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The London Electricity Inquiry.

THE inquiry into the electric supply for London, which was opened by the Electricity Commissioners on June 14, is still proceeding. Owing to the many conflicting interests of the companies and the local authorities, the question is very complicated; but as there is practical agreement on the engineering side it is hoped that an agreed scheme will be evolved. The Commissioners have to consider six proposals, but only three of them both cover (or nearly cover) the whole area and consider the appointment of a Joint Authority as contemplated by the Electricity Act of 1919. These three proposals were submitted by (1) the London County Council; (2) the conference of local authorities owning electricity undertakings in Greater London; and (3) the London Electricity Joint Committee, 1920, Ltd., which comprises nine of the leading London supply companies. In addition there are also proposals by (4) the Metropolitan Borough Council of Poplar, which asks that the East London supply should be considered as one district; (5) the Great Eastern Railway Co.; and (6) the London, Brighton, and South Coast Railway Co.

The first three proposals have much in common from the engineering point of view. It is recognised that, owing to the financial conditions prevailing at present, the proposals suggested in 1914 for the immediate erection of capital stations would not now be advantageous, although the demand for electric power is much in excess of the supply. At present prices it does not pay to shut down even antiquated stations and to replace them by others more efficient. The L.C.C. scheme (1) is based on the retention and development of certain of the existing stations in the area, whilst the other stations gradually cease to be generating stations. In the original scheme the building of capital stations before 1925 was contemplated, but it is now thought inadvisable to hamper the "Joint Electricity Authority" with a large capital outlay. It is proposed to organise on a sound basis the present facilities in the area. In the first stage of the scheme as now modified eighteen of the existing sixty-one generating stations will be gradually shut down, and in the second stage a further twenty-six will disappear, leaving only seventeen, of which twelve are owned by private companies. In the first stage thirty-one of the stations would be interlinked by high-pressure cables, working pressures of 33,000 and 11,000 volts being used for the interconnecting mains. Considerable economies could thus be effected by diminishing the capital plant required and having engines running only at their most economical load. It will be seen that the proposal is a direct reversal of the earlier electrical legislation, which always contemplated having two competing companies in each district.

After 1925 the L.C.C. contemplates the building of four new capital stations each of 250,000 kilowatt capacity. It also proposes to reconstruct the existing stations at Stepney and Deptford on a much larger scale. All the new stations would be situated on the Thames. The one at Chiswick would be capable of supplying the whole of Middlesex at 33,000 volts. The remaining stations would be east of the Blackwall tunnel at Blackwall, Beckton, and Greenwich respectively. It is calculated that by extending existing stations and interlinking them there will be a total plant capacity of 577,000 kw. available in 1925, and this could supply a demand for 500,000 kw. It is thus possible to postpone the erection of these super-stations in the hope that money and plant will be cheaper after 1925. The maximum power available by extending existing stations is 760,000 kw., but it is probable that in four years' time the gain in lower working costs effected by building these large stations will more than offset the higher capital charges that would have to be met.

The companies (3) desire to restrict the area —at least in the first instance—within a radius of ten miles from St. Paul's. In their opinion it would not be economical to supply the outlying districts until the demand increases. They differ also from the L.C.C. and the local authorities in the constitution of the "Joint Authority" which they propose. They suggest that it should consist of sixty-two members. As most of the work would have to be delegated to technical committees, we think that a council of this size is much too big and would prove unworkable.

Very divergent opinions are held by some of the County and Borough Councils interested in the schemes. For example, the Middlesex County Council wants to be excluded, while the Surrey County Council, although only part of its territory is involved, wants to be included. The representative of the Poplar Borough Council, which has a scheme (4) of its own, objected to all the first three schemes.

