laying methods, underground cables, and consumers' connexions are discussed. We were interested to learn that it is not usually worth while to attempt the recovery of cables which have been laid direct in the earth, as the cost of recovery is often greater than their scrap value. We were also interested to find that in situations where leakage currents from tramway systems—the Germans call them 'vagabond currents'—are known to be prevalent, means should be taken to prevent leakage corrosion of the lead sheaths. If the lead sheath is covered (served) with compounded tape or jute yarn, then it will be protected from corrosion. As vagabond currents must be flowing from the central stations in various districts, watch should be kept for signs of electrolytic corrosion in lead pipes.

In the third volume, the apparatus used when controlling the enormous amount of energy generated in a modern power station is discussed. It will be helpful to junior engineers. Vol. 4 deals with the care of switchgear. On the smooth working of these devices depends the continuity of the supply and in some cases the safety of human life. A good description is given of the ironclad gear used in mining work and of the methods used to protect alternating current mains.

Vol. 5 of the work deals with sub-station practice. The modern trend of electrical development is in the direction of making every operation connected with the running of the station practically automatic. In a large electricity supply station there are usually a large number of automatic sub-stations. Some of these are simply transformers for raising or lowering the pressure. In this case they are pure outdoor stations and the transformers and switches have to withstand rain and snow storms. They sometimes have high pressure terminals and so they have to be carefully railed and only officials can have access to them. Other sub-stations are for running machinery, as, for example, rotary converters; in this case the machinery must be placed under cover. When the automatic sub-station consists of mercury vapour rectifiers, the machinery is contained in a building.

The automatic sub-stations are divided into

groups or 'areas', and a junior engineer has charge over each group. A group is divided into 'districts', each of which is under the charge of two attendants, who work in two shifts—one from 7 A.M. to 3 P.M., and the other from 3 P.M. to 11 P.M. The morning period is best for shutting down the plant for cleaning purposes. During the evening shift the attendant visits each sub-station in turn, carefully inspecting it, and at the right times switching on the apparatus required for the peak load demand. Special care has to be exercised, for there is much greater risk of something going wrong than in a manually operated station. Cleanliness of the station plant is of vital importance, and the attendant is responsible for seeing that labourers allotted to him run no risks. Automatic control can now be supplied to almost every type of converting and transforming plant, and hence considerable economies are effected by saving operators' wages.

Pure Mathematics.

(1) *A Course of Pure Mathematics.* By Prof. G. H. Hardy. Fifth edition. Pp. xii + 455. (Cambridge: At the University Press, 1928.) 12*s.* 6*d.* net.

(2) *The Elementary Differential Geometry of Plane Curves.* By R. H. Fowler. (Cambridge Tracts in Mathematics and Mathematical Physics, No. 20.) Second edition. Pp. ix + 105. (Cambridge: At the University Press, 1929.) 6*s.* net.

(3) *An Elementary Treatise on Differential Equations and their Applications.* By Prof. H. T. H. Piaggio. (Bell's Mathematical Series: Advanced Section.) Pp. xviii + 256 + xxvii. (London: G. Bell and Sons, Ltd., 1928.) 12*s.* net.

THE technical use of the term 'limit' in mathematics retains much of the original meaning of the Latin *limes*, a boundary line, from which it is derived. The notion of limit is also a boundary in another sense, for it marks the frontier between elementary and higher mathematics, where the adjectives must not be taken as necessarily synonymous with easy and difficult. The student who arrives at this frontier has before him an important choice of routes. One route leads to an introduction of limits by an appeal to geometrical intuition by means of which, if the illustrations are judiciously chosen and if the language is sufficiently vague, most of the theorems of the calculus can be deduced with a generality which is almost embarrassing. Advance by this route may seem to be rapid, but the cost is a mistrust of mathematical processes which appear to lead to paradoxical results. The other route proceeds to a somewhat longer but rigorous building of foundations on a secure arithmetical basis. The start may be fairly arduous but the reward is a feeling of security founded on understanding. That there is an increasing tendency to realise the value of the more rigorous treatment of foundations is evidenced by the above three books, for (1) is in its fifth edition, while (2) and (3) are in their second.

(1) No introduction to the theory of functions of a real variable can dispense with a discussion of the domain of that variable—the real numbers of the arithmetic continuum. Prof. Hardy leads the student by easy stages through the concept of real number to functions of a continuous variable and so to the differential and integral calculus. Illustrations are freely given and a wide selection of examples. The book is interesting to read and places the elements of the subject on a secure basis for further advance. An appendix to the new edition explains the symbols O, o, $\sim$.

(2) A rigorous treatment of elementary plane differential geometry (curvature, contact, envelopes, singular points, asymptotes), with occasional excursions into three dimensions. It is a pity that Mr. Fowler did not incorporate Neville's revised theory of envelopes which is based on a new definition of characteristic points, the scope of which is indicated in the preface. It would have been kinder to include definitions of symbols such as O and $\sim$, instead of referring the reader elsewhere. The value of this book lies in giving a treatment of geometry in English on the lines of several French works, for example, Goursat's "Cours d'analyse".

(3) This is a really good book, which should appeal to all who embark on the study of ordinary and partial differential equations. The mathematical equipment demanded is not extensive and the subject is treated in a sane and exact manner, with copious illustrations. The chapters on numerical approximation and integration in series are very well written. The examples, which are numerous, contain many important results. In the new edition, a long chapter has been added, introducing among other things a brief note on Schrödinger's wave equation and some recent work of Remes on numerical approximation.

These three books together form a most suitable introductory course on the analytical side of pure mathematics.

L. M. MILNE-THOMSON.

Our Bookshelf.

Analytical Chemistry. Based on the Text of Prof. F. P. Treadwell. Translated, enlarged and revised by Prof. William T. Hall. Vol. 2: *Quantitative Analysis.* Seventh edition. Pp. xiii + 848. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 30*s.* net.

THE seventh edition of this work embodies quite a number of alterations and extensions of the methods in the earlier editions, as, for example, the determination of titanium in steel and in ferro titanium, Moser and Niessner's separation of beryllium from aluminium, the determination of vanadium, the use of potassium phthalate in standardisation. It would have been useful to have an account in this work of some of the more recent methods of determination of metals by means of pyridine-thiocyanate, or the useful pyridine method of separating iron from manganese, and the utilisation of thorium salts for determining fluorine.

The outline of the course of instruction beginning at p. 757 is intended primarily for students of the Massachusetts Institute of Technology, and as regards the problems given it has a wider utility; but much of the course is rather too parochial for general use. Many of the exercises set in this section, especially those dealing with potentiometric titrations, cannot be dealt with from the information supplied in the text, and require reference to other works. It is much to be desired that the use of the form of burette illustrated in Fig. 103 with the rubber tubing and bead should be discouraged as being obsolete and inaccurate.

There are few printing errors, but Problem 1 on p. 789 does not appear to have a meaning. On p. 753 the factor for titanium does not appear to be corrected for the revised atomic weight. British readers need to remember that the tables connecting specific gravity and weight per gallon refer to the U.S. gallon of 8·34 lb. Despite these minor criticisms, this work maintains its reputation as one of the most trustworthy text-books of quantitative analysis available to the chemist, and it is indispensable. J. J. F.

The Profession of Engineering: Essays. Edited by Dugald C. Jackson, jr., and Prof. W. Paul Jones. Pp. ix + 124. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 7*s.* 6*d.* net.

THE object of this book is to give a broad "and yet detailed conception of the profession of engineering". We are told in the preface that "It may be used as a text for freshman orientation". It contains nine short articles on engineering by very eminent Americans, including the President of the United States. But if it is intended to recruit the engineering profession by its means, we are afraid it will not be successful, at least in Great Britain. It lacks in many places the human touch required to rouse the enthusiasm of youthful students.

One of the best of the essays is by John Hays Hammond on "The Chemical Engineer". He points out that however wonderful a process found out in a laboratory may be, it can have little usefulness in industry until it is put into practice economically enough to make it worth while both to the buyer and the person who puts it on the market. It is the function of the chemical engineer to do this. The essay concludes as follows: "The chemical engineer stands to-day on the threshold of a vast virgin realm; in it lie the secrets of life and prosperity for mankind in the future of the world".

The final article on the engineer's contribution to modern life is an address given by Herbert Clark Hoover to the American Institute of Mining and Metallurgical Engineers. He tells of his first engineering job in South Africa: of how the hard-fisted mine managers refused the offers of the young graduates for posts as assistant managers. Ultimately, some of them, including Hoover, took the job of pushing a car and pounding a drill on the wettest level of the mine at a wage of two dollars a day. In after years Hoover was grateful for this apprenticeship. He concludes by saying that we have no right to think in terms of our own generation alone: "A greater America for our children will in large degree depend on the engineering profession".

Die Rohstoffe des Tierreichs. Herausgegeben von Ferdinand Pax und Walther Arndt. Lieferung 1. Pp. 160. (Berlin: Gebrüder Borntraeger, 1928.) 15 gold marks.

THE account of the raw materials of animal origin, of which this part is the first to be received, is to form two octavo volumes. About thirty contributors will deal with the following, among other subjects—fats and oils, wax, skins and pelts, feathers, the hard parts of vertebrates, calcareous material, excrement, sponges, ornamental material, substances used in polishing and grinding, insect galls, pigments, scents, substances used in medicine, poisons, food, and luxuries.

The present part forms the first chapter of the second volume, and gives details of the ornamental use of invertebrates or of parts thereof—the rope of spicules of the glass-rope sponge, the skeletons of Venus's flower-basket, the sertularians, Stylasteridæ, the precious coral, black coral and the stony corals, 'crabs' eyes' (gastroliths), mother-of-pearl and pearls. For most of the materials a brief definition is first given, the history of its use is outlined, the mode of origin of the material, the capture of the animal which formed it, and the preparation and further treatment of the product are described. Methods of testing the quality of the commercial article, and warning as to substitutes and imitations, are given, and finally reference is made to the commercial centres concerned in trading in the material in question; trade names and prices are stated and references to published memoirs are appended. Under 'pearls' is also given an account of the culture pearls of Mikimoto and the methods used for distinguishing these.

The work promises to be of considerable interest and use to naturalists and to business men.

Mrs. Fisher : or the Future of Humour. By Robert Graves. Pp. 95. *Diogenes : or the Future of Leisure.* By C. E. M. Joad. Pp. 102. *Romulus : or the Future of the Child.* By Robert T. Lewis. Pp. 95. *Hibernia : or the Future of Ireland.* By Bolton C. Waller. Pp. 96. (To-day and To-morrow Series.) (London : Kegan Paul and Co., Ltd. : New York : E. P. Dutton and Co., 1928 and 1929.) 2*s.* 6*d.* net each.

AN interesting literary feast is that provided in the " To-day and To-morrow " Series. A hundred 6 in. × 4 in. pages give no scope for exhaustive treatment of any subject, but the writers selected are doubtless those most capable in the main of doing justice within the defined limits. It is unsafe to generalise, but these four, out of a library approaching one hundred volumes, may be taken as representative. The chief titles lend an initial quaintness. One of the four, however, " The Future of Humour ", is deplorably lacking in this quality ; the three other selected works are entirely convincing. Mr. Joad considers the " Future of Leisure " in sympathetic style and laments the destruction of the countryside. Mr. Lewis in his " Romulus " crystallises the modern attitude towards child education. Both Mr. Waller in his thoughtful " Hibernia " and Mr. Joad may illuminate Mr. Graves in regard to true humour : " Good taste is hard to come by and easy to lose ", writes Mr. Joad, and Mr. Waller depicts the cynic admirably, to whom he attributes the view that " any man who has his hand on the tiller must also have his hand in the till ". Will the future establish the accuracy of the views expressed by these augurs in their engaging theses ? P. L. M.

The Propionic Acid Bacteria. By C. B. van Niel. Pp. viii + 187 + 4 plates. (Haarlem : J. W. Boissevain and Co., 1928.) 3 dollars.

THE increasing industrial importance of propionic acid for the preparation of esters and ketones (methylethyl- and diethyl-ketone), and for application in the cellulose industry, led the author to submit the group of propionic acid bacteria to a thorough re-investigation, the results of which are contained in this monograph.

These organisms occur in milk and other dairy products and are best obtained from Emmentaler cheese (Gruyère), in which they are responsible for the formation of the characteristic ' eyes '—bubbles filled with carbon dioxide produced as the result of the propionic acid fermentation. The bacteria, for which the author, following Orla Jensen, adopts the generic name *Propionibacterium*, are facultative anaerobes, and their characteristic chemical effect is the fermentation of lactic acid and glucose, and in some cases the disaccharides and the polyhydric alcohols, with production of propionic, acetic and carbonic acids. Acetic and carbonic acids are produced in molecular proportions from lactic acid, whilst the molecular ratio of propionic to acetic acid is about 1·8, whereas in the fermentation of glucose this ratio rises to 2·4, and from glycerol almost pure propionic acid is produced. The author considers that the manufacture of propionic acid by the action of these bacteria on glucose is a feasible proposition, the great drawback being the slow rate of fermentation. His monograph will supply any prospective manufacturer with a large amount of information on which to base his process.

Dairy Bacteriology. By Prof. Bernard W. Hammer. (Wiley Agricultural Series.) Pp. xii + 473. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1928.) 25*s.* net.

DR. HAMMER'S book covers considerable ground in an interesting and comprehensive manner, and will doubtless be of great use to students of dairy bacteriology and dairy husbandry. It deals with the normal and abnormal microbiology of milk, cream, butter, and cheese, the methods of preservation of dairy products, and tests for quality of milk and cream. Sections are devoted to the bacteriology of evaporated, sweetened, condensed and powdered milks, ice cream and fermented milks (Bulgarian butter-milk, Acidophilus milk, etc.). The subject of butter cultures (' starters ') is well treated, and the importance of the presence of the ' associated ' citric acid fermenting organisms (*Streptococcus citrovorus* and *S. paracitrovorus*) in addition to the lactic acid bacteria, is stressed.

An important section of the work is devoted to the spread of human disease through milk and its derivatives, both with regard to diseases in which the infecting virus comes primarily from the producing animals (bovine tuberculosis, Malta fever) and those in which the milk or milk products are contaminated from human sources (typhoid, diphtheria). In the former connexion the relationship between *Brucella abortus* and *B. melitensis* is gone into at some length, the two organisms being regarded as varieties of the same species and producing similar types of human infection.

R. ST. J.-B.

Cours d'électricité industrielle à l'usage des élèves-ingénieurs : leçons professées à l'Institut industriel du Nord. Par A. Defretin. Tome 1 : *L'Électricité dans la science de l'ingénieur.* Pp. xi + 582. (Paris : Hermann et Cie, 1929.) 95 francs.

THIS treatise on industrial electricity will be completed in three volumes. The first volume is divided into two parts. In the first part the general properties of fixed electrical circuits and of electrical machines are described. The style of the author is admirably clear and he takes great pains to simplify the theory. He lays stress on the importance of the student examining his equations to see that they are homogeneous, a point which is frequently neglected by industrial writers. He points out that permeability is a double valued function and explains why engineers in their formulæ adopt a constant value for it.

Instead of the ' watté ' and ' déwatté ' formerly commonly used by French writers, we have ' active ' and ' reactive ', which we think much better. Very clear line diagrams are given to illustrate the working of dynamos and alternators. Photographs of parts of actual machines are kept quite distinct from the text and are shown at the

end of the book. When the student has mastered the theory, he will find it an excellent exercise to find out the function of the various parts of the machines shown. A good description is given of mercury vapour rectifiers, both single phase and polyphase. Quite a satisfactory and useful theory of their working is given, relations being found between the power expended, the voltages, and the currents.

Colour and Colour Theories. By Christine Ladd-Franklin. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xv + 287 + 9 plates. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1929.) 12*s.* 6*d.* net.

THIS book gathers together the scattered records of the life-work of Dr. Ladd-Franklin on the subject of colour vision, and thereby enables the value of that work to be more readily assessed. Possibly the best short indication of the nature of that work and its accompanying battles is supplied by the author herself in her review of Parsons' "Colour Vision": "The very discreditable state of Colour discussion . . . may be summed up . . . in this way:

Helmholtz. — Trichromatism is a fact.
Hering. — Tetrachromatism is a fact.

"These are evidently two absolutely contradictory statements, but both are true. *Que faire?* At this point I felt myself obliged to interfere, with (1) a reformed terminology, and (2) an adequate colour theory. I substitute for the above two statements this:

The Development Theory.

"*Tri-receptorism* is a fact and tetrachromatism is a fact, and these two facts are reconciled in the development colour theory—. . . ." R. J. B.

The Child's Conception of the World. By Prof. Jean Piaget. Translated by Joan and Andrew Tomlinson. (International Library of Psychology, Philosophy and Scientific Method.) Pp. ix + 397. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1929.) 12*s.* 6*d.* net.

PROF. PIAGET herein gives the next step in the attempt to interpret the results of the painstaking investigations in child psychology carried out at the Institut Rousseau. The problems here dealt with are distinct from those dealt with in his "Studies in Child Logic", and will be followed by a further volume dealing with the "child's physics and the analysis of the explanations children give . . . concerning the detail of phenomena and the way in which transformations and movements take place".

The book is divided into three parts under the heads realism, animism, artificialism. In the first, the origin and growth of a child's notions of thought and dreams are dealt with. In the second we find consciousness attributed to things and the growth of the concept of life. In the third the development of ideas as to the origin of common objects, as sun and moon, trees and mountains, are followed, and the meaning and origin of child artificialism considered. R. J. B.

Über Druckschieferung im varistischen Gebirgskörper. Von Prof. Dr. Axel Born. (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 7, Heft 22.) Pp. vii + 329-428 + 6 Tafeln. (Berlin: Gebrüder Borntraeger, 1929.) 12 gold marks.

THE *Druckschieferung* is interpreted as pressure-cleavage which converts clays into clay-slates and sericitic phyllites. The process is explained as the beginning of dynamo-metamorphism; the various stages, which are classified as shale, jointed mudstones, block cleavage, smooth cleavage, and fold-cleavage, and the microscopic changes in the rocks, are well described and illustrated by Dr. Born.

The monograph deals with the development of the slates in the Rhineland, Harz, and Thuringia and Bohemia. In the bibliography the only British authors included are Sharp, Hutchins, and North. A useful table gives some equivalent terms in English, French, and German.

What is Eugenics? By Major Leonard Darwin. (The Forum Series, No. 9.) Pp. viii + 88. (London: Watts and Co., 1928.) 1*s.* net.

IN many ways this tiny volume is a more effective plea for a eugenic social policy than the same author's large work, "The Need for Eugenic Reform". The need for brevity has made him concentrate on essentials and disregard relatively unimportant considerations, while the style is clearer and less involved. Starting with domestic animals and the selection, conscious and unconscious, to which man has subjected them, he leads the reader on naturally to consider man himself as fundamentally kin to them, the product of evolution by heredity and natural selection. The interaction of heredity and environment is explained with simplicity and common sense: and a swift glance, in the light of these biological principles, is given to the nation's racial qualities. The remaining chapters are devoted to the possibility and desirability of eugenic methods. The book is the best brief answer yet published to the question the title asks.

Le totémisme. Par Maurice Besson. (Bibliothèque générale illustrée, 10.) Pp. 80 + 60 planches. (Paris: Les Éditions Rieder, 1929.) 22 francs.

THIS book may be interesting to the French public, but it is of little value for English students, as the subject has been dealt with at greater length and with more insight and accuracy by many English-speaking writers. An example of the lack of knowledge shown is afforded by the following quotation: "If the Papuan peoples of New Guinea are not totemic, in the western part of this great island, amongst those of the eastern zone, there exist tribes organised into clans but possessing no totems and not observing taboos". The bibliography is meagre. There are 31 excellent plates, which are not referred to in the text; this is scarcely remarkable, as few have any bearing on totemism; two of the figures are upside down.

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.*]

Earthquake Sounds heard at Great Distances.

THE severe earthquake which occurred in New Zealand on June 17, 1929, was remarkable for the great distance at which the sounds which accompanied the shock could be heard.

The sounds were extraordinarily loud. After the shock, people rushed out of whatever building they were in. They were calming down when these tremendous booming sounds were heard. I have heard some say that they thought the earthquake had started a new volcano, or a terrific eruption had

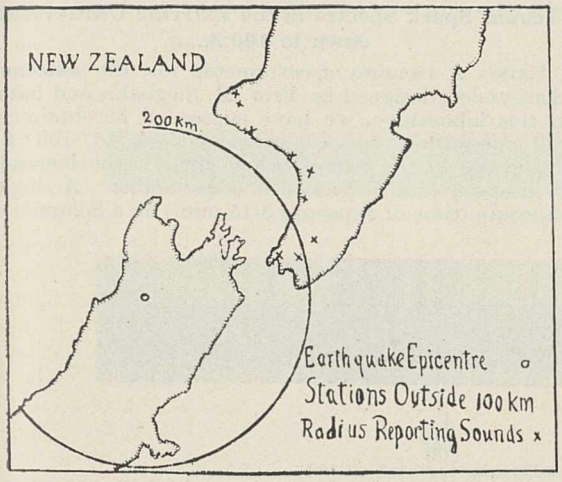

FIG. 1.—Stations at distances greater than 100 km. reporting sounds accompanying New Zealand earthquake of June 17, 1929.

taken place at the hot spring district at Taupo. In the commotion following an earthquake it is very difficult to obtain accurate figures for time elapsing between two events.