It was pointed out, when the 1919 Electricity Act was passed, that it would be to the mutual advantage of the Joint Authority and the railways that the former should supply electricity to the latter. Some of the railway companies, including (5) and (6), think that they will be able to generate electricity more cheaply themselves, one of the reasons adduced being that the Joint Authority would not be able to borrow money more cheaply than the railway companies can, and would be hampered by having to provide a sinking fund on its capital, no such necessity arising in the case of the railway companies. We think that this is a very doubtful reason. It seems probable, however, that in any agreed scheme consideration of any railway load will be excluded, at least for the first few years.

The brief account given above of the first results of the inquiry will show that the great expectations which some engineers based on the 1919 Electricity Act have still to be realised. Financial considerations and vested interests have proved stumbling-blocks. But it is very satisfactory to note the conciliatory spirit in which the engineers immediately affected by the proposals have considered them.

Supply engineers recognise that fuel economy is the most important problem they have to study. Recent tests show that in the boiler-house it is possible by scientific management to employ usefully from 80 to 85 per cent. of the calorific value of the fuel. It is heart-breaking, therefore, for some engineers to have to use old-fashioned engines which consume 40 to 50 per cent. more steam per horse-power developed than the best modern engines. In the national interest it is necessary that these engines should be scrapped at the earliest possible moment. The great increase in electric power consumption is well exemplified in the case of the city of Sheffield. The 1914 consumption was 20 million units. It is now 172 million units, the coal consumption being 5000 tons per week. In this connection we hope that the use of raw coal for steam-raising will soon be a relic of barbarism. There is no difficulty in designing furnaces for utilising coke, and several are in everyday use. The economies effected by using powdered fuel are also worth considering.

A hopeful sign of the times is the increasing co-operation between the electricity and the gas industries. At the inquiry Mr. G. W. Partridge, giving evidence in support of the companies' scheme (3), said that arrangements had been made with the Gas Light and Coke Co. with regard to leasing part of that company's site at Beckton for erecting a super-station which it was proposed to build in sections as the demand grew. Owing to the large quantity of coke and coke breeze on the site, much of which at present goes abroad, the cost of fuel would be very appreciably cheapened. The gas company would also be willing to let to the companies the use of the existing wharves, piers, railway sidings, etc. There would thus be a great saving in capital outlay. Any of the improvements, which are hopefully looked forward to, in the carbonisation of coal, the utilisation of waste heat, and new by-products would be to the mutual advantage of the two interests.

The history of electric supply in this country is largely one of legislative interference with a flourishing industry. We are glad that the industry is now so largely dependent on private initiative. Engineers have no delusions about receiving large Government grants, although the supply of cheap electric power, bringing new industries to life, is vital to the prosperity of the country. The inquiry has proved that the supply engineers are willing to accept the best and, consequently, the most economical solution, even if at first it affects their private interests adversely.

Congress of Universities.

AT Oxford last week the second congress of the Universities of the Empire was held under perfect conditions as to weather and public and private hospitality. The large and distinguished assembly which forgathered in the examination halls on four successive days was drawn from fifty-nine universities widely separated geographically, but inspired by the same ideals and working for the same increasing purpose. This number, it may be observed, has not grown markedly since 1912, when the first congress was held in London; but those who were privileged to attend both congresses must have been impressed by the different conditions, moral and economic, which have arisen during the intervening nine years. Lord Rosebery, in his opening address to the first congress, spoke with eloquence and prevision on the throes of travail which the world was at that time undergoing to produce something new to history—"something, perhaps, better than anything we have yet known, which it may take long to perfect or to achieve, but which at any rate means a new evolution." Two years later the thunderclap of war burst over the world. Evolution ceded place to a process more catastrophic in both its physical and its spiritual workings. May it not be said that the universities, stunned and hesitating, are still groping their way in the new world which is in slow and tentative formation?

Assuredly the note of uncertainty was frequently sounded in the papers read at the congress. Prof. Desch, in an address on the place of the humanities in the education of men of science, asserted that scientific education to-day lacked the "synthetic view" which would harmonise the laws of human society and of the physical universe and life. "Science without sociology is imperfect, but with it the artificial division between scientific and humanistic studies disappears." The relation of the universities to secondary education would appear to be a subject upon which definite conclusions should by this time have been reached by those who have applied their minds to the problem. Prof. John Burnet, the distinguished classical scholar of St. Andrews, confessed that his chief qualification to act as spokesman on this question appeared to be that he had failed in rather a conspicuous manner to find a solution which commended itself to anyone in his own country. Universities have been engaged in the training of teachers from their origin, and have for centuries granted to their masters of arts the *jus ubique docendi*. But, as Prof. John Adams pointed out, the principle that all teachers should be trained in universities is not yet established, and there is indeed a dangerous tendency for local authorities to train directly their own teachers within their own areas.

The subject of adult education found eloquent exponents in Lord Haldane, Prof. G. H. Leonard, Sir Michael Sadler, and other speakers; but how vast and inchoate the issues must appear to universities harassed, almost overwhelmed, in the discharge of their immediate obligations! If there is one lesson enforced by the war, it is the danger of neglecting the applications of science. We find ourselves, as Prof. Smithells pointed out in a singularly temperate and closely reasoned address on the universities and technological education, "a people far spent by the cost of victory over a nation of technologists, a nation which had carried to the highest point the training of its people in applying exact science to the mechanical arts of both peace and war." Nevertheless, he was constrained to raise his voice against the unbridled pursuit of applied science and to direct attention to the restraints under which it should be fostered. The Germans, he admitted, among their excesses of regimentation, had good cause to reconsider their educational plan of isolating seminaries of technology. Technological studies must be given their proper place in our universities as a necessary part of the educational organism.

This line of thought was developed also by Sir Robert Falconer, president of Toronto University, who denounced the conception of a university as a set of public utility schools bundled together by the tie of a common administration. A university should be an organism with an intellectual and moral spirit giving it unity and life. The discussion on the nationalisation of universities raised the temperature of the congress by a few degrees. It is noteworthy that the idea of nationalisation has greater terrors at home than in the overseas dominions, some of the representatives of which seem disposed to hug their chains.

We have referred to a few of the questions of university politics and organisation which were discussed at the congress. There are others not less pressing. The relations of the central and local education authorities to university education in this country are still, in a large measure, unsettled. Further, the question of the future supply of university students under existing economic conditions gives cause for grave anxiety. In NATURE for June 30 we published statistics of students receiving university education, which indicated a total full-time student population for the United Kingdom in 1919–20 of 52,600, of whom nearly 17,000 were ex-Service students. Is it not obvious that this *net* total, assuming it will be maintained, is entirely inadequate to meet the future needs of our great and extending Empire?

The question of the establishment of new universities—how many, in what districts, and with what special characteristics—has to be examined. There are also questions relating to the co-ordination of university work with the view of obtaining the maximum benefit from the minimum expenditure, a consideration which in future will be increasingly in the minds of public men and public authorities. We are reluctant to criticise a congress which has been the means of publishing so many useful contributions to educational thought; but it is impossible to overlook the need for a more systematic discussion of these questions of university organisation and for the formulation of guiding principles. As Lord Rosebery insisted at the first congress, every university must work out its own salvation in its own way, and a centralisation of the Universities of the Empire would be demoralising to them and fatal to their growth and development. Acceptance of this general idea should not inhibit an orderly study of various questions of university organisation, the decision of which is already long overdue. If the universities limit their contributions to these discussions to expressions of personal opinion, however adroit and enlightened, the task of finding solutions to these difficult questions will have to be undertaken by some other authority.

A Psychology of Logic.

Psychologie du Raisonnement. By Eugenio Rignano. (Bibliothèque de Philosophie Contemporaine.) Pp. xi+544. (Paris: Félix Alcan, 1920.) 18 francs.