At Wellington, 165 km. from the epicentre, the sounds were heard approximately 12·5 minutes after the first earth movement was felt. The sounds were described by various observers as resembling heavy rumblings, detonations, boiler explosions, and naval gun practice. Observers gave widely differing estimates of the loudness of sounds heard, but they were sufficiently intense to add to the general alarm. The sound appeared to come from a bank of clouds to the south, in the general direction of the epicentre, and continued for about an hour.

The sounds were reported from coastal towns along the Taranaki Bight and so far north as New Plymouth (Fig. 1). Observers differed considerably about the length of time intervening between the first earth movement and the first sound. The most trustworthy data are set out below.

The epicentre and source of sound were generally believed to be at Murchison. The sounds in the area of greatest destruction were deafening and of extreme loudness, creating as great panic as the earthquake itself. Most observers described them as tremendous subterranean explosions. At Nelson, about 85 km. from Murchison, the sounds resembled the whistling and rush of wind. At Blenheim, 130 km. from the epicentre, only sounds of a local origin directly connected with the earthquake were heard. There is some indication of a zone of silence at several places 125 km. distant, but owing to the general commotion, sounds had to be comparatively loud to be heard.

TRANSMISSION TIME OF EARTHQUAKE SOUNDS.

Place.	Distance from Epicentre.	Time after Earthquake Felt.	Time after Earth Movement at Epicentre.
	km.	sec.	sec.
Wellington .	165	750	817
Orongorongo .	175	675	746
Patea . .	224	600	691
Hawera . .	239	600	698
Wanganui .	246	720	824
Stratford .	250	900	1006
Inglewood .	272	900	1011
Mean . .	224	735	828

Observers probably felt the transverse (S) earthquake waves, which have an approximate velocity of 245 m./s. The earth movements at the epicentre occurred within a few seconds of the accompanying explosive sounds. The time given in the last column is the computed time elapsing after the sounds started at Murchison until heard at the various stations in the Taranaki Bight. A time curve (Fig. 2) drawn from these data approximates closely to that found from great explosions. In most cases the sounds are seen to have taken longer than required if they had travelled along the surface at the normal rate of 340 m./s. in still air.

Doubtless the sound went up to a considerable height and was refracted downward either at a marked inversion in the upper troposphere or in a higher layer in the stratosphere with a marked variation of temperature or density. The average time lag agreed very closely with that which would occur from Borne's hypothesis of a change in density at high levels due to a hydrogen-helium atmosphere.

Good weather conditions prevailed over New Zealand on June 17. An intense anticyclone had been slowly advancing over the Dominion for several days prior to the earthquake. Over the Taranaki Bight the winds were south-west, force 4, and favourable for the transmission of sound to the majority of stations in Table I. Although a northerly air was blowing at Wellington at the ground, pilot balloon observations showed that at one to two km. south-west winds were blowing with an average velocity of 6 m./s. The sky was half overcast with cumulus clouds.

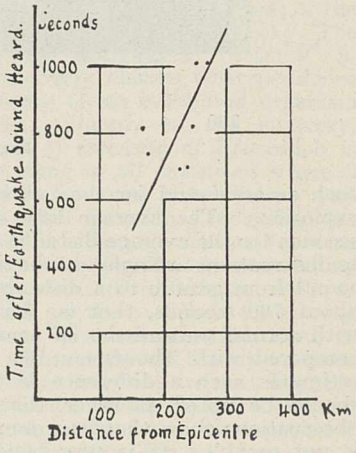

FIG. 2.

It is remarkable that sounds were not reported from points south of the epicentre. The level, thickly populated Canterbury Plains lying within a radius of two hundred kilometres were favourably situated for hearing sounds. Calms or easterly airs were recorded at all stations between the epicentre and this district.

This absence of sound suggests uneven refraction at an inversion in the troposphere. From the area of audibility it would appear that the inversion extended over the Taranaki Bight, but did not extend southward over the Canterbury Plains. The anticyclonic weather conditions which had prevailed for several days were favourable for the establishment of an inversion. ANDREW THOMSON.

Meteorological Office,
Wellington, New Zealand, Aug. 26.

MR. THOMSON'S report with regard to the sounds proceeding from the New Zealand Earthquake of June 17, 1929, is of great interest.

It is usual for sounds to be heard coming from the ground in the neighbourhood of the epicentre of an earthquake, but I have found no earlier reference to sounds transmitted through the air to great distances from such an origin.

One difficulty in understanding the phenomenon is that owing to the high velocity of sound in rocks, waves coming from below and refracted into the air must pass upwards nearly vertically. (Gutenberg, "Grundlagen der Erdbebenkunde", p. 35, gives 13° as the maximum inclination to the vertical.) No possible constitution of the atmosphere would permit the return of such waves to the ground.

Mr. Thomson remarks that the times he has computed for the passage of the initial aerial disturbance from Murchison to various places are on the average such as are found for the 'abnormal' audibility of explosions. The average time in his table is 828 seconds for the average distance 224 km. According to observations in England,[1] the time of passage of the sound from gunfire to a distance 224 km. would be about 760 seconds, that is, the delay as compared with normal transmission of sound is 100 seconds as compared with Thomson's 168 seconds. In rough estimates such a difference is to be expected. It should be noted, however, that the more accurate observations show that von dem Borne's hypothesis is not tenable. It is now believed that abnormal audibility is to be explained[2] by the high temperature of the layers between 40 km. and 60 km. above ground from which the air waves return to earth.

Mr. Thomson lays stress on the fact that the sounds were heard to the north-east of the epicentre and not to the south-west. In this connexion it may be pointed out that the earthquake occurred during the New Zealand winter and that transmission to north-east in the southern hemisphere is analogous to transmission to south-east in the northern hemisphere.

According to War-time experience, the firing on the Western Front was heard in England in summer, in Switzerland in winter. It appears that in our part of the world the zone of abnormal audibility is to be found to the north-west of the source of sound in summer and to the south-east in winter. It is not unlikely that a similar rule holds good in New Zealand, abnormal audibility being possible to the south-west in summer and to the north-east in winter.

I hope that interest in the subject will be stimulated by the experiences related by Mr. Thomson and that an experimental investigation of the transmission of air waves to great distances will be undertaken in New Zealand. F. J. W. WHIPPLE

Kew Observatory, (Superintendent).
Richmond, Surrey, Oct. 15.

[1] Int. Research Council. Commission on Solar and Terrestrial Relationships. 2nd Report, 117; 1929.
[2] NATURE, **111**, 187; 1923; **118**, 309; 1926.

Vacuum Spark Spectra in the Extreme Ultra-Violet down to 100 A.

USING a vacuum spectrometer for the extreme ultra-violet, designed by Prof. M. Siegbahn and built in this laboratory, we have succeeded in obtaining and measuring optical spectra down to 100 A. Especially in the region below 600 A., the increase in intensity and dispersion is considerable. A single exposure (time of exposure 5-15 min.) on a Schumann plate 260 mm. in length gives the region up to 1250 A. with dispersions of 3·5 A./mm. at 100 A. and 6·5 A./mm. at 1000 A., a concave grating on speculum metal with 571 lines per millimetre being used.

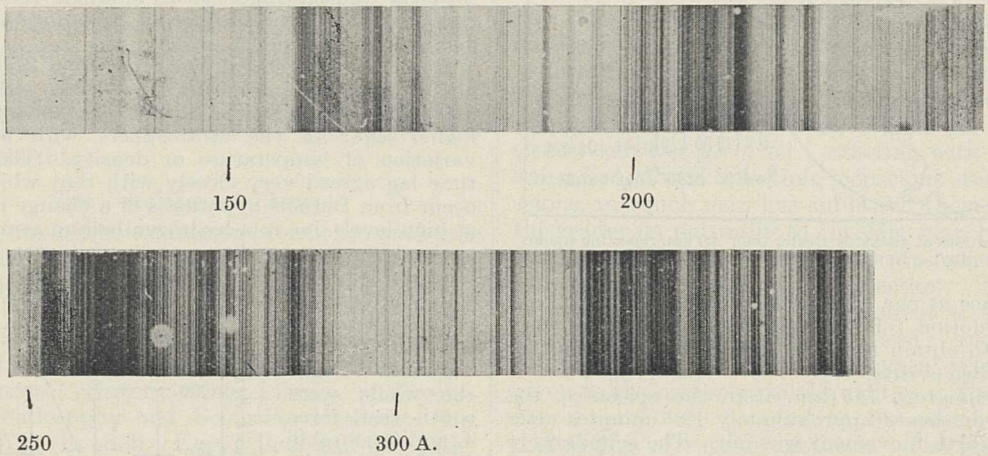

FIG. 1.—Spark spectrum of copper (lower end). Enlarged 4 times.

On a spectrogram of copper (Fig. 1) taken with a slit width of 0·005 mm., all the lines given by Millikan (Millikan and Bowen: *Phys. Rev.*, **23**, p. 1; 1924) down to 155·7 A. are found as intense line-groups. Our measurements on this element extend to 126 A. and include about one hundred and forty lines below 200 A.

An investigation of the lighter elements from lithium (3) to fluorine (9) has revealed hitherto unknown spectral series of highly ionised atoms. The lines reported by Millikan and Bowen are generally found within their limits of error. Especially below 400 A. they are, however, separated into two or more components. But we have not been able to check the lines at 136·6 A. and 144·3 A. ascribed by Millikan to oxygen, which have hitherto been considered as the shortest wave-lengths measured in optical spectra.

Starting from the hydrogen line at 1215·68 A., a system of wave-length standards has been determined, extending to 192 A., in very good agreement with the measurements by Bowen in the region above 500 A.

In the spectrum of Li II we have measured the first three lines of the principal series $1\,S - m\,P$.

Li II.	λA.	ν.	$m\,P$.	$1\,S$.
$1\,S - 2\,P$	199,263	501849	108263	610·112
$1\,S - 3\,P$	177,99	561829	48330	610·159
$1\,S - 4\,P$	171,54	582954	27247	610·201

The P-terms are those given by Werner from higher series (Copenhagen 1927).

Taking $610{\cdot}112 \pm 100$ cm.$^{-1}$ from $1\,S - 2\,P$, which is a mean value from four spectrograms, we get for the ionisation potential of Li II

$$610{\cdot}112 \times 1{\cdot}2339 \times 10^{-4} = 75{\cdot}282 \pm 0{\cdot}012 \text{ volts.}$$

We have also obtained the first line of the corresponding series for Be III, thus extending the ultra-violet spectrum to 100·25 A. Though the ratio of grating-space to wave-length is about 180, the line

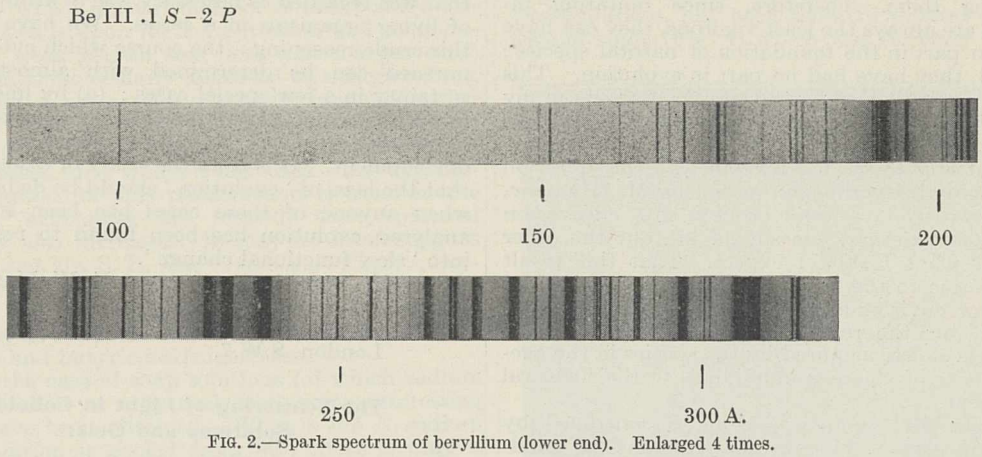

FIG. 2.—Spark spectrum of beryllium (lower end). Enlarged 4 times.

appears extremely sharp (Fig. 2). The spectrum of Be III was hitherto unknown and the $2\,P$ term undetermined.

If we extrapolate $2\,P$ from He I and Li II, we have

$$2\,P = 243{\cdot}263 \pm 500 \text{ cm.}^{-1},$$
$$1\,S - 2\,P = 997{\cdot}506 \pm 300 \text{ cm.}^{-1},$$

and

$$1\,S = 1240{\cdot}769 \pm 800 \text{ cm.}^{-1}.$$

From this we calculate the ionisation potential of Be III to be $153{\cdot}10 \pm 0{\cdot}10$ volts.

In closing this brief preliminary report, we may recall that Mr. Söderman, working in this laboratory, recently followed the X-ray K-series of the lighter elements down to and including beryllium. The $K\alpha$ line of this element as given by Söderman extends from 111 A. to 122 A. with its maximum at 113·4 A. It is interesting to note that the optical spectra and the X-ray spectra of the same element thus overlap each other.

BENGT EDLÉN.
ALGOT ERICSON.
Physics Laboratory, University, Upsala,
Sept. 20.

Natural Selection.

MY letter on "Natural Selection", which appeared in NATURE of Aug. 10, has provoked comments from three correspondents, namely, Prof. Garstang, whose letter appeared in the issue of Sept. 14, Mr. J. B. S. Haldane, whose letter was published on Sept. 21, and, lastly, Prof. Poulton, in his letter in the issue of Oct. 12. I should like to deal with all three letters at the same time.

1. Prof. Garstang's letter appears to me to be trivial and not to touch the main point at issue. Let me briefly restate this principle. When a man builds a house he is the selector of the materials, and his mind guides the selection. In so-called 'natural selection' there is no selector: when an animal is 'selected', all that is meant is that it is there—if we ask why it is there, the answer is that it 'fits the environment'; if we inquire further why it fits the environment, we are told 'because it is a favourable variation'; if now we seek to discover what produced the favourable variation we are told 'the environment' ('conditions of life', Darwin), *therefore the surviving organism is the one which reacts best to the environment*, which was my point. For the rest I commend with confidence Prof. Garstang's letter, both as to logic and taste, to the judgment of readers of NATURE.

2. The thoughtful and reasonable letter of Mr. Haldane deserves a more detailed answer, which I shall give as briefly as possible.

Mr. Haldane asks whether, when I reject natural selection as a cause of evolution with one hand, I am not accepting it with the other, when I say that the most vigorous survives. Did not Darwin talk of the 'survival of the fittest'? My answer is, No! The two statements are not equivalent. 'Fitness' in Darwin's mouth meant any chance correspondence between an idiosyncrasy of an individual organism and the environment. Vigour, on the contrary, denotes a *certain level of intensity of life* which is essentially the same thing in all *organisms where it occurs*. This intensity connotes the efficient performance of all the vital functions, including the *function of growth*; and it is through this last function that the organism acquires all its characters including those that distinguish it as an individual from its fellows of the same race; these are the so-called 'fluctuating variations' of Darwin. Natural selection then, in weeding out the less vigorous, leaves to survive those in whom growth and other functions are most healthy, and only these realise to the full the typical characters of the species. Consequently by it the species is kept true to type and healthy, but nothing new is produced. Of course, if we make the further assumption, that if the environment changes then the vigorous individuals respond to the change by new habits of growth, then I agree, only this is not Darwinism but Lamarckism.

Mr. Haldane further complains that I reject mutations as 'pathological'. Under this head I included those deviations from type which do occur rarely in Nature, and frequently turn up in the farmyard and

garden, and have been the subject of intensive study on the part of geneticists. 'Pathological' perhaps conveys a slightly wrong impression, but if I say that *all mutations are the outward sign of inward constitutional weakness* my meaning will be clear. To give all the evidence in favour of this view would occupy too much space—the recent experimental results all point in this direction. I think that the most unexpected and dramatic support for this position came from Mohr, a distinguished geneticist, in an address delivered to the Genetic Society about two years ago, at which, so far as my memory serves me, Mr. Haldane was not present. Mohr compared the mutations of *Drosophila* to the colours of the spectrum. At the red end there were the (imaginary) 'modifying factors', which produced no effect by themselves on the appearance of the animal, and did not impair its vigour. As one passed towards the blue end the mutations produced visible changes in form and lessened the viability until the sub-lethal mutations were reached corresponding to the violet rays, which entailed the almost certain death of the individuals embodying them. Therefore, since mutating individuals are always the least vigorous, they can have played no part in the foundation of natural species; in a word, they have had no part in evolution. This view was also endorsed by the late Dr. Bateson in my laboratory about one and a half years before his death.

I fail utterly to see the relevance to this question of the Russian experiments quoted by Mr. Haldane. That of two wild varieties brought into cultivation and planted together, one should kill out the other is exactly what I should expect. That this result should be due to the fact that one was better suited to the new environment I gladly concede, but this 'suiting' was the result of habits of growth and metabolism slowly acquired by the species in the age-long response of vigorous individuals to their natural environment.

But, says Mr. Haldane, vigour is controlled by Mendelian 'genes'. I envy Mr. Haldane his child-like faith in the Mendelian genes. Mendelian genes are abstractions which exist in the mind of the geneticist *and nowhere else*. Mr. Haldane, who is a most able mathematician, knows very well that by properly choosing your genes any conceivable difference between two races or mutations can be made to fit. As an old Oxford 'greats' man, he is also well aware that a proof of the validity of the Mendelian scheme attained in this way is not worth the paper it is written on.

I cordially agree with Mr. Haldane that physiological differences are the really decisive factors in the survival of species. I hope to live to see a rational quantitative explanation of these differences in vigour put forward—not an explanation in terms of imaginary and undemonstrable 'genes'.

Mr. Haldane's concluding statement fills me with amazement. He suggests that the random crossing of different genes distributed throughout wild species may supply the material on which natural selection may act. Suppose that we grant for a moment that genes are realities; then the crossing of the genes existing in a species would give a limited number of combinations; selection amongst these would leave only a few surviving, and when this had been done no further evolution would be possible. If he says that new genes arise, then this is equivalent to saying that new variations arise; and we shall have to inquire what are the causes of these new variations, and the whole question is in the melting-pot again. The mutations of the farmyard and garden certainly will not help us, and for an example of the bankruptcy of any attempt to apply the 'gene' theory to explain the difference between two natural local races I recommend to Mr. Haldane a close study of Goldschmidt's work on the geographical races of *Lymantria dispar*.

3. Prof. Poulton, from whom it is a pleasure even to differ, and with whom it would be a joy to agree, deals chiefly with the question as to how far adult butterflies are attacked by birds. On this subject I do not profess to be an expert; in my original letter I quoted the opinion of Bergh, who claimed to have made an exhaustive investigation of the subject, and he could find little evidence of such attacks. Prof. Poulton is probably more nearly right than Bergh was, though I must say that the additional evidence which he brings is not overwhelming. But the real point is this; even if Prof. Poulton could prove—and he is much too honest to claim this—that certain butterflies escaped being eaten because their wings had a certain pattern of pigment, this would throw no light on the process by which they acquired this pattern. In the days of Prof. Poulton's youth, and of my boyhood, to prove an evolutionary series all that was regarded as necessary was to arrange a series of living organisms in a series. We have outgrown this crude reasoning: the course which evolution has pursued can be determined with almost absolute certainty in a few special cases: (*a*) by lineage series in palæontology; (*b*) by the close comparison of allied subspecies or races; (*c*) by the study of individual development. It is from the study of cases like these that the laws of 'evolution' should be deduced; and when anyone of these cases has been successfully analysed, evolution has been found to resolve itself into 'slow functional change'.

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The Scattering of Light in Colloidal Solutions and Gels.

THE scattering of light in colloidal solutions is a fundamental property, which depends upon the size, shape, and nature of the colloidal particles, and is therefore expected to reveal the intimate changes taking place in those systems under different conditions. I planned about three years ago to investigate the different colloidal-chemical problems by a systematic application of the light-scattering technique. Some of the problems which have been so far investigated are: (1) the mechanism of the formation of colloidal solutions from molecularly dispersed material; (2) phenomena like the ageing and coagulation of sols; (3) studies in soap solutions and gels; (4) mechanism of the swelling of gels, and so on.

The investigations consist essentially of the measurement of the intensity and depolarisation of the scattered light, combined with an ultramicroscopic examination (wherever possible), and a study of other physical properties.

One of the systems first studied was agar sol, and some of the results obtained have been published already (*Proc. Roy. Soc.*, **122** A, p. 76; 1929). The other systems investigated include gelatin and silicic acid sols and also soap solutions. Some of the interesting results obtained are briefly given below:

(1) The mechanism of the formation of silicic acid sols by the hydrolysis of methyl silicate has been investigated by following the changes in the intensity of the Tyndall light with time. The results indicate that primary particles are formed at first and that these form bigger aggregates after some time.

(2) The changes in the light-scattering capacity during the ageing of silicic acid sols have also been

studied. The time – Tyndall intensity curves are quite regular and distinctly *S*-shaped, being at first convex to the time axis and concave towards the later half. The results could be explained both qualitatively and quantitatively by assuming that ageing consists of the slow aggregation of colloid particles, and that the formation of these aggregates, upon which the increase in the intensity of the Tyndall light depends, is determined by two factors—(*a*) an increase in the number of effective collisions between the particles, probably due to a slow decrease in their charge, and (*b*) a continual decrease in the number of the original particles, which causes a corresponding decrease in the rate of formation of the aggregates.

(3) The results obtained with gelatin sols (at the iso-electric point) are very similar to those of agar sols (loc. cit.). The following view is suggested to explain the results : Gelatin sols have been considered to be polydisperse systems in which part of the gelatin is present in the molecularly dispersed condition, and the rest as polymolecular micells. The extent to which a particular sol is molecularly dispersed depends upon its concentration and temperature. In weak gelatin sols (less that 0·5 per cent) the gelatin is molecularly dispersed to a large extent. When such a sol (at the iso-electric point) is cooled below 25°, the intensity of the scattered light increases rapidly, whereas the depolarisation factor first decreases, after which it increases. The explanation suggested for this phenomenon is that, as the molecular aggregates are formed, their spherical symmetry also increases. It may be interesting to mention that Mr. S. R. Rao (*Ind. Jour. Physics*, September 1928) observed a similar effect, namely, a decrease and a subsequent increase in the optical anisotropy as the molecular association of liquids like propionic and butyric acids increases.

(4) In the case of soap solutions (of which sodium oleate is taken as a typical case) some interesting results have been obtained. When a 0·5 *N* sodium oleate solution is cooled from 80°, there is only a slight increase in the Tyndall intensity until about 25° ; but below 25° the intensity increases rapidly. The lower the temperature the more rapid is this increase. This suggests that lowering the temperature causes a supersaturation of the solution, and hence the sodium oleate is condensed in the form of colloidal particles. This view is further supported by the recent work of Dr. Thiessen, who found that the formation of particles on suddenly cooling sodium oleate solutions obeys a law similar to that found by Prof. Tammann in the case of the formation of nuclei from supercooled liquids.

Further, the temperature – Tyndall number curves do not follow the same course during the initial cooling and the subsequent heating of the sodium oleate solution ; that is, they show *hysteresis*, very similar to that observed by me in the case of agar and gelatin sols. The variation of the depolarisation factor (θ) when the solution is cooled shows a striking similarity to that observed with gelatin and agar sols, namely, a marked decrease in θ at first and afterwards an increase. This indicates that we are here concerned with the formation of molecular aggregates, which have a greater spherical symmetry than the original molecules.

One of the interesting points discovered by Prof. McBain and Miss Laing is that the conductivity and the osmotic activity of a sodium oleate solution are unaffected when it sets to a clear gel. From this they conclude that the colloidal particles in the sol and gel must be identical in nature and amount. A more significant property of colloidal solutions is their light-scattering capacity. I have found that the intensity of the light scattered by the clear gel of sodium oleate is distinctly higher than that of the sol state, thus indicating that the particles in the gel are bigger than in the sol.

A detailed account of this work will be published elsewhere. The above researches were carried out in the chemical laboratories of University College, London. I am at present carrying out an investigation in the laboratory of physical chemistry, Upsala, to see how far the above views regarding the molecular state of gelatin are supported by an ultracentrifugal study of gelatin sols. K. KRISHNAMURTI.

Upsala, Sweden,
Oct. 3.

A New Species of *Cronartium* from the Himalayas.

OF the various parasitic rusts of the coniferous trees now under investigation, one which baffled us for many years and has been a serious pest of *Pinus longifolia* Roxb., the *Chir* pine, in north and north-western India, has been recently worked out. The æcidial stage (Fig. 1) which was formerly known as

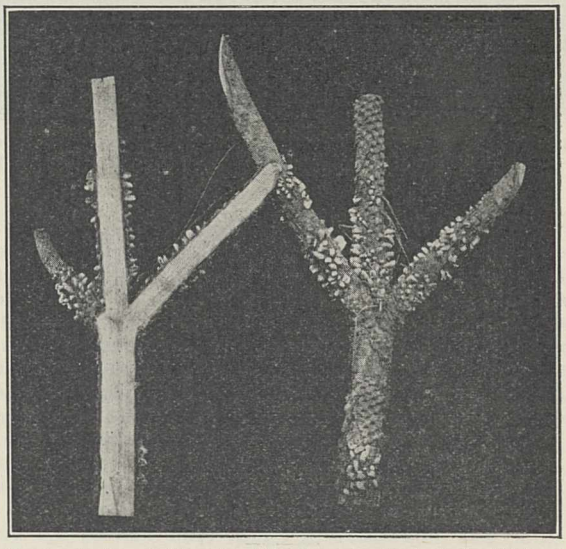

FIG. 1.—Section of *Pinus longifolia* stem showing typical æcidial sori of *Peridermium himalayense*.

Peridermium orientalis Cooke, and also as *Peridermium complanatum* var. *corticola* Barclay, has been recently redescribed as *Peridermium himalayense* Bagchee (*Indian Forest Records*, Botany Series, Vol. 14, Part 3, 1929). This fungus has caused much mortality every year not only in the plantations of Almora (Fig. 2) and Naini Tal, but has also impeded natural regeneration in Kumaon and Garwhal Himalayas, where the young pine stands appear to be doomed to eventual extermination. The infection and mortality is very severe in young crops of pine up to the advanced sapling stage, but the poles and mature trees are apparently safe from attack. The *Cronartium* stage has been discovered on *Swertia* species, of which *S. alata* Royle, *S. angustifolia* Ham., *S. cordata* Wall., appear to be very susceptible to this rust. The biological relationship of the two stages has been proved recently by cross-inoculation experiments. The detailed report of this investigation will appear in a subsequent issue of *Indian Forest Records*.

An interesting point appears in connexion with this stage of the fungus on the broad-leaved host. *Swertia* species, being annual herbs, appear soon after

the early monsoon rains, and at this time infection takes place through the æcidial spores from the diseased pine of the neighbourhood. They die off at the close of the autumn after a short span of life of about four months. On examination of the herbarium specimens at Dehra Dun, some were noticed with this rust on the leaves, specially *S. alata* and *S. cordata*. They were collected between the years 1891 and 1894 and from widely separated localities, from Bashahr, Punjab, and Jaunsar in the United Provinces. The earliest infection of pines was recorded from these divisions. The above species of *Swertia*, being native of the Himalayas, often grow in the *Chir* pine forest; if there is a diseased pine in the neighbourhood, there is a chance of infection of *Swertia* growing close by. It will be interesting to know from the historical side of the disease if some of the infected specimens have found their way to any other phanerogamic herbarium of the world. Not infrequently one can find certain fungi by looking through a collection of flowering plants in a herbarium. The species of *Swertia* carrying the *Cronartium* infection, the date of collection, and the locality, are the points which interest me.

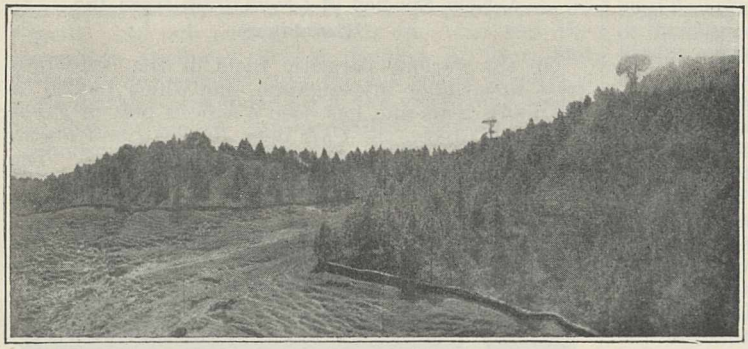

FIG. 2.—Typical gaps (left-hand portion) caused by heavy mortality of young growth as compared with the better stocking (right-hand portion). Attempts to fill up the gaps by periodic sowings have been unsuccessful.

KRISHNADAS BAGCHEE.
Mycological Laboratory,
Forest Research Institute, Dehra Dun,
Sept. 19.

Raman Effect from Powdered Crystals.

MAY I make the following remarks concerning Mr. A. C. Menzies' letter in NATURE of Oct. 5, p. 511, on the "Raman Effect from Powdered Crystals". For several months I have been engaged in studying the Raman effect from different crystalline powders, and I can corroborate Mr. Menzies' statement that the reflection of the incident radiation by such powders is no obstacle in observing at least the stronger Raman lines. I tried several ways of obtaining Raman spectrograms, and found that the best results could be secured when the powdered crystals were filled into a rectangular plate-glass vessel of a few cubic centimetres contents, on which the light of a mercury arc was focused through one side surface, while the secondary radiation was observed by putting the spectrograph as close as possible to another side of the vessel perpendicular to that where the primary radiation entered.

The scope of my investigation was to compare the Raman spectra of different crystals with the already known Raman spectra of solutions of those crystals in some liquid. My first material was naphthalene ($C_{10}H_8$), the Raman spectrum of which is known as a liquid (cf. A. Petrikaln and J. Hochberg, *Zeitschr. f. phys. Chem.*, B **3**, 217; 1929) and as a solution in carbon tetrachloride (cf. A. Dadieu and K. W. F. Kohlrausch, *Sitzber. Wien. Akad.*, IIa, **138**, 335; 1929, and *Phys. Zeitschr.*, **30**, 384; 1929), both of which are identical. I obtained 9 lines, namely, at the wave-numbers 21,541, 21,637, 21,910, 22,170, 22,420, 23,320, 23,682, 23,950, and 24,195 cm.$^{-1}$, all of which coincide within the experimental error with already known stronger Raman lines, which have been found and classified by the above-mentioned workers. I may add that with no other substance was I so little hampered by the continuous background on the Raman spectrograms, which in this case very likely results from reflection of the primary radiation. The Raman lines came out especially clear, in fact, little less than in a solution of carbon tetrachloride.

I proceeded then to the investigation of some crystals, which, when dissolved in water, split up into ions, and I chose substances of which the solutions have already been investigated (cf. A. Carelli, P. Pringsheim, and B. Rosen, *Zeitschr. f. Phys.*, **51**, 511; 1928; R. G. Dickinson and R. T. Dillon, *Proc. Nat. Acad.*, **15**, 334; 1929). For this reason amongst the nitrates those of sodium, ammonium, and calcium were chosen. The 4358 A. mercury line, when scattered by ammonium nitrate, gives rise to two lines of almost equal intensity with wave-numbers 22,232 and 21,882 cm.$^{-1}$, corresponding to a frequency shift of 706 and 1056 cm.$^{-1}$ respectively (against 723—weak—and 1050—strong—observed by Dickinson and Dillon). With calcium nitrate I obtained but one line with 21,884 cm.$^{-1}$, corresponding to 1054 cm.$^{-1}$ shift (Dickinson and Dillon observed 1052 strong and 723 weak). From sodium nitrate a strong line at 21,864 cm.$^{-1}$ was obtained (shift = 1074 against 1050 as observed by Dickinson and Dillon), whilst the existence of two weaker lines remained doubtful. This is the only case where I found a difference outside the experimental error between the 1050 shift in the solid state and in the solution. One large $NaNO_3$ crystal has since been examined by C. Schaefer, F. Matossi, and H. Aderhold (*Phys. Zeitschr.*, **30**, 581; 1929), and four lines were observed, which proves that the use of one big crystal, when available, is of course preferable to that of powder. The difference between the size of the shift in the solution and in the crystalline state is corroborated and fully discussed in this paper, but it seems not to exist for ammonium and calcium and also not for potassium (cf. Mr. Menzies' communication).

Of the other crystal powders investigated I can say that $NaNO_2$ gave one line at 21,605 cm.$^{-1}$, corresponding to a shift of 1333 (Carelli, Pringsheim, and Rosen observed 1303 and besides 696 and 785), and that NaCl and NH_4Br gave no lines. As a last example solid carbon dioxide may be mentioned, with which I equally failed to obtain Raman lines, although one knows by the work of Rasetti on gaseous carbon dioxide that such lines exist.

R. BÄR.
Physikalisches Institut der Universität,
Zürich, Oct. 9.

Golgi Body and Vacuome.

A SMALL piece of ovary of a very young pigeon was kept for about twenty minutes in a trough of dilute solution of neutral red, just pink in colour (strength—1/25000 physiological salt solution). It was then teased out and examined under an oil immersion lens in artificial light. The young oocytes

showed a nucleus and a thick granular mass at one end of the nucleus in the general cytoplasm (C. F. D'Hollander's " yolk nucleus of Balbiani " observed with classical methods). In this area particularly, in more advanced oocytes, could be seen the following three structures (Fig. 1).

(1) A large number of small bodies, some of which are spherical, with a clear core in the middle, and others, very minute crescent-shaped structures, embracing a little dense archoplasm (G.B.). These we identify as Golgi bodies. We get exactly similar

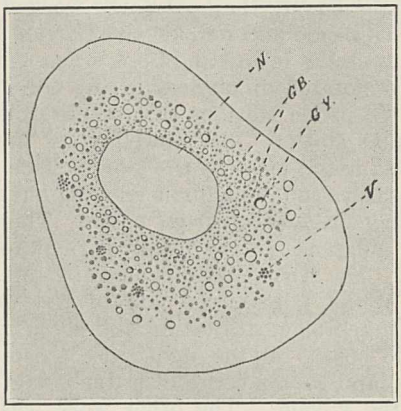

FIG. 1.

bodies occupying the same position in material fixed with silver nitrate formalin or osmic methods.

(2) Prominent and highly refractive bodies each surrounded by two or three crescents of the nature of Golgi bodies referred to above. We identify these as Golgi yolk (G.Y.).

(3) Dispersed in between the Golgi elements are groups of vesicles which take a cherry red colour with dilute neutral red, and are evidently Parat's ' vacuome' or Gatenby's ' vacuoles ' (V.).

After the red vacuoles had appeared, we added a little 2 per cent osmic acid, but observed no special change in the cells, except that the osmiophilic portion of the Golgi bodies got a little darker. *The vacuoles remained unaffected.* We then tried the reverse process, that is, we first examined the ovary in 2 per cent osmic acid solution. We could observe the Golgi bodies and refractive Golgi yolk but *no vacuoles.* On adding the dilute neutral red solution, the vacuoles appeared in about fifteen minutes. This evidently shows that the red bodies are not osmiophile and therefore are something totally different from Golgi bodies, which always respond to the well-known specific tests.

D. R. BHATTACHARYA.
R. S. DAS.
Zoology Dept., Allahabad,
Sept. 20.

Lethal Action of Ultra-Violet Light on Micro-Organisms in a High Vacuum.

IN comparing the action of low velocity electrons on micro-organisms with that of ultra-violet light, the question arose as to what the action of ultra-violet light on micro-organisms in a very high vacuum would be. It was rather expected that the lethal action *in vacuo* and in air might be different, since, in a high vacuum, the organisms are of necessity in a very dry state and in open air they may be very moist. In order to get a general idea of the lethal action *in vacuo* the following experiments were tried.

Slides of platinum and glass, coated with a thin smear of *Staphylococcus albus*, were placed in a vacuum of 5×10^{-6} mm. of mercury and exposed for various periods, through quartz, to the full radiation of a 110 volt A.C. quartz mercury arc at a distance of 24 inches. After exposure, the slides were removed from the vacuum, coated over with a thin strip of moist solid agar and incubated for from twenty-four to forty-eight hours. The results obtained are as follows:

1. *Staphylococcus albus* on glass or platinum in a vacuum of 5×10^{-6} mm. is readily killed by ultra-violet light. This may indicate that the lethal action is a direct one rather than due to some chemical change taking place.

2. Comparison of slides exposed simultaneously *in vacuo* and in air show that the lethal action in a vacuum is just as great as in air.

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University of Cincinnati.

Witchcraft and the Black Mass.

IN the notice of Dr. Kittredge's " Witchcraft in Old and New England " in NATURE of Oct. 5, the reviewer says: " One of the accused gave evidence that he had carried away from Mass a part of the Host, which points to a knowledge of the ritual now known as the Black Mass ". Surely this inference is very precarious. G. G. Coulton gives numerous examples of the use of the Host as a vaguely powerful charm, quite apart from any ritual except such as is implied in the use of any charm whatever; for example, it was sometimes scattered over the fields to promote the growth of the crops. Such practices would seem to be the raw material out of which ritual is manufactured, and suggest that the Black Mass would be a later development.

H. WALLIS CHAPMAN.
Whitethorns, King's Road,
Berkhamsted, Oct. 17.

JAMES DEVICE'S statement must be taken in its context. If the Host had been required merely for the purpose of a charm, he would scarcely have been instructed to hand it over to " a Thing " which he thought would have torn him to pieces when he failed. It is, therefore, legitimate to infer something more vital to the witches' organisation. As Boguet only a few years before had had the Witches' Sabbath and the Satanic Mass under investigation, and Gaufridi's case was raising the same issue, a reference to that ritual becomes still more probable, though whether due to the witness's own knowledge or to the suggestion of his examiners remains an open question. On the Continent the existence of the Satanic ritual had been recognised for centuries.

THE REVIEWER.

Dipterous Parasites of Tsetse Flies.

IN a recent issue of the *Bulletin of Entomological Research*, Major E. E. Austen has a very interesting paper on the flies of the genus *Thyridanthrax*, which are parasitic on tsetse flies, and are the only Diptera known to be parasitic on *Glossina*. I thought at once of the species of *Glossina* fossil in the Miocene of Colorado, and of the numerous genera of Bombyliidæ also fossil in the same shales. These, or some of them, may well have been parasitic on *Glossina*, and may have had something to do with its extinction in America. It is interesting to note, however, that *Thyridanthrax* belongs to a series of Bombyliidæ little related to the fossil genera, and can have no connexion with them.

T. D. A. COCKERELL.
University of Colorado,
Boulder, Sept. 13.

Final Report on the Great Barrier Reef Expedition.

By Dr. C. M. YONGE, Balfour Student in the University of Cambridge.

THE last members of the Expedition left Low Island on July 28, 1929, one year and twelve days after the arrival there of the original party from England. We were so fortunate as to survive the year without serious illness and without damage to the huts, boats, and equipment. The original programme of work was not only completed in almost every particular but also was extended in many ways. It is also gratifying to report that the money raised (less than £9000 in actual money, though much assistance was received from shipping companies, the Queensland Government,

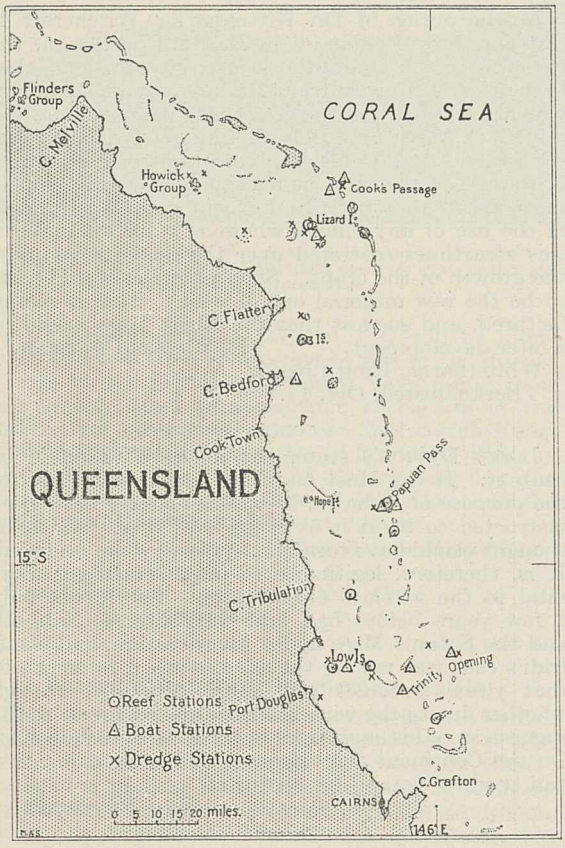


FIG. 1.—Map of the coast of North Queensland between Cairns in the south and the Flinders Group in the north, showing the Great Barrier Reef and principal islands, and indicating the range of operations of the Expedition.

and scientific sources, representing a considerable additional sum) proved sufficient, but only a very small sum remains for publication, and additional money will be needed for this purpose.

During the second half of the year spent on Low Island, work was extended in many directions up and down the Barrier, when the knowledge gained during the long period of intensive work on the Island enabled the fullest use to be made of comparatively short visits to other regions. Fig. 1, which shows the coast of Queensland from Cairns northward past Cooktown to the Flinders Islands, a stretch of some 200 miles, covers the regions most intensively worked, plankton and hydrographic stations, dredging stations, and reef surveys being all appropriately indicated.

In addition to their weekly station three miles east of Low Island, the boat party worked a series of stations inside and outside the Barrier at intervals between the Island and Cook's Passage. They found no notable differences in the conditions at any of the inside stations from those obtained at the regular station. An upwelling of the deeper water was found close to the Barrier face outside, oxygen saturation being little effected but nutrient salts being brought up from below. There was a notable difference in the forms of plankton taken outside. Mr. Orr, accompanied by Mr. Otter, visited Willis Island, the site of the Commonwealth Meteorological Station and some 240 miles from the coast, on the lighthouse steamer *Cape Leeuwin*, and took a series of water bottle samples during the voyage. The other work was carried out on the *Magneta*, a powerful motor launch hired from Townsville.