THE distinguished editor of *Scientia* has given us in this volume a valuable and most useful study, which is likely to take its place as a recognised book of reference. It is original, both in its method and in its subject-matter, to a very high degree, and part of its originality is the way in which it brings together, and works into a complete scheme, the researches and theories based on the researches of experimenters and theorists in all the sciences. The main purpose is to present a psychology of reasoning. By reasoning is meant the higher logical processes of the mind which are distinctive of intellect, and by psychology a descriptive science which interprets a definite domain of reality by bringing it into relation with other domains.

The theory is given in the chapter entitled "Qu'est-ce que le raisonnement?" This appeared as the first of a series of articles in *Scientia* eight or nine years ago, and it forms now a kind of centre or nucleus around which the argument plays. The answer to the question is that reasoning is nothing but a consecutive series of actions or experiments carried out simply imaginatively in thought and not effected materially. The result of the imaginatively represented process is the demonstration or conclusion to which reasoning leads and at which it aims. Reasoning is experimenting internally, thoughts are merely imagined acts.

It will be seen, therefore, that Signor Rignano's psychology moves on the scientific plane and ignores the metaphysical problem. It accepts existence and is unconcerned with the genesis or with the ultimate nature of reality. Given the physical, biological, and physiological basis, psychology can define its data by relation to it. Memory, perception, and productive and reproductive imagination can be described and their function, scope, and limitations determined. The scheme of the work is then clear. A psychology of logic has to show, first, the evolution of reasoning from inferior forms of mind which do not attain to it; secondly, the evolution of reasoning itself into its higher forms; and, finally, the positive factors as they are revealed by the study of abnormality.

On the basis of the assumption that mentality is a phenomenon within the objective world of physical science and presupposes the independent existence of that world, it is undeniable that a great deal of practically useful science can be formulated. The author's numerous, excellently chosen illustrations of the reasoning process are very fascinating. They provide the kind of interest which used to thrill us in the old descriptive "natural histories." Certain doubts as to the soundness of the method, however, very soon invade us. There are extraordinary stories of animal intelligence—all standard illustrations and taken from recognised authorities (Romanes, Jennings, and others), and to be differentiated, therefore, from the tall stories which fill the correspondence columns of some newspapers; but, even so, it is questionable whether they do not darken rather than enlighten judgment as to the mode of working of the animal mind.

To understand the mentality of a dog or of an amœba, surely we ought to study the most ordinary responses and not single out some special case of anthropomorphic behaviour as peculiarly significant. This vice of method spoils a good deal of Signor Rignano's excellent work. For example, take his theory of intuition. In contrast with deductive reasoning, intuition is characterised by immediacy. But this immediacy, if we have understood the author correctly, is always relative: the reasoning has been so swift that we have not noticed the stages. Intuition is simply a telescoping of that imaginative experimenting in which all reasoning consists. No one, we venture to suggest, would adopt such a view had he studied instinctive behaviour directly and in its general aspect without attempting to base theories of genesis on specially induced experiments, whether on the infusoria or on the higher vertebrates. The theory may not be wrong, but the method is suspect.

One of the most penetrating and instructive sections is the critical review of the forms of mathematical reasoning. Algebra stands at the top of the scale, logistic at the bottom. The former never parts company completely with the concrete as the latter does. Moreover, logistic stands condemned in our author's view for its utter inability to advance by reasoning to any new fact. Creative imagination is the driving force of reasoning, and this is not only absent from, but also definitely eschewed by, logistic.

Where Signor Rignano will seem to some to fail is in what he denies rather than in what he affirms. The concept when detached from the sensible imagination is for him purely verbal. A concept, self-contained and self-subsistent, a concrete universal, has no place in his theory of reasoning, and in itself is unintelligible. The polemic against metaphysics seems to us the weakest part of his book, and as it is quite unnecessary to his argument its introduction is to be regretted. The metaphysical inquirer is described as one who is determined at all costs to save values. He is moved by affective, and not by intellective, motives. The reply is simply that, as a matter of fact, it is notoriously untrue. The philosopher, as philosopher, is absolutely indifferent to values as values. What impels him to metaphysical inquiry is not desire, or emotion, or affective consideration of any kind; it is the pure need of intellectual satisfaction. Even the author protests that the most "positive" and least metaphysical of inquirers cannot be indifferent to values—why, then, is it presumed to vitiate the motive in one case and not in the other?