A series of local dredging stations was also worked with the *Magneta* and an extended cruise made as far as the Howick Islands. The rectangular dredge and the Agassiz trawl were used, and a varied and interesting collection of the bottom fauna and flora was made. The mud bottom, which is very widespread within the Barrier, is singularly deficient in life of any kind, but the sandy bottom around Lizard Island in particular is covered with a rich growth of *Halimeda*, on which lives a varied invertebrate fauna providing food for fish which there abound. Wherever there was a big tidal scour, the clean rocky bottom provided a rich, though difficult, dredging ground. Both dredging and trawling were attempted outside Cook's Passage and Papuan Pass in several hundred fathoms of water. Some material was obtained, but without an ocean-going boat equipped with suitable power winches, this type of work cannot be properly conducted. The small motor and friction winch purchased by the Expedition proved invaluable for dredging everywhere and for plankton and water samples in deep water.

The shore party, accompanied by Mr. Spender as surveyor, carried out detailed ecological surveys of Three Isles, an island resembling Low Island in many particulars, and also of portions of the Outer Barrier which was worked from Lizard Island. This latter excursion, carried out on the M.L. *Tivoli* from Townsville, was undertaken during the new moon spring tides in June, when remarkable day low tides were experienced. These coincided, fortunately, with calm weather, which alone rendered such work on the Outer Barrier possible. During these same low tides the remainder of the party at Low Island visited several of the adjacent reefs on the *Luana*. Fig. 2 gives some indication

of the wealth of coral exposed at Pixie Reef, a small coral formation which lies isolated in the middle of Trinity Opening. During the corresponding tides in July, a four-day trip was undertaken with the M.L. *Daintree* by the majority of the members of the Expedition and portions of the Outer Barrier to the north and south of Papuan Pass examined. The weather on this occasion was far from favourable, but the spectacle of the Pacific rollers breaking on the cemented outer ridge of the Barrier, on to which it was driven by a strong south-easterly gale, was of an impressive grandeur.

A party consisting of Dr. and Mrs. Yonge, Mr. Moorhouse, and Mr. Nicholls left Low Island towards the end of April and spent five weeks in the Torres Straits. The pearling industry at Thursday Island was investigated, also the work of Papuan Industries, Ltd., at Badu Island, and a fortnight was spent on Murray Island, the site of Dr. Mayor's expedition in 1913. The particular object of this trip was a survey, so far as the limited time allowed, of the marine industries in the Straits and an examination of further economic possibilities. The members of the party were especially impressed with the policy of the Queensland Government, which aims at making the Islanders self-supporting; they already run some thirty boats, cutters, and luggers, which collected a considerable proportion of the sixty thousand pounds worth of *Trochus* shell exported from Thursday Island during 1928. Dense shoals of 'sardines' (a small clupeoid) congregate around the shores of Murray Island during the daytime, dispersing at night, presumably for food, for their stomachs are always found empty during the day. They probably come inshore for protection, as they are pursued relentlessly by sharks and other predatory fish. So dense are the shoals and so easy of access, that the natives are able to catch them with

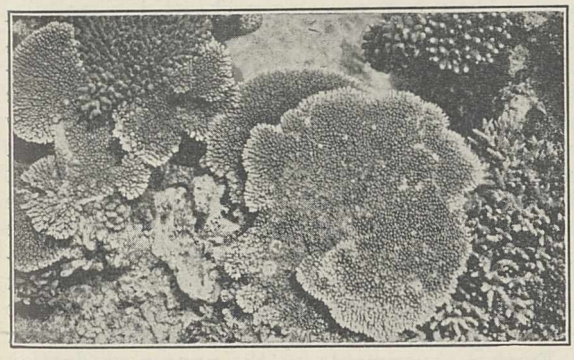


FIG. 2.—Exposed coral, largely species of *Acropora*, on Pixie Reef, taken during low water springs at the beginning of June.

multipronged spears, as many as six fish being sometimes caught with one throw of the spear. The more usual method of capture, however, is by means of a cast net, and Fig. 3 shows a typical catch. The economic possibilities of this fishery are apparent; the fish are always present, always accessible, and in practically unlimited numbers. Apart from existing fisheries, pearlshell, *Trochus*, bêche-de-mer, and turtle, there should be great possibilities in the development of a trade in cured fish with the East, while the value of dugong oil is such that a development of this fishery would probably be a sound commercial undertaking. The labour question is greatly simplified by the presence

FIG. 3.—Typical catch of 'sardines' after one throw of cast net at Murray Island.

of a highly intelligent and physically almost perfect population on the Islands.

The final excursion took place after the departure from Low Island, Miss Marshall, Mr. Orr, and Dr. and Mrs. Yonge breaking their journey south at Gladstone, whence they visited the Capricorn Islands, a series of isolated coral islands south of the true Barrier. Probably as a result of the more varied character of the winds, these islands differ considerably in character from the northern reefs, while the coral, though less rich in variety, is, if anything, more luxuriant and certainly more spectacular. The economic possibilities are considerable; there is a turtle-canning factory on Heron Island while fish are abundant, Gladstone possessing the only fish freezing and curing factory in Queensland.

The routine work on phytoplankton and zooplankton from the station three miles east of Low Island and from the lagoon were continued until the end of year by Miss Marshall and Mr. Colman respectively. Only minor fluctuations were found. Mr. Colman also investigated the vertical distribution of the plankton by day and by night, and found that the surface waters by night were five or six times as rich as by day, while the night catches contained many organisms rarely caught by day. Miss Marshall also continued her work on the production of oxygen by the planulæ of *Pocillopora* and *Porites* and found that, in the former, the production of oxygen is greatest between

9 A.M. and 3 P.M., when it just balances the loss due to respiration.

As foreshadowed by the plankton figures, Mr. Orr failed to find any significant changes in the chemical constituents of the sea, in the course of his routine analyses. He continued work on the diurnal changes over the reef flat and in the mangroves, and for a comparison with the latter worked, in conjunction with Mr. Moorhouse and Mr. Nicholls, on those at the mouth of the River Daintree and made an examination of the river itself. With the assistance of Miss Marshall on the biological side, he continued his work on the distribution of sediment and its effect on corals with results which are not in agreement with current views. This work was completed by an examination of the reef flat to a depth of 15 feet by a hand bore. The samples, which will have to be worked out later, were of unexpected interest, Low Island lying apparently on a foundation of soft mud !

The work of the shore party under the direction of Dr. Stephenson has been concerned primarily with the ecology of Low Island and of Three Isles and the region about Lizard Island. The general ecological survey of Low Island, a general account of the physical features of the island and of the faunas associated with the different regions, has been illustrated and extended by the detailed quantitative survey of narrow strips of ground traversing several different zones and by additional surveys of smaller patches. The arrival of Dr. E. Fraser and Dr. S. M. Manton, who both spent some four months on Low Island, alone rendered possible the completion of this extensive programme of work. Dr. Stephenson also had the assistance of Mrs. Stephenson, while Mr. Spender's surveys of the various regions provided the topographical background.

The other work of the shore party included, as previously noted, an investigation of the breeding seasons of selected corals and other animals by the periodic taking of gonad samples over 10 months, and by other means. Special attention was paid to the production of planulæ by *Pocillopora* and *Porites*, the development of which was studied in great detail. Dr. Fraser also did interesting work on the development of a species of *Eudendrium*. The experiment on the growth rate of corals secured on to cement blocks was successfully completed with striking results in many cases. Further data were secured by the marking of corals *in situ* under water, using the diving helmet. A number of young colonies was collected on clean shells, stones, etc., put out for the purpose. Considerable collections of animals were made during the survey, while Mr. Tandy's botanical collections were supplemented in many ways, notably by the preparation by Miss M. D. Glynne, who stayed with us for three weeks in April, of a map showing the distribution of the *Lithothamnion* zones.

Mr. Moorhouse confined himself very largely to work of economic importance, although he took every opportunity of assisting Mr. Orr and gaining experience in all branches of the work, experience which will be of great value to him in the future when he will be in charge of work, largely economic in character, for the Government of Queensland. He has spent much time observing the habits and life-history of *Trochus*, which he found (contrary to previous reports) to discharge its eggs freely into the sea between the months of March and July, the smallest laying animal having a basal diameter of 5 cm. His work on their growth, from measurements of marked animals and monthly measurements of extensive unsorted collections, points to an increase of some 1·7 cm. in basal diameter in 7 months. He is also able to estimate the basal diameter of *Trochus* one, two, three, and four years old, respectively 2·5-3 cm., 4·5-5 cm., 7-7·5 cm., and 9·5-10 cm. This work represents the first accurate information about the breeding and growth of this economically most valuable animal.

Excellent results were obtained with the sponges cut up and planted out, very considerable growth being recorded. Work was continued on the breeding of bêche-de-mer, while all possible information concerning the fish, either at first hand or from fishermen, was obtained. The work done on Murray Island has been noted above.

The leader's party, consisting of Dr. and Mrs. Yonge and Mr. Nicholls, continued their work on the physiology of corals and certain reef animals. The feeding mechanisms of some forty genera of corals were studied ; all were found quite capable of capturing animal prey, though the actual mechanism involved showed interesting variations. Further work on the digestive enzymes of corals showed that the amylase previously reported comes from the algæ, not the coral, which, however, contains a weak glycogenase. The powerful protease really consists of two enzymes, an ' erepsin ' and a ' trypsin '. Further work was done on the speed of digestion of captured plankton. Waste matter is excreted exclusively by way of the ' absorptive ' zone in the mesenterial filaments. Symbiotic algæ have been found degenerating in many places in the tissues, besides the mesenterial filaments, though never in such numbers as in the ' absorptive ' zone. By heating for an appropriate time at certain temperatures, it is possible to kill many of the algæ without damaging the coral ; this occurred naturally on many parts of the reef flat during the low tides in the summer. The algæ intercept the phosphate excreted by the coral, the phosphate content of the surrounding water dropping quickly to zero, but in the case of corals without algæ (for example, *Dendrophyllia*) the phosphate content quickly rises many hundred per cent.

Further experiments on the oxygen production of the algæ in coral has been carried out, notably experiments with eight corals in jars, samples being taken every three hours over 27- and 12-hour stretches, the results showing that oxygen production only exceeds oxygen consumption during the middle of the day. Similar experiments were conducted at various depths. Owing to the absence of algæ from its tissues, *Dendrophyllia* was frequently used as a control in these experiments. The effect on certain corals of long deprivation of

oxygen was tested. The experiment involving the feeding and starving of corals in light and darkness was continued, and gave results confirming those recorded in previous statements. Corals kept for four months in a light-tight box on the reef flat showed no ill effects other than those caused by the heavy deposition of sediment which smothered some; the survivors were pale, almost all the algæ being dead, but otherwise healthy. Further evidence has done nothing but confirm the view previously expressed that the algæ are useless as food for the coral, but may be of vital importance as the source of an accessory supply of oxygen.

Less detailed work on the algæ in *Tridacna* showed that the algæ here are probably of great importance as food. They form the bulk of the contents of the stomach (here modified in structure) and are found in process of digestion in phagocytes and in the digestive diverticula. There is no evidence that they provide any appreciable amount of oxygen, but they may serve to maintain the hydrogen ion concentration in the mantle cavity. The feeding of *Tridacna*, *Pteroceras*, and *Vermetus* was examined in the light of previous work on the feeding of mollusca.

Mr. Nicholls did special work on the calcium metabolism. He was unable to find any evidence of enzyme agency in the formation of the skeleton in corals. He also did further work on the variation in calcium and excess base in coral pools during low tides by day and by night, and on the calcium content of the fluid in the gut and body cavity of Holothurians. A second spawning period for the pearl oyster (*Pinctada margaratifera*) was found in May, and data as to the rate of growth obtained.

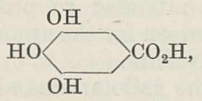
Mr. Spender, who worked for the most part in conjunction with the shore party, completed his detailed survey of Low Island, including soundings outside the anchorage and also at various positions to give characteristic profiles to the reef edge. He also made several level traverses across the flat, along the rampart and over the strips which were being surveyed ecologically. He also surveyed Three Isles, and made general surveys of outer barrier reefs near Lizard Island and around Papuan Pass.

In conclusion, it is particularly gratifying to be able to state that the work of the Expedition, especially on the economic side, will be continued by the Queensland Government, to whom the huts on Low Island and the bulk of the equipment have been given.

The Vegetable Tannins.[1]

By Prof. K. FREUDENBERG, University of Heidelberg.

THE subject of the vegetable tannins [2] is a small field in organic chemistry. Although the subject has been considerably developed and extended in recent years, its beginnings date back to the rise of modern chemistry. One hundred and fifty years ago, Carl Wilhelm Scheele, one of the discoverers of oxygen, in his dark apothecary's shop at Køping in Sweden, allowed an aqueous infusion of Turkish oak galls to be fermented by moulds, doubtless not the first occasion that such a fermentation took place in a pharmaceutical laboratory. But Scheele was one of the best observers chemistry ever had. He noticed that a crystalline substance settled down below the layer of the mould and he was able to recrystallise this substance from water. He called it *sal essentiale gallarum*, and it became known in the literature as gallic acid, having the formula



that is, a trioxybenzoic acid.

In Scheele's opinion, the action of the mould on the extract consisted in the removal of impurities, which might prevent the crystallisation of the *preformed* substance. Some years later, French chemists, however, pointed out that crystalline gallic acid and the amorphous gallotannic acid are not identical. A Flemish botanist, van Tieghem, made a detailed investigation of the fermentation of gallotannin. In the course of his work he discovered a mould specially suited for the fermentation of gallotannin, namely, the well known *Aspergillus Niger*. He was able to show that a mould mycelium, weighing only a few milligrams, was able to decompose some fifty grams of gallotannic acid. He therefore ascribed the action of the mould to an enzyme, named tannase, and further showed that at the same time an alcoholic fermentation sets in, a fact already mentioned by Liebig and attributed to the presence of sugar in the gallotanic acid molecule.

Previously, in 1834, it had been found by Liebig and Pelouze that gallotannin acted upon by dilute acids splits off the same gallic acid obtained earlier by fermentation. In 1850, Strecker published an account of a fundamental investigation on the subject. With hot dilute acid, he obtained in addition to a large amount of gallic acid, a small but definite quantity of glucose.

Unfortunately, at about the same time, theoretical speculations began to obscure clear-cut experimental results. Under the influence of Gerhardt's work on acid anhydrides, Mulder interpreted gallotannin as an anhydride of gallic acid, the sugar content being ascribed to the adventitious presence of an admixed glucoside. Curiously enough, the more analytical methods were improved, the less could Strecker's results concerning glucose be confirmed. His yield of fifteen and more

[1] A lecture given to Section B (Chemistry) of the British Association at Cape Town on July 26, 1929.

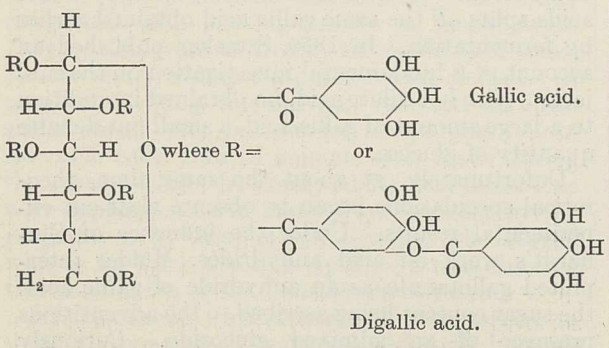
[2] There is some confusion in the nomenclature owing to the fact that 'tannins' (*Gerbstoffe*) in general and 'gallotannin' have been termed simply 'tannins' by Emil Fischer.

per cent was never again obtained; there seemed to exist samples containing not more than a few per cent of sugar, or even none at all. To-day we know that, presupposing exact laboratory methods, no gallotannin exists yielding less than seven to eight per cent of glucose. I may add that the view that sugar-free gallotannin exists has been abandoned by everyone except Dr. Nierenstein. Some years ago, Dr. Mitchell and, afterwards, Dr. Nierenstein described a gallotannin which was stated to be nearly free from sugar. Through the kindness of Prof. A. G. Perkin, I was able to obtain a sample of their original material. This has been shown by Dr. O. Schmidt (unpublished results) to yield seven per cent of glucose when E. Fischer's method is closely followed. It may be mentioned that Prof. P. Karrer has confirmed E. Fischer's formula quite independently. We know further that the failure to confirm Strecker's work was due to the employment of different specimens of gallotannin.

Strecker's gallotannin originated from Turkish oak galls which do actually contain 15 per cent of glucose, as Strecker has stated. Subsequent investigators were furnished with Chinese gallotannin resulting from galls in the leaves of *Rhus semialata*. This Chinese product, on hydrolysis by dilute acids, does indeed only furnish seven per cent of glucose, as mentioned above.

I have laid some stress on the above results, because they are typical of investigations dealing with amorphous substances. When crystalline material is worked up no discussion about identity or purity need arise.

It is no mere accident that the task of solving the problem fell to Emil Fischer. His experience in handling amorphous proteins and carbohydrates, backed by an exceptional knowledge of analytical and synthetical methods, which he had previously applied to crystalline substances, enabled him to attempt the solution of the problem. At the outset he showed that the glucose does not result from an accidental admixture, but is an essential constituent of the gallotannin molecule. In a manner which was so far as possible quantitative, he studied both the amount of glucose present and the manner in which it is linked to the gallic acid. As a result he proposed the following formula:



R is the residue of gallic acid, and five such residues are attached to a glucose molecule which is here represented according to Haworth's amylene oxide formula, which I venture to think has been conclusively established. We thus get a five-fold ester of gallic acid with glucose, the latter playing the part of a pentahydric alcohol. This is the scheme given by Emil Fischer for the Turkish gallotannin studied by Strecker. Joining two molecules of gallic acid we obtain a digallic acid, likewise able to function as *R*; this is the scheme given for Chinese gallotannin where ten gallic acid residues are accumulated on one glucose molecule by esterification.

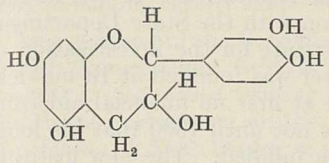
These formulæ are not to be taken as a strict expression of any single chemical individual, but rather as a type. There is no doubt that both varieties of gallotannin, Turkish and Chinese, are a mixture of substances of the same type but differing to a minor extent (P. Karrer). The Turkish gallotannin, composed on the average of five gallic acids and one glucose, may quite well be mixed with similar molecules containing four or six gallic acids. In Chinese gallotannin, the possibility of variations is even greater and it can only be said that the number of gallic acid residues lies between eight and twelve. At the time of Fischer's researches, this kind of structural problem was new, for he only attempted to give a general scheme for the kind of chemical bodies in question. I have already referred to his special fitness for this task due to his experience with amorphous substances.

There is another trait in Fischer's tannin work, characteristic of this master of organic synthesis. We may distinguish two kinds of organic biochemical research. In the first kind, for example, that of indigo or other chemical individual, the goal lies open in front of the investigator like the summit of a mountain. He can measure it and survey it from below and at last venture to attack the summit by undertaking a synthesis. The other kind is that inaugurated by Fischer, my venerated teacher. He explored the large tracts of amorphous substances where marsh land prevents access and primeval forest obscures the view, so that no fixed points are available on which to base a survey. There the master penetrates into the unknown field with a band of his apprentices and obtains a view not only by cutting down some giants of the forest, but also by building up artificial structures from which to survey the surrounding country. Thus the synthesis of a five-fold gallic and digallic ester of glucose was intended to provide an artificial object of comparison for the amorphous substances given to us by Nature.

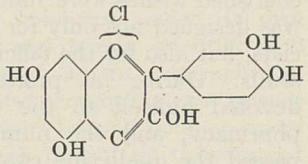
Apart from the gallotannins already dealt with, there exists only one other group of tannins the chemistry of which is based on a sure foundation. The chemistry of catechin and catechol-tannins was outlined only after the gallotannin class had been explored, and in this second group the biochemical relationships are of some interest. The widely distributed amorphous tannins of the catechol group seem to originate by polymerisation and condensation from crystalline primary substances called catechins.

Catechin itself is not uncommon in the leaves

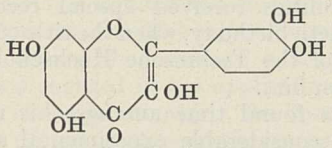
and the wood of various tropical plants. Its constitution, first surmised by A. G. Perkin, shows



Catechin.



Cyanidin hydrochloride.