Regarded from the author's point of view, as it should be, the book is full of interest, clear and sustained in its argument, and maintained throughout at a high level. We hope there will be a good English translation, for it should prove an excellent text-book for advanced courses.

H. WILDON CARR.

Text-books on Theoretical Chemistry.

(1) *Die chemische Literatur und die Organisation der Wissenschaft.* By W. Ostwald. (*Handbuch der allgemeinen Chemie.* Band 1.) Pp. iv+120. (Leipzig: Akademische Verlagsgesellschaft m.b.H.: Gustav Fock, 1919.)

(2) *The Foundations of Chemical Theory.* By Prof. R. M. Caven. Pp. viii+266. (London: Blackie and Son, Ltd., 1920.) 12*s.* 6*d.* net.

(3) *Inorganic Chemistry.* By E. I. Lewis. Third (revised and enlarged) edition. Pp. xv+443. (Cambridge: At the University Press, 1920.) 9*s.* net.

(1) PROF. OSTWALD'S book constitutes vol. i. of the "Handbuch der allgemeinen Chemie" which he is editing in conjunction with a number of eminent collaborators—Kuenen, Drucker, Marc, Bruni, Dutoit, Cohen, Halban, Bredig, and others—all recognised authorities on the several sections of physical chemistry to which they contribute. This introductory volume is, in effect, a long and discursive essay on the methods of propaganda of science and on the gradual development of the means of disseminating scientific truth. It traces the spread of scientific knowledge through the agency of societies, general and specialised, by means of discussion and publication, by scientific journals, and lastly by treatises, monographs, and text-books. It contains nothing but what is generally known to those familiar with the history of science, but the story is put together with considerable skill, and constitutes an eminently philosophical disquisition on an aspect of that history which has hitherto had few expositors.

Towards the conclusion of his essay Ostwald gives a free rein to his imagination in seeking to forecast the lines upon which the dissemination of scientific knowledge must proceed in the future. He is thus naturally led to what is an obsession with him—the possibility of the universal language —and we are treated to a short *excursus* on the relative merits and disadvantages of Volapük, Esperanto, and Ido. Recent events, for which Prof. Ostwald's own countrymen are wholly responsible, have absolutely shattered whatever hopes he may have entertained of the speedy realisation of his ideals. But, as he says in his preface: "Die Schrift wurde bereits 1914 fertiggestellt und gesetzt: die Ausgabe ist durch den Weltkrieg bisher verzögert worden." To allow the concluding paragraphs to remain unaltered when the work appeared in 1919 is characteristic of German mentality. It requires a very robust faith in the future to believe in their appositeness in present circumstances. We fear that the probability of the learned author being called upon again to preside over such a gathering in Paris as that which met there in 1907 to discuss the universal language is, to say the least, very remote. Nor have the prospects of German co-operation in the International Association of Chemical Societies, which Prof. Ostwald laboured to found when in Paris, and the Belgian manufacturer, Ernest Solvay, so generously endowed, been rendered any brighter by Prof. Ostwald's subsequent action in connection with the notorious *pronunciamiento* of German "intellectuals," directed against his quondam friends in France and England.

(2) Prof. Caven's book on "The Foundations of Chemical Theory" is an attempt to explain the fundamental conceptions which constitute the basis of the modern theory of chemistry. It is avowedly an introductory text-book, primarily intended for the young student with an elementary knowledge of the science; but it is also hoped that it may be within the compass of the general reader who, in the words of the preface, "wishes to know what modern chemistry really means." We fancy that the general reader who peruses the book will have a rude awakening in that respect. Recent occurrences have led him to believe that modern chemistry is mainly a matter of munitions—high explosives and poison-gases. He will find nothing relating to these subjects in the book, but he will be introduced to such eminently non-militant matters as the atomic and molecular theory, the periodic law, the doctrine of valency, reversible reactions, complex ions, and catalysis. The scope of the book is thus sufficiently indicated. In fourteen chapters distributed over 262 pages the author describes in simple and concise language the main principles and facts upon which theoretical chemistry rests.