Quercetin.

a phloroglucinol and a pyrocatechol nucleus, and between them a heterocyclic ring containing an oxygen atom. The connexion between cyanidin and quercetin is evident. Quercetin belongs to the type of yellow colouring matters called flavonols. They are widely distributed throughout the plant kingdom. Cyanidin, in acid solution, is the colouring matter of the red rose and, in an alkaline medium, the blue pigment of the cornflower. On reduction of cyanidin, catechin was ultimately obtained, whereby the constitution of the latter substance was established. I say ultimately, because at first another catechin results, which I called epicatechin. Its presence in plants has likewise been realised. Epicatechin, as well as catechin, contains two asymmetric carbon atoms which cause the existence of two inactive and four optically active forms. They have all been prepared. In passing, it may be observed that the constitution of cyanidin, on which the constitution of catechin and epicatechin depend, has been completely established by synthesis, first by Willstätter and more recently by Robinson. Those botanists who consider that cyanidin and quercetin play a part in the respiratory process of plants should also take catechin into account.

The most widely used of all vegetable tanning materials to-day is the extract of the wood of *Schinopsis*, called *quebracho*, and is produced in South America. Its resemblance to the amorphous tannin produced by condensation of tannin leads to the assumption that there exists likewise a primary substance of the quebracho-tannin which we could name quebracho-catechin. We can even predict its probable constitution. It seems to be distinguished from catechin by the lack of the phenolic hydroxyl group adjacent to the methylene group. Unfortunately, all attempts to isolate this presumed crystalline substance have failed. We know only the amorphous quebracho-tannin, which is recognised as a product of condensation and polymerisation of the hypothetical quebracho-catechin. As catechin is generally accompanied in the plant by the corresponding flavonol, in this case quercetin, so quebracho-tannin contains a flavonol of lower oxygen content, differing from quercetin by the absence of the corresponding hydroxyl group.

Most of the chemical facts we know about the other tannins suggest that these belong to one or other of the two groups described. There exist, indeed, some other types which are evidently quite distinct from these; but their constitution still requires elucidation. So the question is still open whether the tannins of the Cape sumach, *Colpoon compressum*, and of the wattle (*Acacia*) belong to the catechol group or not. The Sicilian tanning material generally called *sumach* is a member of the gallotannin group.

The only resemblance between gallotannin and catecholtannin lies in their high content of phenolic hydroxyl groups. To these they owe their ability to combine with proteins and to convert hide into leather. As a chemical concept the name tannin is without value. In spite of this, however, the group deserves further investigation, on one hand, because its members are widely distributed constituents of plants; on the other hand, because their investigation calls for novel methods which I have endeavoured to indicate.

Obituary.

Dr. E. E. Slosson.

A WIDE circle of scientific workers and lay readers will learn with regret that Dr. Edwin E. Slosson, director of Science Service, Washington, died at his home there on Oct. 15. He had been suffering from cardiac trouble for some time, and an acute attack about a week previously hastened his end.

Dr. Slosson was born in Albany, Kansas, in 1865, and graduated in the University of Kansas. In 1891 he went to the University of Wyoming to take charge of the department of chemistry, and he also conducted chemical research for the Wyoming agricultural experiment station. He married Dr. May Preston, the first woman who ever received a Ph.D. degree from Cornell University.

In spite of his manifold teaching and research duties, Dr. Slosson found time to work towards his own doctor's degree during the summers, and received it in 1902 from the University of Chicago. He also found time to write numerous little essays on scientific subjects, which, because of their happy style and lucid presentation of ideas in ordinary English, rapidly won him a wide audience. In 1903 he was invited to become literary editor of the *Independent*, a position which he held until 1921, when he was asked to become director of Science Service, then newly organised as an agency for the dissemination of popular knowledge on scientific subjects. He held this latter post until his death.

The most successful of Dr. Slosson's books has

been "Creative Chemistry", which for a decade has held its own among the best sellers. Among his other works are "Easy Lessons in Einstein", "Science Remaking the World", "Keeping Up with Science", "Chats on Science", "Sermons of a Chemist", "Great American Universities", "Plots and Personalities", "The Spirit of American Education", and "Six Major Prophets". He contributed prolifically to magazines, newspapers, and reference works, including the new edition of the "Encyclopædia Britannica". During his eight years as director of Science Service he trained a group of young writers in the ways of popular presentation of science, and these will now carry on his work.

Prof. Heinrich Beckurts.

Dr. Heinrich Beckurts, who resigned the chair of pharmaceutical and food-stuffs chemistry at the Technische Hochschule at Brunswick in 1925, died suddenly on Sept. 15 at Bartgeheide, near Hamburg. From the *Chemiker-Zeitung* we learn that Prof. Beckurts was born at Brunswick in 1855. He graduated at Jena, and in 1877 was appointed an assistant at the Institute of Pharmaceutical Chemistry at Brunswick, where in 1885 he was elected to the newly founded chair, which he retained for forty years. At the same time his former chief, Dr. Robert Otto, who had been professor of general and pharmaceutical chemistry, remained as director of the laboratories. On the retirement of Otto in 1899, Beckurts became director of the pharmaceutical chemical institute, and shortly afterwards the title of Geheimer Medizinalrat was conferred upon him. This title he held until his death.

In spite of the fact that Beckurts remained throughout his career in his native place, he soon achieved a world-wide reputation. It was largely owing to his connexion with the State Department of Health that an institute for the investigation of foodstuffs and of water was founded at Brunswick. The project received at first no financial aid from the State, and it was not until 1900 that his long-cherished wishes were fulfilled. The new institute was designed not only for the training of pharmacists, but also for the official investigation of foodstuffs. During his professorial career, Beckurts devoted himself to the training of students of pharmacy, and the number of candidates who passed the qualifying examination increased very rapidly as the years progressed. His administrative abilities received special recognition on his seventieth birthday, when the title of 'Honorary Senator' of the Technische Hochschule was conferred upon him.

Beckurts found time amongst his multifarious duties for considerable experimental and literary work. His numerous researches, which dealt principally with alkaloids, sulphones, nitriles, and propionic acid, were usually published in the *Archiv der Pharmazie*, which he edited in conjunction with E. Schmidt of Marburg, or in the *Apotheker-Zeitung*, which was established at his suggestion. He also published a work on analytical chemistry for pharmaceutical chemists, and for many years he issued the *Jahresbericht für Pharmazie, Pharmakognosie und Toxicologie*. In collaboration with Dr. B. Hirsch he published a "Handbuch der praktischen Pharmazie", and with Dr. O. Lüning he remodelled Mohr's well-known treatise on volumetric analysis.

News and Views.

The celebration, not only in the United States, but also in Amsterdam, Rome, and other places, of the fiftieth anniversary of the production by Mr. Thomas A. Edison of his first incandescent electric lamp was a remarkable tribute to the great inventor, now in his eighty-third year. The principal gathering took place at Greenfield, the village constructed by Mr. Henry Ford on his estate at Dearborn, Michigan, to which has been transported the laboratory in which Mr. Edison worked so long at Menlo Park, New Jersey. In the re-erected laboratory, in the presence of President Hoover and many distinguished guests, on Oct. 21, Mr. Edison repeated his historical experiments which resulted in the completion of his first successful lamp. During the celebrations, an account of which was broadcast, Mr. Hoover voiced the nation's appreciation of "men who have that originality of mind and that devotion to industry to carry scientific thought forward in steps and strides until it spreads comfort in every home". The village of Greenfield is to be a part of a great museum of Americana, an object lesson in American progress, which Mr. Ford is inaugurating in connexion with the Edison Institute of Technology.

It is a pity that the celebrations in honour of Mr. Edison and 'Light's Golden Jubilee' should have been marred by the extravagant claims made for him in connexion with the incandescent electric lamp. In the *Scientific American* for November, Mr. Ford is reported to have said that Edison "by his invention of the incandescent light contributed more to the progress of the world and the comfort of his fellow beings than any other man". The world acclaims Edison as one of the greatest of inventors, but it is not true to say that it recognises him as the founder of the electric lighting industry. It will be remembered that the Institution of Electrical Engineers in Great Britain commemorated the fiftieth anniversary of the invention of the incandescent lamp by Sir Joseph Swan on Dec. 20 of last year. A résumé of the historical facts on which the claim is founded is given by K. R. Swan in the *Electrician* for Oct. 25. In a recent biography of Edison by G. S. Bryan, Edison is credited with the invention of the 'squirted' filament which gave such stimulus to the more general use of incandescent lighting in the early days. This vital improvement in the manufacture of carbon filaments was due, however, to Swan, who invented it so far back as 1883. It seems a pity that history should be so garbled. In Great Britain the practical manufacture of the incandescent carbon filament lamp owes little to Edison; it was based entirely on Swan's work. Moreover, Mr. A. A.

Campbell Swinton has pointed out on several occasions that the first patentee of the method of 'flashing' used in making carbon lamps was Mr. Lane Fox Pitt.

AT a meeting of the Council of Management of the British Science Guild, held on Oct. 17, the following resolution was passed relating to the constitution of the Royal Commission on the Civil Service recently appointed: "That having in view the circumstance that the State directly conducts, under its own management, important and highly scientific and technical undertakings, such as the telegraph and telephone services, and also recognising that science has to-day a very important bearing upon so many of the problems dealt with in and by Government Departments, the Council is greatly disappointed to find that the Royal Commission on the Civil Service recently set up by His Majesty's Government does not include among the members a single man of science or one engaged in the application of science to the needs of the community. The Council records its emphatic protest at the omission to appoint upon the Royal Commission a due proportion of members familiar with national aspects of pure and applied science, particularly in view of the fact that an urgent necessity exists at the present time for a complete and impartial review of the status and functions of the considerable body of scientific and technical experts forming part of the Civil Service." The Council also adopted a resolution urging the Government to appoint a Royal Commission on the Post Office with the view of considering the separation of the telegraph and telephone department on one hand from that of the mails on the other, in order to secure the efficient development of the electrical communication services.

THE problem of increasing size in heavier-than-air flying machines is largely one of a conflict between two contending factors. The structural weight increases roughly as the cube of the dimensions, while the lifting capacity, depending as it does on the wing area, increases only as the square. Advance, therefore, in this direction depends largely on the low aerodynamic resistance qualities of the exposed parts and on progress in design of the power unit. The flight over Lake Constance on Oct. 21 of the 12 engine flying-ship *Do. X* appears to mark a distinct advance on previous work of this description. With 169 persons on board, including 10 of the crew, the ship rose from the water in about 50 seconds, carrying fuel for a flight of 750 miles, and landed after a trial run lasting nearly an hour. The machine is said to have weighed almost 52 tons, but it was not fully furnished. This preliminary test stamps Herr Dornier's ambitious effort as a complete success, and this monster flying boat as, broadly speaking, a practical machine.

FROM the few figures available it appears that, when fully equipped for a 500 mile flight, the *Do. X* has a disposable load of 16 tons at a cruising speed of 100 m.p.h. Herr Dornier's achievement really consists of the fact that he has succeeded in building a very large flying boat in which the proportion of structure weight to total weight is about what is considered ordinarily feasible in other machines. There are, however, certain consequent disadvantages. An alighting speed of 90 miles an hour as against 60 miles an hour for most British boats is very high, implying as this does almost a full minute of running before rising; and coupled with a heavy h.p. loading of 18-19 lb., it would indicate that there is little reserve for adverse water conditions. Thus, when fully loaded, she would require to operate from relatively sheltered waters under prepared conditions. There is little reason to doubt that if the greater margin of safety insisted upon in Great Britain were to be sacrificed, corresponding advances could equally be achieved.

THE president of the North-East Coast Institution of Engineers and Shipbuilders this year is Mr. L. E. Smith, chairman and managing director of Smith's Dock Co., South Shields, a business which was established in 1768, and is mainly concerned with ship-repairing. Mr. Smith's presidential address on Oct. 25 was therefore devoted to ship-repairing, which is as old as shipbuilding itself. The earliest slipway for ships was probably that near Phalerum, in Greece, constructed about the fifth century B.C.; the first English dry dock was that built at Portsmouth in 1494, by order of Henry VIII. Early dry docks were closed by embankments of piles and clay, and it took weeks to 'undock' a ship. Reminding his audience of the important work done by ship-repairers during the War, Mr. Smith referred to the great changes taking place and the growth in the size of ships. Though there are plenty of building berths, he thinks that there will soon be a great shortage of docks.

OF recent developments in shipping, the oil tankers and motor-ships are most notable. From Lloyd's Register Book it appears that in 1909 the gross tonnage of oil tankers was 789,000; in 1929 it was 7,071,000. Also, during the last ten years, the tonnage of ships built and fitted with steam reciprocating engines has fallen from 2,633,000 to 853,000, the tonnage of ships with steam turbines from 1,051,000 to 209,018. The total tonnage of motor ships in 1909 was negligible; in 1919 it was 752,000, and in 1929, 6,628,000. Though great problems confront the shipbuilding world, it is, Mr. Smith said, "the admitted fact that Great Britain has at last regained the commanding position she always held before the War both in the shipbuilding and ship-repairing world, and she has been able to do so almost entirely owing to her highly efficient organisation and very low cost of production".

THE October issue of the *Journal of Philosophical Studies* contains the report of a lecture entitled "Beyond Physics" delivered by Sir Oliver Lodge on July 26 at the fourth ordinary general meeting of the British Institute of Philosophical Studies. After an appreciative criticism of Prof. Eddington's Gifford Lectures, there follows a philosophically important attempt to find a permanent physical basis for life and mind. While admitting the impossibility of the transmission of anything substantial or energetic with a velocity faster than that of light, Sir Oliver Lodge is not prepared to grant that velocity through the ether is meaningless, and he even suggests that such a velocity may hereafter be observed by using as a frame of reference the rare cloud of interstellar matter

which recent advances have detected. The ether or space is regarded as stationary in respect of locomotion and as the seat of tremendous rotational energy. At places where group waves are formed, we get material particles and locomotion.

SIR OLIVER pointed out that waves can exist which travel faster than light, but they are mere forms which convey no energy and are therefore unable to affect instruments. The energy is all associated with the groups, which subserve the functions of matter. Experimentally, then, we can deal only with the groups. But what of the component waves which give rise to the groups, which interact with them, which are in fact the very condition for the group's existence? They have no energy of their own, but they achieve results which would not otherwise be achieved. Now life is just such a guiding and directing principle, and the bold hypothesis is advanced that these constituent waves of excessively high frequency may be the physical basis, though not in the least a material basis, for an idealistic interpretation of the universe in which life and mind are supreme. How spontaneity and free will can be given a physical basis Sir Oliver Lodge does not fully see, but he maintains that it is not in a postulated defect in the law of causality for small particles, for chance is no way to aim at freedom nor do the laws of probability apply to the individual. The point of view here briefly summarised is so novel and has such implications that it is worthy of careful consideration even should it prove to be untenable.

SIR THOMAS PURVES, the Engineer-in-Chief of the British Post Office, delivered his inaugural address on electrical communications as president of the Institution of Electrical Engineers on Oct. 24. The audience included not only a large gathering at the Institution's headquarters on the Victoria Embankment, London, but also similar gatherings at the local centres of the Institution at Manchester, Liverpool, Birmingham, Glasgow, Leeds, Newcastle, Cardiff, Southampton, and Portsmouth. Transmitters and loud speakers were fitted at each place, so that speech from any point was reproduced at all other points. The occasion furnished a demonstration of an interesting innovation in the British trunk telephone service known as 'Conference Communication'. This facility, which is now available to the public, enables conferences and discussions to be carried on by joint participants assembled at several different places. In the course of the proceedings, speakers at all the centres took part, and their speeches were clearly heard at all the other centres.

IN his presidential address, Sir Thomas Purves gave a very interesting résumé of the tremendous advances that have been made in systems of electrical communication during the last few years. Seven years ago it was only possible for the British telephone user to communicate with Paris and Brussels. To-day anyone can speak from any telephone in Great Britain to nearly ninety per cent of the telephone stations of the world. In seven years' time the number of automatic exchanges in the central London business area will have increased from its present value of 21 to 100. This rapid increase has to be made without interrupting the continuous service which every subscriber expects. Luckily, the difficulties and mishaps that have arisen during the last few years are much fewer than had been anticipated. England was practically the only country in the world which had an appreciable number of trunk telephone circuits before the advent of the telephone valve repeater. These circuits had a limit of about 200 miles, and the weight of copper used in them was about 300 lb. per mile. The harnessing of the electron has made possible the use of light gauge cables containing about 30 lb. of copper per mile, and these cables will work through valve repeaters to at least 14,000 miles. The Post Office station at Rugby can telegraph to any properly equipped ship in any of the oceans of the world. The trans-Atlantic radio circuits connecting London and New York enable the millions of telephone users in America and Europe to communicate with one another. The stability of the service across the Atlantic depends mainly on the 'long wave' service, but there are two, and there will soon be three, short wave services in addition. The combination of these services ensures practically a 100 per cent continuity of service. They also enable sudden heavy demands to be met. Language difficulties between America and continental nations are the main source of trouble.

AT a meeting of the Newcomen Society held on Oct. 23, a paper by Mr. L. F. Loree of New York was read dealing with "The First Steam Engine in America". Copper ore had been discovered on land belonging to Arent Schuyler of New Jersey about 1714, and for thirty or forty years mining was carried on vigorously, the ore being sent to England to the Bristol Copper and Brass Works. Smelting and refining were not permitted in the colonies, and the export of machinery from England to the colonies was forbidden. By 1748 the mine shaft had been sunk so far that water gave very serious trouble. News having reached America about the Newcomen steam engine or 'fire engine', Colonel John Schuyler, through his agent, ordered an engine from the Hornblowers of Cornwall and, accompanied by Josiah Hornblower (1729–1809), this engine, the very first erected in America, was taken across the Atlantic in the *Irene*. It was shipped in June 1753, but it was not until March 1755 that the engine-house had been built and the engine erected ready for use. Of its subsequent history, its partial destruction by fire, its repair twenty-five years later, and of the acquisition by the Smithsonian Institution of one-half of what is supposed to be the original cylinder, Mr. Loree gave an interesting account. He described Hornblower, who became an American citizen, as a man of simple tastes, courtly bearing, and commanding presence, and said that he served as a member of the Legislature and occupied other public offices. Buried in the grounds of the Belleville Reformed Church, his tomb has recently been restored by the American members of the Newcomen Society, who have also erected a memorial to this "pioneer in the use of steam in the western hemisphere and a foremost promoter of our American industrial civilisation".

THE small-pox which is now somewhat prevalent in Great Britain (131 cases were notified in England and Wales in the week ended Oct. 12), being of a mild type, is apt in early cases to bear so close a resemblance to chicken-pox that diagnosis becomes exceedingly difficult. A 'flocculation test', first devised by M. H. Gordon, and suggested by him as a means of differentiating the two diseases, is the subject of a report by W. L. Burgess, J. Craigie, and W. J. Tulloch (Med. Res. Council; *Special Rep. Series*, No. 143. London: H.M. Stationery Office. 1*s*. 3*d*. net). A 'vaccinia serum' is prepared by treating rabbits with vaccine material, and this serum mixed with an extract of the crusts from the patient gives flocculation when the crusts are derived from a small-pox case, but not if derived from chicken-pox or other diseases. Cases of small-pox (53 cases), chicken-pox, vaccinia, and other conditions occurring in Dundee and elsewhere, were examined by the authors, 93 cases in all, and in every instance in which the test could be carried out satisfactorily, the results obtained by it were in complete agreement with clinical findings and epidemiological inquiry.

IT is significant of the activity in anthropological studies of the Bernice P. Bishop Museum of Honolulu, that the valuable series of monographs which are appearing as *Bulletins* of the Museum are now being issued at frequent intervals and cover an increasing range in the Pacific area. Among recent issues are an extended study of Tongan society by Mr. Edward Winslow Gifford, one of the Bayard Dominick Expedition series in which a number of monographs by different members of the Expedition have already appeared, a valuable study of the archæology of Tonga by W. C. McKern in the same series, and a study of Lau Island, Fiji, by Mr. A. M. Hocart, the outcome of a stay of four years in Fiji, which bears witness to the industry and powers of observation of the author. Mr. Hocart is not the only British author represented in the series.

BULLETIN 63 of the Museum at Honolulu is by Prof. F. Wood Jones and is entitled "Measurements and Landmarks in Physical Anthropology". The reason for its inclusion in the series is not obvious, and indeed its value to the anthropologist at large is such that it may perhaps be regretted that it should have been published in a form in which it may escape the notice of many to whom it would be of value. It is intended as a guide for both the laboratory and the field worker. Prof. Wood Jones in fact has selected a series of the twenty measurements for the use of the field worker which he considers most significant, having in view also the conditions under which the measurements will be taken. The author has described the measurements of the living and the skeleton in great detail, and each part is dealt with at some length. In view of the consideration now being given to the character and method of anthropometric measurement and the suggestions recently submitted to the Royal Anthropological Institute by Miss M. L. Tildesley and transmitted by that body for the consideration of the Committee on Anthropometric Measurements of the Congress of Anthropology of the Institut International de Paris, we hope that Prof. Wood Jones' work will not be overlooked by the physical anthropologists in England and on the Continent.