The work is well written and forms interesting reading. The judgment of the author is, however, occasionally open to question. There are, for example, two opinions as to the expediency of the standard $O=16$ adopted, largely at the suggestion of the Germans, by the International Committee on Atomic Weights. At the recent conference in Rome it was proposed—and the proposition was favourably received—that the committee should revert to the old standard $H=1$. Prof. Caven expresses the hope that no such modification of the standard will be made. There is no question that any change will lead to confusion, but it is open to doubt whether the consequences will be so serious as Prof. Caven surmises. Even under a constant standard there have been numerous instances of changes in the value of an atomic weight, due, not to the variable standard, but to improvements in the methods of determining the constant. The atomic weight of chlorine, which the author adduces as an instance of confusion due to a changing standard, has been referred to a constant standard for many years past; but the value has suffered a progressive diminution owing to more rigorous experimental inquiries. The same is true of several of the fiduciary values employed in atomic-weight determinations. At the same time, there is much to be said for the retention of the present standard. It is remarkable how many of the atomic-weight values approximate to whole numbers, and are thereby more easily remembered and more convenient in use. The contention of Stas has lost much of its force, since the ratio of $H:O$ is now known to a very high degree of accuracy. The question is certain to be discussed by the reorganised committee in the near future, and it will largely turn on the relative merits of rationalism and expediency, for which the recent re-issue of Lord Morley's "Compromise" may well prepare the members.

For an elementary text-book the work may be said to cover its subject-matter adequately, and it is put together with a due sense of proportion. It is reasonably up-to-date, and, so far as we have been able to discover, it is free from errors. We would, however, point out that Hofmann's name in the table of contents is wrongly spelled, and the mistake is repeated on pp. 27 and 29.

The student who works through this book carefully and intelligently will acquire a considerable stock of chemical facts, and gain a sound knowledge of the generalisations to which they have led.

(3) Mr. Lewis's book on inorganic chemistry, originally published in 1907, is now in its third edition. It is designed for school teaching, and in the preface to the first edition, which is reprinted, the author describes his methods and the plan of his course of lessons. No attempt is made to cover the whole ground of inorganic chemistry; this is not called for where the main object is to teach principles and illustrate them by relevant facts. The plan of the work is original and has evidently been well thought out; for advice concerning it Mr. Lewis was indebted to many Cambridge friends, among them the late Mr. Humphry Jones and the late Mr. F. H. Neville. Mr. Lewis is, indeed, very faithful to his *alma mater,* and he loses no opportunity of acknowledging his gratitude to her and her sons. The lessons are accompanied by carefully chosen experiments, the apparatus for which is illustrated by figures in line drawing.

Each section is followed by "problems," some of which, it must be admitted, are absurdly "academic." Thus, to give the weight of a crucible as 26·59625 grams is what the Germans call "Decimalspielerei," and is apt to convey a perfectly illusory impression of the degree of accuracy attained in an ordinary weighing. The problems should be not so much arithmetical exercises as examples of the principles involved, and to this end it is unnecessary and unwise to inflict upon the student an unwieldy row of decimals which, especially in the hurry of written examinations, may land him into arithmetical blunders and so defeat what should be the real object of the examiner. It is also desirable that foreign proper names should be correctly spelled. The colleague of Dulong in the formulation of the law connecting atomic weight with specific heat is not usually styled Pettit (p. 141), nor, although there are variants in the name, is Ingen Houss (p. 183) commonly so written. Oxygen was discovered by Priestley on August 1, 1774, and not in 1775, as stated on p. 249 and elsewhere. As a matter of fact, Priestley had prepared it from nitre in 1771 without actually recognising it. Scheele, as is now known, was an independent discoverer, and had probably obtained the gas some time prior to 1774; but his first announcement of its existence was made in his treatise on Air and Fire, published in 1777.