MR. J. J. JOICEY has presented to the Department of Entomology of the British Museum (Natural History) the whole of his collection of butterflies from South and Central America belonging to the subfamily Theclinæ, amounting to between five and six thousand specimens and including eighty-eight types. Many of the latter represent species of very considerable rarity. The butterflies of this subfamily, of which the few British representatives are known as hairstreaks, are mostly small in size, but are noted for the extraordinary brilliance of their colouring. The Department of Geology of the Museum has acquired the Buckman collection of fossil Brachiopoda and ammonites. This numbers about 25,000 specimens, mostly brachiopods, and nearly all from the English Jurassic rocks. It is the bulk of the material collected by the late Prof. James Buckman and his son, the late Sidney Savory Buckman. The former had unique opportunities for collecting, since he lived in the south-west of England when the early railways were being made, and this involved not only the opening of the railway-cuttings, but also the quarrying of local stone for bridges, etc. His son studied and collected from the English Jurassic strata all his life and acquired a specialist's knowledge of brachiopods and ammonites. He did not stop at mere classification, but developed interesting theoretical considerations both in palæontology and stratigraphy. Another important recent purchase for the same Department is a large portion of the skeleton of a rhinoceros, *Diceratherium cooki*, from the locality in Nebraska which yielded the skeleton of *Moropus*, purchased lately. The specimen represents an adult animal, rather larger than a Shetland pony. The diceratheres are distinguished from all other rhinoceroses by having the paired nasal horns placed side by side, instead of tandem. They arose in North America and migrated to Europe: bones and teeth have been found in France.

THE provision of national parks has made great progress in Canada. Apart from the enormous Wood-Buffalo Park in the Peace River district, there are more than thirty thousand square miles of national and provincial parks in which no land is for sale and no concessions are allowed. Great care is taken of the wild life, and hunting and trapping are prohibited. Roads and trails are made for visitors, but the natural scenic features are not interfered with. Sites for residential purposes are leased but not sold. The National Parks Service of the Canadian Department of the Interior has published a number of hand-books on several of the parks in the Rockies and Selkirks. The books are well supplied with photographs and maps and give an excellent idea of the value these parks must have as centres of recreation and sanctuaries of wild life.

AT the annual statutory meeting of the Royal Society of Edinburgh, held on Monday, Oct. 28, the following officers were elected: *President*: Prof. Sir E. A. Sharpey-Schafer; *Vice-Presidents*: Em. Prof. W. C. M'Intosh; Prof. Sir Robert W. Philip, Prof.

J. Graham Kerr, Prof. W. Wright Smith, Prof. Francis G. Baily, Prof. T. J. Jehu ; *General Secretary* : Prof. R. A. Sampson ; *Secretaries to Ordinary Meetings* : Prof. C. G. Darwin and Dr. James Ritchie ; *Treasurer* : Dr. James Watt ; *Curator of Library and Museum* : Prof. D'Arcy W. Thompson ; *Councillors* : Prof. J. H. Ashworth, Prof. E. Taylor Jones, Dr. J. B. Clark, Prof. F. A. E. Crew, Prof. J. Montagu F. Drummond, Mr. D. A. Stevenson, Prof. H. W. Turnbull, Em. Prof. Sir James Walker, Dr. James Drever, Mr. A. H. R. Goldie, Dr. R. A. Houstoun, The Hon. Lord Sands.

THE auction sale to be held by Messrs. Sotheby and Co., at 34/35 New Bond Street, W.1, on Nov. 4–7, should be of special interest to many readers of NATURE, seeing that on the first two dates will be offered many important works formerly the property of Sir E. Ray Lankester and Sir William Thiselton-Dyer. The Lankester collection is particularly rich in first editions—among which we notice Darwin's " The Origin of Species " and " The Descent of Man ", Galton's " Natural Inheritance ", and thirty-four volumes by H. G. Wells, many autographed. The Thiselton-Dyer collection includes a complete set of the *Kew Bulletin*, long runs of " Flora Capensis " and " Flora of Tropical Africa ", and the first edition (black letter) of Lyte's translation of Dodoens' " A Nievve Herball ".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A headmaster of the Wandsworth Junior Technical (Day) School—The Secretary, Technical Institute, Wandsworth, S.W.18. (Nov. 9). An assistant lecturer in engineering at the Bath Municipal Technical College—The Director of Education, Education Office, Sawclose, Bath (Nov. 9). An assistant pathologist at the Mount Vernon Hospital, Northwood—The Secretary, Mount Vernon Hospital, 7 Fitzroy-square, W.1 (Nov. 9). A director of Public Health and Medical Services under the Government of Southern Rhodesia—The Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, W.C.2 (Nov. 15). A pathologist to the Royal Hospital and demonstrator of pathology in the University of Sheffield—The Registrar, The University, Sheffield (Nov. 16). A lecturer in pathology in the University of Sheffield—The Registrar, The University, Sheffield (Nov. 16). A public analyst of the Harcourt Butler Institute of Public Health, Rangoon—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Nov. 23). An assistant lecturer and demonstrator in geography in the University of Leeds—The Registrar, The University, Leeds (Nov. 25). A Geoffrey Duveen travelling student in oto-rhino-laryngology in the University of London—The Academic Registrar, University of London, South Kensington, S.W.7 (Dec. 31). A full-time lecturer in the Electrical Engineering Section of the Engineering Department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A laboratory assistant for the Medical Department of the Government of the Uganda Protectorate—M/1720, The Crown Agents for the Colonies, 4 Millbank, S.W.1.

Our Astronomical Column.

Mars.—*La Science Moderne* for September contains an article on Mars by A. Nodon, president of the Astronomical Society of Bordeaux. He reproduces several drawings made by E. M. Antoniadi at Meudon and J. Comas Sola at Barcelona. A description of the temperature measures of Menzel, Coblentz, and Lampland leads to the conclusion that the conditions are likely to be suitable for the presence of vegetation, and that the various tints observed in the darker regions of the disc are compatible with this view of their nature. Some of the drawings show numbers of small round dark markings, the positions of which appear to change between one opposition and the next. It is noted that snow or frost on the ground can be distinguished from cloud or mist in the air by the greater permanence in the position of the former. There are some speculations about the future of the earth ; it is suggested that in the distant future the ocean may have largely disappeared, and the height of the mountains have been greatly diminished by denudation, which would bring about a resemblance to the present condition of Mars.

Greenwich Observations, 1927.—There are two novel features in this annual volume. First, the time service has been derived from observations made with a small reversible transit instrument instead of using the transit circle as heretofore ; the time derived from the transit circle appears to be that of a meridian about 0·10 sec. to the east of it. The cause of this is supposed to lie in the determination of collimation ; the aperture in the central tube of the instrument, through which the south collimator is viewed from the north one, is crossed by radial bars, which seem to have some effect on the character of the image. The collimation errors adopted for the last half of 1927 varied from 1·44″ to 1·05″ ; it is found that if 1·65″ had been used throughout, the results would have agreed with those of the small transit.

Another change is in the method of reducing the moon observations ; Brown's longitude of the moon is in error by some 6″ in the mean ; owing to the eccentricity of the orbit, this causes varying errors in the individual observations. An estimated value of the mean error of longitude for the year is formed, and the time for the moon to go through this arc is multiplied by the rates of motion in R.A. and declination at each observation. Improved tabular places are thus formed for comparison with the observations. When the mean error of longitude for the year is formed from these, the constant that was removed must be put back. Another special feature of this volume is a comparison of magnetic storms and sunspots from 1874 to 1927. The great magnetic storms are on the average accompanied by large spots not far from the centre of the disc. There is a semi-annual wave in the frequency of magnetic storms ; the maxima are near March and September, the months when the earth is farthest from the sun's equator.

Occultation of Jupiter by the Moon on Oct. 28, 1928.—This phenomenon was well observed at Johannesburg with the 26½ inch refractor and two smaller instruments (*Union Obs. Circ.*, No. 79). Satellite III. took 3·5 sec. to disappear, II. 1·5 sec., I. 2·0 sec. I. appeared to have the greatest surface brightness. Jupiter appeared very dim beside the moon ; it was described as " a grey ghostly disc " with indefinite limbs.

Research Items.

Unknown Tribes in Arabia.—An account of a journey undertaken in 1928 in a part of S.E. Arabia previously untrodden by Europeans, is given by Mr. Bertram Thomas in the *Journal of the Royal Anthropological Institute*, vol. 59, part 1. The journey of 650 miles from Suwaih to Dhufar occupied 48 days. From Wadi Sarab (lat. 20.10 : long. 57.45 E.) to Salala, capital of Dhufar (lat. 17.20 : long. 54.6 E.) is the habitat of a group of five tribes which are racially distinct from the Semitic Arabs, speaking four dialects not understood by Arabs, and having closer affinities with Ethiopia than Arabia. There are Harasīs, Bautāhara, Mahra, Qara, and Shahara. They are clearly a block of non-Arab tribes of great local antiquity, and as regards the last four, at least, of Hamitic origin. They have an ancient tradition of a North African origin. They have many interesting and perhaps unique customs. The women are not veiled and tattoo the chin with a short vertical line with a dot on each side. Some have a bracelet-like design round the wrist. In Dhufar they paint the face red, black, and green for religious festivals, marriages, circumcisions, etc.—generally a line along the edge of the cheek under the cheekbone and one bridging the nose across the eyebrows. The men are not tattooed. The women shave a half-inch parting along the centre of the top of the head and around the forehead to show a large expanse of brow. The boys' hair is cut short except for an inch wide strip. The men shave clean except for the chin tuft by which they swear. Circumcision is universal, the boys at adolescence, the girls on the day of birth or the second day, the reverse of the custom in Oman, where the ages are 6 for boys and 10 years for girls. In Dhufar elaborate rites are performed in which, after the operation, the boy, carrying a sword, is chased three times round the assembly by an unveiled virgin, also holding a sword. A wife must not show grief at the death of her husband. With the Qara death is a time of wholesale sacrifice of cattle, camels, and sheep. Special reverence is shown for the cow, especially at milking, which is a male prerogative. It is shameful for a woman to touch the udders. This reverence for the cow is completely reversed in Oman, where milking is only fit for women, and the cow is almost an unclean animal. The Harasīs will neither milk nor slaughter their sheep in sunlight, and two breeds of sheep no tribesman whatsoever will slaughter until after dark.

Variations in the Composition of Milk.—It is well known that the composition of milk is somewhat variable, and a committee of the Ministry of Agriculture and Board of Agriculture for Scotland has issued a summary of the circumstances known to be associated with such variations (Min. Agric. and Fish., *Miscellaneous Publications*, No. 65, London : H.M. Stationery Office, price 4*d*.). The mean percentages of fat and of solids-not-fat have been found to be respectively 3·70-3·95 and 8·746-8·78 (Tocher, Crowther, Cranfield). The fat content is likely to be low when a long interval elapses since the previous milking, and when the milker is inexperienced and fails to draw the 'strippings'. As the cow ages, the average percentage of fat falls, and during lactation there is a gradual fall until the 14-16th week, followed by a gradual increase. Different breeds yield different fat contents, the Jersey being richest (5 per cent or more) and the British Friesian lowest (3·7 per cent). Underfeeding, while reducing the *yield*, affects the *quality* of the milk only slightly. Day-to-day variations in composition occur and are difficult to explain. From figures derived from two dairy companies, 7-8 per cent of churn samples are likely to be deficient in fat, and 5 per cent in non-fatty solids. Cranfield and Ling have recorded the composition of the milk of an abnormal cow during three lactations. Fat percentages were very variable, but solids-not-fat were consistently low, only 2 per cent of the samples exceeding 8·5 per cent. During the first two lactations no abnormality of the animal could be detected, but during the third tuberculosis of the udder and lungs developed, and it is suggested that an abnormally low solids-not-fat content may be a sign of incipient disease (*Jour. Agric. Sci.*, vol. 19, p. 491).

Birds of North-Eastern Brazil.—The bird fauna of north-eastern Brazil is rich in species, for a comprehensive list, based upon collections made by Heinrich E. Snethlage between 1923 and 1926, but including every species recorded in literature from the three States concerned, comprises 524 forms (Charles E. Hellmayr in *Field Mus. Nat: Hist. Zool. Series*, vol. 12, No. 18, 1929). Within the boundaries of the region discussed, little differentiation seems to have taken place, and, contrary to the conditions in the Amazonian region, the rivers in this part of Brazil have little zoogeographical significance. But it is clear that the bird fauna contains several distinct elements. A group of forest birds of Amazonian parentage appears to have penetrated eastward by following the gallery forest which extends along the banks of many rivers far into the open country. Many of these are unknown in eastern Brazil. Beyond the forested belt, in a southerly direction, occurs a second, very different fauna, which presents a great resemblance to the bird life of Bahia. Other elements are less evidently associated with the neighbouring geographical areas, some having been found so far in a restricted portion of the area investigated, while others find a limit set by the Rio São Francisco, east and south of which they are either absent or are represented by allied forms.

Histology of the Mid-Gut of *Vanessa*.—H. Henson has examined the histology of the mid-gut in the five larval stages of *Vanessa urticæ* (*Quart. Jour. Micr. Sci.*, vol. 73, part 1, 1929). The mid-gut has three categories of cells—interstitial, goblet, and columnar. The interstitial cells renovate the epithelium by the addition of new cells at each larval ecdysis. There is a period at the beginning of each instar during which occurs cell differentiation from interstitial nests, but this process soon ceases. Cell division, by mitosis, of the interstitial cells occurs throughout the instar. The goblet cell cannot become a columnar cell, neither can the former be derived from a senescent columnar cell, for goblet cells are present at the time of hatching. Both are derived by independent modification of interstitial cells. The contents of the goblet have the same affinity for counter-stain as the striated border and appear to consist of a closely packed mass of fibrils not optically distinguishable from the striated border. The author favours the view that the secretion vesicles seen on the ends of many of the columnar cells are not the result of a secretion process but of a process of cell disintegration due to wear and tear or to the incidence of metamorphosis.

Internal Secretion in Invertebrates.—G. Koller (*Biological Reviews*, vol. 4, No. 3, 1929) reviews our present knowledge of internal secretion in invertebrates. The presence of active sexual hormones can be assumed with reasonable certainty in cases where

parasitic or experimental castration brings about specific changes in secondary sexual characters, for example, the parasitic castration of *Carcinus*, *Inachus*, and *Pagurus* by Rhizocephala, the result of which in male crabs is a definite approach to the female facies. It has been shown by the castration, by radium, of *Asellus aquaticus* that the development of the brood pouch in this animal is dependent upon the presence of functional ovaries, but experiments on caterpillars by several investigators do not permit the assumption that sex hormones exist in these animals. In the Sipunculid *Physcosoma*, Harms has demonstrated histologically and physiologically the existence of an endocrine gland (internephridial organ) the secretion of which is essential to the life of the animal. The characters of the branchial and pericardial glands of Cephalopods suggest endocrine action. The œnocytes of larval and adult insects are unicellular endocrine glands. Koller has shown by blood transfusion that internal secretions are probably concerned in the ecdysis and pupation of caterpillars, but the site of formation of the hormones is unknown. Koller and Perkins have shown experimentally that the expansion and contraction of the chromatophores of shrimps and prawns is due to substances secreted into the blood in response to light stimuli. The two secretions concerned are formed respectively in the eyes and in the rostral region.

Pug-headed Trout.—The occurrence of the abnormality known as pug-head or bulldog-head amongst fishes has often been recorded, and E. W. Gudger has summarised the cases found in Salmonoids, and describes new examples which have come to his notice (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, Sept. 1929, p. 531). The deformity would appear to be due to a failure of the base of the skull to elongate, the check to the growth of the parasphenoid tying down the surrounding bones, so that the upper part of the head remains in an essentially embryonic condition, while the lower jaw attains almost normal size. Feeding is not prevented by either of the two forms which the deformity assumes amongst salmonoids, but there is a suggestion, founded on a limited number of breeding observations, that the malformation is inheritable and transmissible. The author makes a geographical error which we cannot pass: "Next for England", he says, and proceeds to discuss more Scottish examples. Indeed, in a wonderfully complete catalogue, he omits one of the few examples which England has supplied, that of the bulldog-headed trout from a beck on Pennyghent, described by Clarke and Roebuck in "The Vertebrate Fauna of Yorkshire".

Origin of Cultivated Wheats.—Further attempts are being made to throw light on the origin of cultivated wheats by a study of the chromosomes. The hexaploid wheats might be autopolyploid, with six similar sets of chromosomes, or allopolyploid with unlike sets derived through crossing of different species. Mr. Fuyuwo Kagawa (*Jour. Coll. Agric. Tokyo*, vol. 10, No. 3) has made measurements of the chromosome sets in various species of *Triticum* and *Ægilops* in order to obtain evidence on this point. The chromosome sets of *T. monococcum*, *T. dicoccum*, *T. polonicum*, and *T. vulgare*, *Ægilops speltoides* ($2n = 14$) and *Æ. cylindrica* ($2n = 28$) were compared as regards the length and the number and position of constrictions in the chromosomes. In *T. polonicum*, for example, the 28 chromosomes are of at least eight types, differing in length and the position of constrictions. Six of these types do not correspond to chromosomes in the set of *T. monococcum*. The 28 chromosomes of *T. dicoccum* are classified into ten types, seven of which are different from those of *T. monococcum*. The 42 chromosomes of *T. vulgare* belong to at least nine types, eight of which appear to differ from those of *T. monococcum*. It is concluded that the polyploid wheats possess only one pair of most of the chromosome types and that they did not originate through duplication of a basic set, but probably from crossing among ancestors having different sets. Similarly it is concluded that the tetraploid *Ægilops cylindrica* did not arise through duplication of the chromosome set of a diploid species such as *Æ. speltoides*.

The Great Barrier Reef.—The nature and origin of the Great Barrier Reef and the Queensland coast are discussed in great detail in a paper by Mr. J. A. Steers in the *Geographical Journal* for September and October. Previous writers on the origin of the reef fall into two classes, those who regard the reef as a thin veneer on a platform, and those who see in it evidence of the submergence that Darwin suggested. Mr. Steers, who was attached to the Great Barrier Reef Expedition, believes that faulting or flexing of the peneplain of north-eastern Australia has been more important in the formation of the reef than the subsidence of the continent. Evidence of faulting was found in practically all parts of the reef region visited. Similar evidence is known from other parts. Faulting has obviously played an important part in the formation of the coast-line. Mr. Steers goes on to show that the trend lines of the continental shelf are similar to those of the mainland, and he concludes that the Barrier has grown up concurrently with the subsidence of a series of fault blocks. At the same time he shows that faulting has been most intense in northern and north-central parts of the Barrier area. It is of interest also to note that borings on the Michaelmas cay show that a coral reef can grow up on unconsolidated material.

Miocene Mollusca from Jamaica.—The first part of an important work by W. P. Woodring on the Miocene mollusca from Bowden, Jamaica, appeared in 1925 and was noticed in these pages at the time (NATURE, Dec. 12, 1925, p. 881). We have now the pleasure to record the publication of Part 2 dealing with the gastropods and giving a discussion of the results (Carnegie Inst., Washington, *Pubn.* No. 385). This ponderous volume of 564 pages and 40 plates in every respect resembles its predecessor in the scrupulous care with which it has been compiled and produced and it fully merits similar praise. It seems that the total number of molluscan species present is 610, all marine, for though some land snails have been recorded, the author considers them to have been accidental introductions of living animals that fell into openings in the ground and so got collected with the fossil material. No other American Tertiary locality has yielded so abundant a molluscan fauna. The origin, ecology, and age of the Bowden fauna are fully discussed. The author summarises the published information on the Miocene mollusca from other localities in the American tropical region to which naturally they are most akin, whilst directing attention to their similarity to those of southern France and the Mediterranean region. The Bowden horizon would appear to fall at the top of the Middle or at the base of the Upper Miocene.

Italian Earthquake of Mar. 27, 1928.—Two useful studies of this earthquake in the Carnic Alps have been published, one by Prof. A. Cavasino (*Ital. Soc. Sism. Boll.*, vol. 28, pp. 77-100; 1929), the other by Prof. M. Gortani (*L' Universo*, Dec. 1928). Though the intensity was high (9 or 10, Mercalli scale), the epicentral area contained only 30 square miles, its centre

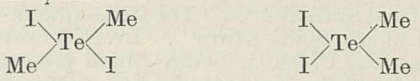
being in lat. 46° 21′ N., long. 12° 59′ E. The intensity decreased rapidly outwards, implying a small depth of focus, 4 or 5 miles according to Gortani, and 11 miles according to Cavasino (using Seebach's method). The epicentral area was elongated north and south, transversely to the tectonic lines of the Carnic Alps. Cavasino, from a large number of observations, estimates the mean velocity of the primary waves as 7·3 km. per sec. and of the secondary waves as 4·0 km. per sec.

Variations of Mean Sea-level.—It is often supposed that once the variations of sea-level due to astronomical (tidal) and meteorological causes have been eliminated, carefully made tidal observations afford a secure basis for establishing the datum plane required in geodetic levelling, and for detecting possible changes in the level of the land. In "Studies of Mean Sea-level" (*Bull. Nat. Res. Council*, No. 70, Washington, 1929), Douglas Johnson, in a report written for a Committee appointed by the Council to make shore-line investigations of sea-level, indicates various causes why this supposition is untrustworthy. Chief stress is laid on variations of level due to changes in inlets and bars at the mouth of estuaries or nearly enclosed bays into which rivers flow; the changes in tidal currents due to such and other causes can alter the mean sea-level in an estuary or bay by amounts which depend on the form of the shore-line, the direction of prevailing winds, and other factors, and which may in favourable circumstances be so great as a number of inches. Observations of mean sea-level in Jamaica Bay near New York have disclosed local inequalities, while the level inside differs from that outside by from three-quarters of an inch to two inches—in close agreement with the predictions made in a theoretical study of the local conditions.

Heat Insulators.—Special Report No. 35 of the Food Investigation Board deals with heat insulators, contains nearly 100 pages, and is issued at 2*s.* 6*d.* (London: H.M. Stationery Office). It covers the whole of the work done on the subject by Dr. E. Griffiths at the National Physical Laboratory, for the heat insulation sub-committee of the Board since its formation in 1918. Almost every known type of cork, wood, powder, rubber, and fibre has been investigated, and the general conclusion is that for refrigeration purposes there are several materials which possess the necessary mechanical strength, do not too readily absorb moisture, and the heat conductivity of which does not exceed 0·00010 in c.g.s. units.

Amorphous Carbon.—A preliminary investigation of the anomalous diamagnetism of graphite, described by S. Paramasivan in the August number of the *Indian Journal of Physics*, is of interest in its bearing on the problem of the nature of amorphous carbon. Specimens of the latter which had been prepared from very different sources—naphthalene, anthracene, sugar, coal gas, wood charcoal, and two kinds of coal—all had a specific diamagnetic susceptibility close to that of diamond ($0{\cdot}5 \times 10^{-6}$), whilst only one body examined, graphitic anthracite, had an appreciably higher susceptibility ($0{\cdot}97 \times 10^{-6}$), and even that was well below the number for pure graphite ($4{\cdot}2 \times 10^{-6}$). There is some evidence that the susceptibility of graphite is less when it is finely divided than when it is in a massive state, and the X-ray investigations that have been made of similar bodies tend to show that a graphitic structure develops in course of time if rearrangement of the atoms is facilitated by heat, but the immediate conclusion to be drawn from the present experiments is that, so far as its magnetic properties are concerned, freshly prepared amorphous carbon is practically indistinguishable from diamond.

Quadrivalent Tellurium Derivatives.—In 1920, Vernon obtained two different forms of dimethyl telluronium iodide, Me_2TeI_2, and explained these as space isomers in which the valencies of the tellurium were in one plane:



In the March number of the *Journal of the Chemical Society*, however, H. K. K. Drew showed that the first compound is normal, and in it the valencies are probably directed towards the vertices of a regular tetrahedron, as in methane, whilst the second compound was not a true isomer but a complex substance, of salt-like character, having the same empirical formula. This was extended to similar compounds. In the September number of the same journal, Prof. Lowry and F. L. Gilbert review the properties of quadrivalent derivatives of tellurium in the light of Drew's formulæ, which they accept in their main features, although they consider that the properties of the two types of compounds are not so sharply separated as Drew suggested. They consider, from other evidence, that the complex form may have either the formula proposed by Drew, namely, $[TeMe_3]^+[TeMeI_4]^-$, in which all the halogens and methyl groups are covalently linked to tellurium, or $TeMe_3I$, $TeMeI_3$, corresponding with a mere aggregate or double salt of the two components. This explains the colours of some of the compounds. The authors give the results of experiments on the absorption of light by the compounds as well as the conductivities, which support their assumptions.

Pulverised Fuel in Electric Power Stations.—The paper on the modern use of pulverised fuel in electric power stations, by R. A. Chattock, the electrical engineer to the Birmingham Corporation, which is published in the *Journal of the Institution of Electrical Engineers* for October, is a very timely one. Mr. Chattock gives the results of experiments carried out in Birmingham which demonstrate that the use of pulverised fuel gives a higher combustion heat efficiency in the boilers than that obtained by mechanical stokers. With pulverised fuel firing a much larger proportion of the ash appears in the form of fine dust, the bulk of which is carried away by the waste furnace gases. The ash consequently is now becoming more apparent and is objectionable. With stoke fired boilers a coarse grit is carried out of the chimneys and is deposited in the immediate neighbourhood. After trying various experiments the 'cyclone' catcher was adopted, and it is found that this catches 90 per cent of the dust that formerly escaped up the chimney. With pulverised fuel boilers, however, the same type of cyclones only stopped about 35 per cent of the dust. What escaped was so fine that it was carried away to great distances and deposited over a very large area. At present two cyclones in series are being used which catch 75 per cent of the dust. It is hoped by washers and electrostatic catchers to increase this percentage very appreciably. The elimination of the sulphur products in the furnace gases is a new problem. Mr. Chattock thinks that it would be impossible to use only coals which contain very little sulphur, as he had to purchase coal from thirty or forty different pits and the proportion of sulphur in the coal varies considerably. Washing the gases is probably the simplest and best way of preventing both the emission of these products into the atmosphere and catching the dust.

Population Studies in South Africa.

DURING the recent meeting in South Africa of the British Association, Dr. J. E. Holloway, the Director of the Office of Census and Statistics, Pretoria, read an informative paper to Section F (Economic Science and Statistics) on " The Demographic Position in the Union of South Africa ". Dr. Holloway pointed out that the Union of South Africa presents many interesting phases for the scientific study of population.

In the census of South Africa, the classification of the population is limited to four groups, namely : (1) European, (2) native, (3) Asiatic, and (4) other coloured, or for short ' coloured '. European refers to all people who are accepted as white, whether the original home is in Europe or not. White Syrians, for example, of whom there are some 2500 in the country, are included in this category. The term Asiatic refers chiefly to the descendants of indentured Indians introduced in the nineteenth century to work the Natal sugar estates. A certain number of Chinese and a few representatives of other races are also included. In 1921 the number of Asiatics in the Union was 165,731, and of these 97·3 per cent were Indians. The ' native ' population comprises the various groups of Bantu, such as the Ama-Xosa, Fingos, Tembus, and Pondos of the Cape, the Zulus, the Basuto, the Bechuana, and numerous smaller groups found all over the Transvaal.

All coloured peoples not included in the terms Asiatic or native are comprised in the group ' other coloured '. The main constituent of this group consists of descendants of the Hottentots, admixed with a certain proportion of European blood. Their religion is for the most part Christian, their speech is Afrikaans, and politically they have come to be regarded in the Cape Province as on the same footing as the other white inhabitants. Descendants of Malay slaves imported during the seventeenth and eighteenth centuries also form part of this classification. At the Census of 1921 the ' coloured ' population exceeded half a million and nearly 90 per cent were enumerated in the Cape Province.

The Dutch population being predominantly agricultural forms the bulk of the rural population, but the British preponderate in the population of all the larger towns except Bloemfontein and Krugersdorp, and of many of the smaller ones. The eastern province of the Cape, having obtained a large British settlement early in its history, is still largely British in rural as well as in urban areas. In Natal, British colonisation followed close on the Dutch, and the latter therefore effected very little permanent settlement. Those rural settlements in which less than 50 per cent of the population is of Dutch descent all occur in Natal and the eastern districts of the Cape. The only exceptions are Baberton and Pilgrim's Rest, which, being the two districts where the earliest gold discoveries in the Transvaal were made, attracted a British mining population.

Figures based on returns received at the population census of 1926 show that, in round numbers, 57 per cent of the Europeans were of Dutch-South African descent and 34 per cent were of British origin. The age distribution of the white races reveals some interesting facts. The population of Dutch descent predominates over that of British descent in all the age-groups except 45-49 years and 50-54 years. The population of Dutch descent in the age-groups 25-29 years and 30-34 years is practically equal, while a similar feature is evident for the British population in the age-groups 10-14 years and 15-19 years. The Dutch population preponderates at an increasing rate as the ages decrease. The first three features are the direct result of war. The preponderance of persons of British descent in the age adjacent to 50 years is caused partly by the immigration of young people of British stock after the Anglo-Boer war and partly by casualties on the republican side during the war. The stationary group around the ages 25-34 years in the Dutch group is due to the fall in births during the war and increased infant mortality. The stationary period in the British group is due to the absence of a large number of men on active service during the European War. The fourth feature must be ascribed to the relatively higher birth rate in the rural areas which are predominantly Dutch in character.

The so-called ' rural exodus ' of which most countries complain has also its counterpart in the Union, though unlike Australia, huge urban communities have not developed in South Africa. In the Commonwealth, 43 per cent of the population lives in urban communities of more than 100,000 persons, whereas in the Union the corresponding percentage is 9. The same disproportion is noticeable in the urban and rural populations of the two countries ; Australia showing 62 per cent urban as against 25 per cent for the Union. In the latter case, however, the lower percentage is mainly due to the fact that the Bantu are still largely country dwellers, only 12 per cent living in urban areas as compared with 56 per cent of the Europeans.

The urbanisation of the population of South Africa is on the increase, and this movement is proceeding more rapidly among the European than the non-European population. This increasing urbanisation of white population is held to be a result of the growth of a poor white landless population, and the tendency is therefore not regarded with equanimity. The last two censuses have shown not only a failure of the rural areas to absorb their own natural increase but also an actual absolute decrease of population in certain districts. This is notably the case in the eastern Karroo and the southern districts of the Orange Free State, where the uncertainty of the rainfall renders the prevailing pastoral industry somewhat precarious.

The densest native population is that which is concentrated for industrial purposes along the Witwatersrand and in Durban. The densest rural native populations centre on the Natal coast belt, in certain Transkeian districts and in Kingwilliamstown, Glen Grey, and Harschel. It becomes relatively less dense as one proceeds northwards and westwards. At the census of 1921, the Bantu population numbered 4,697,813, just three times the white population.

In conclusion, Dr. Holloway pointed out that the main question which is exercising the minds of South Africans in regard to population is that of the relative growth of the European and native populations. Very divergent estimates have been given by various authorities on the subject owing to the insufficiency of the statistical material at present available on the subject. Since 1921, a census of the European population has been held, but no new data are available in regard to non-Europeans. The line of attack indicated by the method of fertility statistics is not available, therefore, as the basic data are unprocurable for non-Europeans. The census of the total population which will be held in 1931 will throw a good deal of light on the subject, and the results of that census will therefore be awaited with the keenest interest.

The Pectic Substances of Plants.

A KNOWLEDGE of the properties of the pectic compounds present in fruits and other plant tissues is of considerable practical interest: thus they play an important part in the setting of jams, in the fermentation processes of wine, beer, and cider, and in the preparation of textile fibres. They undergo changes during the ripening and senescence of fruit, or with the onset of disease, and hence are closely connected with problems of storage. Branfoot,[1] in a recent review of these compounds, classifies them into five groups: *pectose* is an insoluble compound of cellulose and pectin, present in the cell walls of tissues; it is of variable composition, since a variable number of the methoxy groups of pectin may be replaced by cellulose residues. *Pectin* is a neutral methoxy ester of pectic acid, and contains 11·76 per cent methyl alcohol; *pectinic acids* are intermediate between pectin and pectic acid, simple carboxyl groups replacing those esterified with methyl alcohol. *Pectic acid* is a complex of four molecules of galacturonic acid and one each of arabinose and galactose; methylpentose is possibly present in some pectic acids. Pectic acid forms salts of definite composition, of which that with calcium is insoluble and is useful in the estimation of the pectin content of plants. The simplest compound of the group is *metapectic acid*, which appears to be *d*-galactose-galacturonic acid.

Pectin and pectinic acids can be removed from the plant tissues by washing with water: pectose cannot always be extracted unchanged, and it is therefore usual to hydrolyse it first to pectin with dilute mineral acid. After treatment with water and acid there is still pectic material present in the middle lamella: this can be extracted by boiling with very dilute sodium hydroxide or by solution in dilute ammonium oxalate. For the preparation of pectose it is sometimes possible to dissolve out the cellulose with Schweitzer's reagent and thus obtain it unchanged, but in many plants this reagent also dissolves the pectose: pectin is precipitated from its solutions by alcohol, especially if acidified, whilst pectic acid can be prepared by the hydrolysis of pectin with sodium hydroxide, followed by addition of excess of acetic acid to dissolve out impurities, and calcium chloride to precipitate the insoluble calcium pectate. The pectic compounds can be estimated as pectin by precipitation with alcohol, but the method is not strictly quantitative, or better as calcium pectate after hydrolysis to pectic acid.

The distribution of the pectic substances in the cell walls and middle lamella of plant tissues can be followed by staining sections with ruthenium red before and after the application of known pectic solvents. They undergo definite changes during development and senescence, which can be well followed in fruits: the general course is a breakdown into nonpectic soluble bodies. The changes have now been so far worked out that it is possible by chemical and microscopical examination to gauge the stage of maturity of a given sample of fruit with considerable accuracy. These hydrolytic changes are due to the action of enzymes of which at least three have been described, a pectosase, a pectinase, and a pectase, producing respectively pectin and pectinic acids, pectic acid, and reducing sugars, etc. Similar changes occur in fungal and bacterial diseases and are presumably due to enzymes secreted by the organisms.

[1] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 33: A Critical and Historical Study of the Pectic Substances of Plants. By M. H. Branfoot (M. H. Carré). London: H.M. Stationery Office, 1929. 3*s*. 6*d*. net.

Locomotive Firebox Stays and Plates.

FROM relatively early days, the problem of the wastage of firebox stayheads has troubled successive locomotive engineers, who from time to time have devoted considerable attention to investigating its cause, with, however, little real success. In 1924 the British Non-Ferrous Metals Research Association, with the co-operation of all the British railway groups, commenced an exhaustive examination of the problem, a report on which has now been published by the Institute of Metals. The main conclusions of the authors of the paper, Messrs. O. F. Hudson, T. M. Herbert, F. E. Ball, and F. H. Bucknall, may be summarised as follows:

The wastage of stayheads is primarily due to oxidation of the copper which, though not serious under dry conditions, at once becomes so when leakage of water occurs. Apart from the effect of the water, an oxide scale is formed which, being hard and tenacious, causes little trouble. As a result of plastic deformation of the firebox plate and stay, however, due to the thermal stresses set up in service, leakage sets in, causing the detachment of the scale and exposing fresh surfaces to attack. Much speculation has existed in the past with regard to the actual temperatures attained at the stayhead and plate surfaces, but by inserting metallic plugs of known melting point in selected stays, the authors have shown that the temperature attained at the top of the firebox was of the order of 200°-250° C. with, perhaps, 300°-350° C. under the arch. In no instance was a temperature exceeding 350° C. observed.

The work, therefore, has been extended to discover an otherwise suitable alloy which at a temperature of 300° C. is not appreciably softened and will still possess an elastic limit of about 5 tons per sq. in. Of the materials so far examined, one of the most hopeful is a copper alloy with about 0·05 per cent of silver, which in the cold-worked condition had, after being annealed at 300° C. for 100 hours, a Brinell hardness of 73, an elastic limit of 7·2 tons per sq. in., and a tensile strength of 18·3 tons. That such material possesses all the ductility required is shown by the fact that the elongation on 2 in. is 36 per cent.

Considerable attention has been paid to the chemical nature of the oxidation of copper at high temperatures, and it is shown that the presence of small quantities of hydrochloric acid and sulphur dioxide, both more or less normal constituents of the firebox atmosphere, have a profound influence in accelerating the attack. Further, the conditions which determine the adhesion of the oxide to the metal have been carefully investigated. The presence of both soot and smoke is essential to the formation of a hard, adherent oxide of the nature of that produced on actual stayheads. A dark grey scale is then formed at 260° C., which readily withstands subsequent exposure to at least 400° C. without perceptible reduction of hardness or adherence. Such a scale would certainly not be removed by the abrasion encountered in a firebox.

Finally, experiments have been carried out on the effect of salts in the water. These have demonstrated that the detachment of scale from stayheads in service is independent of the composition of the leakage fluid, the presence of corrosive salts playing little part in the actual detachment of the scale.

F. C. T.

University and Educational Intelligence.

LONDON.—Mr. Charles Manning has been appointed, as from Jan. 1, 1930, to the Sir Ernest Cassel chair of international relations tenable at the London School of Economics.

ST. ANDREWS.—The Senatus Academicus has resolved to confer the honorary degree of LL.D. on the following, on the occasion of the installation of Sir Wilfred Thomason Grenfell as Rector of the University on Nov. 6: Sir Wilfred Grenfell; Sir William Allardyce, formerly Governor of the Falkland Islands, of the Bahamas, of Tasmania, and of Newfoundland; Mr. H. M. Richards, senior chief inspector, Board of Education, London; Sir Arthur Steel-Maitland, late Minister of Labour; and Mr. J. E. Wrench, chairman and editor of the *Spectator*.

THE following scholarships have been awarded by the Council of the Institution of Naval Architects: Fairfield Scholarship in Naval Architecture (1929), £150 a year for four years at the University of Glasgow, to Mr. Samuel M'Murray, of Messrs. Harland and Wolff, Belfast; Denny Scholarship in Naval Architecture (1929), £75 a year for four years at the University of Glasgow, to Mr. C. R. Wynne-Roberts, of Bedford School, Bedford; Parsons Scholarship in Marine Engineering (1929), £150 a year for three years at the City and Guilds (Engineering) College of the Imperial College of Science and Technology, London, to Mr. F. L. Weatherdon, of H.M. Dockyard, Devonport.

WE have received from the Education Section of the British Psychological Society, and from the Child-Study Society of London, copies of memoranda on courses of study in junior schools, prepared at the request of the Consultative Committee of the Board of Education. The Education Section of the B.P.S. makes three recommendations: it is of the greatest importance that psychological grouping should take the place of chronological grouping; the development of the concrete real interests of the children should supersede the hard-and-fast school 'subjects'; and the school should be staffed with teachers who may be safely encouraged to experiment in both curriculum and method, and will be able to make educational use of local and individual interests, whilst keeping a universal, humane, and practical outlook. The report is signed by Mrs. Susan Isaacs and Miss Margaret McFarlane, as chairman and secretary, and may be regarded as authoritative. The Child-Study Society, taking its stand on the principle that in every educational problem the child's point of view should always be taken into account, urges that in the junior school place should be found for subjects which prove stimulating to the child, such as handicrafts, art, music, dancing, acting, organised games. It suggests rambles for Nature study, pictures and dramatisation in history; that models and slides in geography are useful devices that should be abundantly used; and, indeed, that all the resources of modern pedagogy should be drawn on to make work in the junior school vivid, intelligible, and memorable. The memorandum also lays particular stress upon the importance of the junior school taking over the essential features of individual methods, the success of which in the infant school is now beyond question, though at the same time exploiting to the utmost the newer methods in collective teaching, which allow and even encourage the more brilliant scholars to make their own pace. The memorandum is issued by Dr. C. W. Kimmins and Dr. P. B. Ballard, as chairman and vice-chairman of the council of the Society.

Calendar of Patent Records.

November 2, 1847.—An improved method of making gelatine medicinal capsules, which was widely adopted later, was probably the invention of a French chemist but was patented in England in the name of James Murdock, the patent agent, on Nov. 2, 1847. The capsule was made in two similar parts, formed by dipping the end of an iron rod of the required dimensions and shape into a solution of gelatine, one part fitting into the other and the two being hermetically sealed together by moistening the overlapping edges. The inventor preferred to use a vegetable gelatine produced from a species of marine moss.

On the same day, Nov. 2, 1847, Anthony Bernard von Rathen, civil engineer, was granted a patent for a compressed air motor-car. A car was built to his specification in the workshops of the Putney College of Civil Engineering and publicly tried on the road between Putney and Wandsworth in August 1849, when it attained a speed of from 8 to 12 miles an hour. Nothing further is known of the machine.

November 3, 1817.—The process of 'gassing' thread and lace, which greatly increased the English lace-trade in the early part of the nineteenth century and rendered it capable of competing with the continental trade, was the subject of the patent granted to Samuel Hall on Nov. 3, 1817, for a "method of improving every kind of lace or net, whether fabricated from flax, cotton, wool, silk, or other substances". The lace is passed over a flame with a motion sufficiently rapid to singe the woolly fibres covering the fabric without injuring the texture of the lace.

November 5, 1895.—A patent that greatly hindered the development of the American motor-car industry was that granted to George B. Selden in the United States on Nov. 5, 1895, which had been applied for in 1879 and thus took sixteen years for the examination before it was finally sealed and the patent rights began to run. The Electric Vehicle Company secured the rights and enforced them, with the help of some of the prominent makers, by charging a royalty of one per cent of the selling price on every petrol vehicle produced in the United States. The patent was upheld in the lower court, but Henry Ford took it to the Circuit Court of Appeals and won his case, the previous decision being reversed.

November 7, 1789.—The patent granted to Ralph Gout, clockmaker of London, for "certain machinery for the purpose of measuring distance, which will ascertain with the greatest precision the number of miles a person travels", on Nov. 7, 1789, was for the first taximeter that appears in the records. The apparatus was in the form of a 'pedometer'—of which instrument also Gout was a patentee—connected by levers and wires with the running wheels of the vehicle.

November 8, 1721.—The first artificial fertiliser to be patented was the invention of John Piper and Matthew Tyndale, Jr., who on Nov. 8, 1721, were granted an English patent for "a certaine compound, consisting of prepared chalk and sea-water, which abundantly increaseth all manner of grain, pulse, and grass, beyond what hath been known".

November 9, 1786.—The patent granted to Joseph Geib, musical instrument maker of London, on Nov. 9, 1786, for "a new improvement upon the pianoforte and harpsichord by which the same will become perfect and compleat instruments of their kind, which have never before been discovered, and by which the same can be more easily tuned and played upon", introduced the 'hopper escapement' for square pianos. The new mechanism was first brought out by Longman and Broderip, of Cheapside, the predecessors of Collard and Collard.

Official Publications Received.

BRITISH.

Journal of the Indian Institute of Science. Vol. 12A, Part 8: i. Studies in Enzyme Action, Part 3, Amylase from Cumbu (*Pennisetum typhoideum*), by D. Narayanamurti, C. V. Ramaswami Ayyar and Roland V. Norris; ii. Studies in Enzyme Action, Part 4, Tyrosinase, I., by D. Narayanamurti and C. V. Ramaswami Ayyar. Pp. 105-129. (Bangalore.) 1.8 rupees.

Rubber Research Institute of Malaya. Bulletin No. 1: The Natural Coagulation of Hevea Latex. By Dr. A. S. Corbet. Pp. 17. (Kuala Lumpur.) 1 dollar.

Journal of the Federated Malay States Museums. Vol. 14, Parts 3 and 4, July. Pp. 325-481+plates 5-13. (Kuala Lumpur.)

Memoirs of the Archæological Survey of India. No. 41: Survival of the Prehistoric Civilisation of the Indus Valley. By Ramaprasad Chanda. Pp. iv+40+2 plates. (Calcutta: Government of India Central Publication Branch.) 1.2 rupees; 2*s*.

Malayan Forest Records. No. 7: Mangrove Bark as a Tanning Material. By T. A. Buckley. Pp. 40. (Kuala Lumpur.) 50 cents; 1*s*.

Royal Observatory, Hong Kong. Meteorological Records 1884–1928. (Appendix to Hong Kong Observations, 1928.) By C. W. Jeffries. Pp. 16. (Hong Kong.) 60 cents.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Lucia, 1928. Pp iv+31. (Barbados.) 6*d*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 394, October. Pp. 1177-1268+xxxvi. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

FOREIGN.

Bulletin of the National Research Council. No. 69: Molecular Physics in relation to Biology. Report of the Subcommittee on Molecular Physics, of the National Research Council. Pp. 293. 3 dollars. No. 70: Studies of Mean Sea-Level. Report of the Committee on Shoreline Investigations, National Research Council. Pp. 50. 50 cents. No. 71: Bibliography of Bibliographies on Chemistry and Chemical Technology. First Supplement 1924–1928. Compiled by Clarence J. West and D. D. Berolzheimer. Pp. 161. 1.50 dollars. (Washington, D.C.: National Academy of Sciences.)

Reprint and Circular Series of the National Research Council. No. 89: Science and Progress in the Industries. By John J. Carty. Pp. 8. (Washington, D.C.: National Academy of Sciences.) 20 cents.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 88: Myths and Tales of the Southeastern Indians. By John R. Swanton. Pp. x+275. 1.00 dollar. Bulletin 90: Papago Music. By Frances Densmore. Pp. xx+229+19 plates. 1.25 dollars. (Washington, D.C.: Government Printing Office.)

Mededeelingen van het Nederlandsch Instituut voor Documentatie en Registratuur. No. 6, 1928, 10-12. Pp. 2073-2249. (Amsterdam: Nederlandsch Instituut voor Efficiency.) Bi-monthly, 50*s*. a year.

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 12, 1928. Pp. 265+vii. (Rochester, N.Y.: Eastman Kodak Co.)

Department of Commerce: Bureau of Standards. Research Paper No. 78: Relative Visibility of Luminous Flashes from Neon Lamps and from Incandescent Lamps with and without Red Filters. By F. Chapin Breckenridge and J. E. Nolan. Pp. 11-25+1 plate. 5 cents. Research Paper No. 84: Bunsen Flames of Unusual Structure. By Francis A. Smith and S. F. Pickering. Pp. 65-74+5 plates. 5 cents. (Washington, D.C.: Government Printing Office.)

CATALOGUE.

Watson's Microscope Record. No. 18, September. Pp. 32. (London: W. Watson and Sons, Ltd.)

Diary of Societies.

FRIDAY, NOVEMBER 1.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—W. M. Mollison, G. J. Jenkins, L. Graham Brown, and J. P. Stewart: Triumphs and Failures of the Mastoid Operation.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—J. G. Pearce: Modern Engineering Cast Irons and their Properties.

ROYAL ASTRONOMICAL SOCIETY, at 4.30.—Geophysical Discussion on Cyclonic Disturbances of Sea Level. Chairman, Sir Richard Gregory. Speakers, Dr. Doodson and Prof. Proudman.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.—Cases by W. S. T. Neville, Dr. D. McKenzie, V. E. Negus, H. A. Kisch, T. B. Layton, and others.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Spinal Deformities in the Sacroiliac Region.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Prof. H. L. Callendar: Critical Relations between Water and Steam (Thomas Hawksley Lecture).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Burn: The Development and Performance of the Richardsons-Westgarth Oil Engine.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (jointly with Institute of Chemistry, Society of Dyers and Colourists, and Manchester Literary and Philosophical Society) (at Engineers' Club, Manchester), at 7.—Dr. F. A. Freeth: Industrial Research.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section) at 7.—E. W. Hill: Chairman's Inaugural Address.

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

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Conversazione.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Alfred Herbert, Ltd.: Technical Film: The Age of Speed.

PHILOLOGICAL SOCIETY (at University College), at 8.—Prof. E. Weekley: Words and Names.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. J. Blomfield, Sir Francis Shipway, and others: Discussion on Avertin Anæsthesia.

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—J. W. Berry: Cold Working of Metals.

SATURDAY, NOVEMBER 2.

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—A. H. Allcroft: The Significance of Circular Churchyards.

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Athenæum, Manchester), at 6.30.—J. Litchfield: Lace, its Characteristics, Technique, Classification, and Yarn Requirements.

MONDAY, NOVEMBER 4.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Dr. Frances M. Ballantyne: Notes on the Development of *Callichthys littoralis*.—Dr. A. W. Greenwood: Some Observations on the Thymus Gland in the Fowl.—Dr. A. C. Fraser and Dr. B. P. Wiesner: Variations of the Rest Metabolism of the Rat in Relation to the Sex Cycle.—Dr. L. Mirski: On the Presence of a Kothyrogen Substance in the Mouse Placenta.—Dr. B. P. Wiesner: On the Mechanism of the Diphasic Sex Cycle.—Prof. H. W. Turnbull and Dr. J. Williamson: Further Invariant Theory of Two Quadratics in n Variables.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens of Cysts.

ROYAL INSTITUTION, at 5.—General Meeting.

SOCIETY OF ENGINEERS (at Geological Society), at 6.—G. A. Wright: Land Drainage.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Miss K. Leopold: Creative Work and its Effect on Appreciation: An Experiment in the Teaching of Poetry.

INSTITUTION OF AUTOMOBILE ENGINEERS (Bristol Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—Capt. L. W. Johnson: The Inspection of Metals and their Alloys.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—R. Borlase Matthews and others: Discussion on Paris and the Pyrenees: Notes on some of the Technical Features of the I.E.E. 1929 Visit.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—J. Wright and C. W. Marshall: The Construction of the 'Grid' Transmission System in Great Britain.

KEIGHLEY TEXTILE SOCIETY (at Kiosk Café, Keighley), at 7.30.—A. Bailey: Artificial Silk and its Everyday Manufacturing Problems.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Burlington House), at 8.—N. Heaton: Titanium Oxide Pigments.—A. Marshall: The Vapour Pressures of Nitroglycerin and Dinitroethyleneglycol, and The Function of Sulphuric Acid in Nitrations.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—H. G. Watkins: River Exploration in Labrador by Canoe and Dog Sledge.

SOCIETY OF DYERS AND COLOURISTS (Huddersfield Section) (at Huddersfield).—M. Carter: Dyeing of Indigo and Blue Serges.

TUESDAY, NOVEMBER 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. J. A. Arkwright: The Virulence of the Micro-organism in Infective Disease (Bradshaw Lecture).

MINERALOGICAL SOCIETY (Anniversary Meeting), at 5.30.—Dr. C. E. Tilley: Scawtite, a New Mineral from Scawt Hill, Co. Antrim.—Dr. F. Coles Phillips: On the Composition-plane of [010]-twins in the Acid Plagioclases.—M. H. Hey: On the Variation of Optical Properties with Chemical Composition in the Rhodonite-Bustamite Series.—Dr. F. Coles Phillips: A Preliminary Account of some Mineralogical and Chemical Changes in the Green Bed Group of the Scottish Dalradian on Progressive Metamorphism.—E. Heron-Allen: Exhibition of a So-called Meteorite from Hangchow, Chekiang, China.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Major S. S. Flower: (*a*) Exhibition of a Fat Dormouse (*Glis glis*) from Hastoe, Herts; (*b*) Notes on a Recent Visit to some Continental Zoological Gardens.—W. S. Bristowe: (*a*) The Spiders of Skomer Island (S. Wales); (*b*) The Distribution and Dispersal of Spiders.—J. R. Norman: Notes on the Fishes of the Suez Canal.—E. Banks: Interbreeding among some Bornean Leaf-Monkeys of the Genus *Pithecus*.

INSTITUTION OF CIVIL ENGINEERS, at 6.—W. W. Grierson: Presidential Address and Presentation of Medals.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.—E. C. Stuart Baker: The Animals and People among whom we carry on our Natural History Work in the Jungle of India.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—Dr. P. Macgillivray: D. O. Hill and his Work.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates) (jointly with Coventry Graduates) (at Broadway Café, Coventry), at 7.15.—Discussion: That Mass Production is Detrimental to the Industry.

INSTITUTION OF AUTOMOBILE ENGINEERS (jointly with Iron and Steel Institute) (at Royal Society of Arts), at 7.45.—Dr. W. H. Hatfield: Steels for Automobiles and Aeroplanes.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (at Museum, Leicester), at 8.—Miss C. H. Spencer: Colloids (Presidential Address).

TELEVISION SOCIETY (at Engineers' Club, Coventry Street, W.1), at 8.—F. Langford-Smith: Amplification and Television.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 8.30.—D. McCrae Aitkin: Respiratory Rhythm in Physiological Relation to Movement and Posture, with Suggested Applications to Treatment (Presidential Address).

WEDNESDAY, NOVEMBER 6.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. H. Bolton: Fossil Insects of the South Wales Coalfield.—Major A. R. Dwerryhouse and A. A. Miller: The Glaciation of Clun Forest, Radnor Forest, and some Adjoining Districts.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Capt. C. E. Kennedy-Purvis: Chairman's Inaugural Address.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—R. Grierson: Electric Warming, with Special Reference to Low Temperature Panel Systems.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—H. A. Morham: Chairman's Address.

BACUP TEXTILE SOCIETY (in Natural History Rooms, Bacup), at 7.30.—A. Anderson: Automatic Looms.

HALIFAX TEXTILE SOCIETY (at White Swan Hotel, Halifax), at 7.30.—T. W. Hanson: The Early Days of the Woollen and Worsted Industries.

SOCIETY OF GLASS TECHNOLOGY (London Section) (at Osram G.E.C. Glass Works, North Wembley), at 7.30.—Discussion: The flow of Glass in Tanks.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—E. R. Bolton and K. A. Williams: The Grouping of Fatty Oils, with Special Reference to Olive Oil.—Dr. C. Dukes: The Heat Resistance Curve: A New Bacteriological Test for Pasteurised Food.—W. R. Mummery and F. Bishop: A New Borax Solubility Test for Lactic Acid or Natural Sour Casein.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

ROYAL SOCIETY OF ARTS, at 8.30.—Ll. B. Atkinson: Fifty Years of Electrical Science and Industry.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 8.30.—H. Cairns and others: Discussion on Surgery of the Spinal Cord.

HASLINGDEN DISTRICT TEXTILE SOCIETY (at Grammar School, Haslingden).—J. H. Townson: Taylor Lang's Treble Spindle Speed Condenser Mule.

THURSDAY, NOVEMBER 7.

ROYAL SOCIETY, at 4.30.—W. A. Lamborn: The Remarkable Adaptation by which a Dipterous Pupa (Tabanidæ) is preserved from the Danger of Fissures in Drying Mud.—Prof. H. E. Roaf: The Absorption of Light by the Coloured Globules in the Retina of the Domestic Hen.—R. G. Tomkins: Studies of the Growth of Moulds (I.).—R. H. Stoughton: The Morphology and Cytology of Bacterium Malvacearum E.F.S.—E. C. Smith: On the Coagulation of Muscle Plasma.—*Papers to be read in title only:*—Dr. Sunder Lal Hora: Ecology, Bionomics, and Evolution of the Torrential Fauna.—N. J. Berrill: Studies in Tunicate Development. Part I.—J. C. Kernot, J. Knaggs, and Madge Kaye: The Swelling of Fish Skins in Solutions of Inorganic and Organic Acids—Prof. A. V. Hill: Anaerobic Survival in Muscle.—Prof. A. V. Hill and P. Kupalov: Anaerobic and Aerobic Activity in Isolated Muscle.—Sybil Cooper and Dr. D. Denny-Brown: The Interaction between two Trains of Impulses converging on the Same Motoneurone.—C. H. Best and Ruth Partridge: Observations on Olympic Athletes.—H. S. Holden: On the Structure and Affinities of Ankyropteria Corrugata.—W. R. I. Cook and E. J. Schwartz: Life-history, Cytology, and Method of *Plasmodiophora brassicæ* Woron, the Cause of Finger and Toe Disease of Cabbages and other Crucifers.—Dr. R. Broom: On the Structure of the Mammal-like Reptiles of the Suborder Gorgonopsia.—H. K. Mookerjee: (*a*) On the Development of the Vertebral Column of Anura; (*b*) On the Development of the Vertebral Column of Urodela.—Prof. R. R. Gates and F. M. L. Sheffield: Megaspore Development in Œnothera Rubricalyx.—C. F. A. Pantin: On the Physiology of Amœboid Movement. (I., II., and III.).—Dr. O. Rosenheim and Dr. N. K. Adam: Monomolecular Films of Irradiated Ergosterol in Relation to the Production of Vitamin D.—R. N. Mukerji: Effect of X-Radiation on the Spermatogenesis of Lepisma Domestica.—Prof. J. B. Gatenby, R. N. Mukerji, and Sylvia Wigoder: The Effect of X-Radiation on the Spermatogenesis of Abraxas Grossulariata.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. D. H. Scott: Exhibit of Fossil Seeds of *Eospermatopteris*, the Oldest Known Spermophyte.—Dr. H. Scott: A Natural History Excursion into Basutoland.—Prof. G. E. Nicholls: *Micraspides calmani*, a New Syncaridan from the West Coast of Tasmania.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. F. Still: The History of Pædiatrics in the Seventeenth and Eighteenth Centuries (FitzPatrick Lectures) (I.).

ROYAL SOCIETY OF MEDICINE (Tropical Diseases Section), at 5 30.—Prof. A. C. Ukil: Epidemiology and Pathology of Tuberculosis in India.—Dr. G. Giglioli: Paratyphosus C. Infections in British Guiana.—Dr. W. Broughton-Alcock: Section Showing Structures Morphologically Resembling Spirochætes of a Species Common to the Mouth, Lying Deep Within the Mucous Membrane.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—B. A. G. Churcher and A. J. King: The Analysis and Measurement of the Noise emitted by Machinery.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. A. E. Dunstan: Recent Developments of Fuels and Dopes for Aircraft Engines.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (at Bristol University), at 7.30.—T. G. Elliot and R. J. Sarjant: Recent Developments in Corrosion and Heat Resisting Steels.

BATLEY AND DISTRICT TEXTILE SOCIETY (at Batley Technical College), at 7.30.—J. Brooke: Practical Hints on Carding.

CHEMICAL SOCIETY, at 8.—F. Challenger, C. Higginbottom, and A. Huntington: The Nitration of Aromatic Thiocyanates.—F. Challenger and A. D. Ainley: Studies of the Boron-carbon Linkage. Part I. The Oxidation and Nitration of Phenylboric Acid.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Centre) (at Manchester).—Prof. H. L. Callendar: Critical Relations between Water and Steam (Thomas Hawksley Lecture).

NELSON TEXTILE SOCIETY (at Nelson).—H. Holt: Defects in Yarns and how to try to avoid them.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at 39 Elmbank Crescent, Glasgow).—Lt.-Col. Sir Arnold Wilson: A Central Building for Technical Institutions.

FRIDAY, NOVEMBER 8.

TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 1.15.—G. Smith: The Mildew Problem in the Cotton Industry.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. M. Green: The Indian Cinema Industry.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. E. A. Milne: The Masses, Luminosities, and Effective Temperatures of the Stars.—Prof. A. S. Eddington: Internal Circulation in Rotating Stars.—Dr. H. Spencer Jones: A Revision of Newcomb's Occultation Memoir.—R. A. McIntosh: (*a*) The Meteor Swarm of Halley's Comet; (*b*) Observations of the Orionid Meteors.—Prof. A. S. Eddington and S. Plakidis: Irregularities of Period of Long Period Variable Stars.—Report of the British Expedition to Observe the Total Solar Eclipse of 1929, May 9.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Prof. Sir C. V. Raman: Diamagnetism and Molecular Structure (Lecture).

MALACOLOGICAL SOCIETY OF LONDON (in Zoological Department, University College), at 6.

ILLUMINATING ENGINEERING SOCIETY, at 7.—W. H. Villiers and S. G. Double: Modern Incandescent Lighting in Kinema Studios.

INSTITUTION OF LOCOMOTIVE ENGINEERS (London) (Manchester Section) (at 36 George Street, Manchester), at 7.—E. M. Cass: Undue Compression in the Cylinders of Steam Locomotives and Means of Combating Same.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

LEICESTER TEXTILE SOCIETY (at Victoria Hall, Leicester), at 7.30.—J. Morris: Cotton Spinning and Doubling.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—F. Orme: Nickel-Silver.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Liverpool).—Dr. Fox: Some Reminiscences of a Government Laboratory.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry—South Wales Section) (at Thomas' Café, Swansea).—H. J. Hodsman: Smokeless Fuels and how they burn.

NATIONAL SMOKE ABATEMENT SOCIETY (at College of Technology, Manchester).—A. McCulloch: Coal and its Combustion.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 1.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinative Bio-chemistry of the Cell and Tissues: Tissue Anarchy (Harben Lectures) (III.).

BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 5.15.—Prof. J. Boeke: The Nervous System in Relation to Health (Chadwick Lecture).

ROYAL ANTHROPOLOGICAL INSTITUTE (in Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic), at 5.30.—Prof. G. Elliot Smith: The Evolution of Man.

SATURDAY, NOVEMBER 2.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Ancient Egyptian Sculpture in Relief.

MONDAY, NOVEMBER 4.

UNIVERSITY COLLEGE, at 2.—Prof. L. N. G. Filon: Cosmography in the XVIth Century.—At 5.—Prof. Sir C. V. Raman: The Molecular Scattering of Light. (Succeeding Lectures on Nov. 5 and 7.)

GRESHAM COLLEGE, at 6.—W. H. Wagstaff: Geometry. (Succeeding Lectures on Nov. 6, 7, and 8.)

TUESDAY, NOVEMBER 5.

LONDON SCHOOL OF ECONOMICS, at 5.—Dr. M. Ginsberg: The Contribution of Prof. Hobhouse to Philosophy and Sociology.

KING'S COLLEGE, at 5.30.—Mrs. N. A. Duddington: Russian Philosophy at the Present Time.

WEDNESDAY, NOVEMBER 6.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—S. Cade: The Possibilities and Limitations of Radium Treatment.

KING'S COLLEGE, at 5.30.—Prof. D. M. Blair: The Contribution of King's College to the Advancement of Learning during the Century 1829–1928: Medical Science.—Dr. F. A. P. Aveling: Personalism: a Psychological Approach to Reality—The Approach to Transcendental Reality.

ROYAL VETERINARY COLLEGE, at 5.30.—Major G. W. Dunkin: Immunisation against Distemper in the Dog. (Succeeding Lectures on Nov. 13 and 20.)

THURSDAY, NOVEMBER 7.

KING'S COLLEGE, at 3.—C. J. Gadd: The Babylonian Background of the Captivity.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. L. Robbins: The Present Position of Economic Science.

UNIVERSITY COLLEGE, at 5.30.—Viscount Grey of Fallodon: Natural History, the Pleasure and Purpose of Observation (Rickman Godlee Lecture).

FRIDAY, NOVEMBER 8.

LONDON HOSPITAL MEDICAL COLLEGE, at 4.30.—Dr. A. F. Hurst: Precursors of Carcinoma of the Stomach (Schorstein Memorial Lecture.)

SATURDAY, NOVEMBER 9.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—G. T. Clark: Geometry—Boys, Girls, Us.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—J. E. S. Dallas: Wild Flowers in London's Open Spaces.

CONFERENCE.

NOVEMBER 1 TO 3.

LEPLAY HOUSE AND THE SOCIOLOGICAL SOCIETY.