Every conscientious teacher, properly equipped with knowledge and experience, and gifted with sympathy and enthusiasm, evolves his own methods of instruction sooner or later; but he can always learn from other teachers, even if at times it is only the negative gain of "how not to do it." From Mr. Lewis his gain will be positive. He will find his system rational and well-ordered, his methods of exposition clear and direct, and his experimental illustrations carefully chosen and strictly to the point.

A Jungle Book.

The Diary of a Sportsman-Naturalist in India. By E. P. Stebbing. Pp. xvi+298. (London: John Lane; New York: John Lane Co., 1920.) 21*s*. net.

A GREAT part of Mr. Stebbing's book is devoted to the sport and natural history of the big-game jungles of India, and no reader will escape their fascination. They are so primitive, so wild, so full of the unexpected, so tragic in their hidden vestiges of remote civilisation, and withal so rich in possibilities of present-day pleasure—to the sportsman-naturalist especially.

"The log fire burning and crackling merrily outside, the subdued buzz of talk from the servants' lines, the whinnying of the picketed ponies or the shrill voices of the syces raised in execration when a biting or kicking match commences, the dull rumbling of the elephants engaged on their fodder, resembling distant thunder; the great columns of trees forming a background to the camp, on to which the camp-fires cast fitful shadows, whilst overhead the picture is closed in by the blue-black vault picked out with innumerable jewels and spangled with diamond dust. How pleasant it all is. . . ."

Mr. Stebbing tells of his first bull bison (*Bos gaurus*), his first sambhar stag, his first tiger, his first leopard, his first bear, his first boar, not to speak of creatures like pangolins and porcupines which the naturalist enjoyed and the sportsman spared. It is a sanguinary book, but it is very well written, and the tale is adorned with vivid thumbnail sketches by the author and with excellent photographs by Mrs. Stebbing, Mrs. E. M. Sparkes, and Sir John Prescott Hewett.

Mr. Stebbing's general impressions of the jungle are very interesting. One is the warning which the jungle folk pass on when danger is approaching. "This warning, though intended for the friends of the utterer, is understood by the whole community, even though among themselves they may be respectively the oppressor and oppressed." From the moment the tiger or leopard is descried,

"every animal in the jungle is put at once on its guard by the performance of the birds and monkeys. The deer know perfectly well what it portends, and remain on the alert till their enemy has left the neighbourhood. In fact, it is quite common for a tiger or leopard, once he has been discovered in a jungle, to be fairly mobbed out of it; for he knows that once all the jungle animals have been informed of his presence he has a poor chance of getting even a plump young doe to make his meal off."

Another impression is the great difficulty experienced in "picking up" the animals—from elephant to partridge—in their natural surroundings.

"Even a large animal like the tiger can move along in his surroundings in an almost invisible manner. His outline becomes merged in the general colour of the grass or scrub jungle, but there is nothing definite to pick up, and when he is motionless he is almost invisible, if not quite, to the untrained eye. . . . It is usually the eyes of the animal which are first perceived if it is facing the observer. . . . Whilst, therefore, in a new environment and with an untrained eye, the newcomer finds some difficulty in picking out any of the animals in his neighbourhood from their surroundings, the reverse is the case with the jungle folk. They will hear, smell, and see him seconds, even minutes, before he has any chance of getting on terms with them."

Some people have spoken of the silence of the Indian jungles; but this is true only of the hotter part of the day, when most of the mammals and birds are taking their siesta. In the morning and evening, and at night, the jungles are full of sound.

The interrelations of living creatures are perennially interesting, and Mr. Stebbing gives some fine examples. Thus certain caterpillars, which he names, defoliate great blocks of teak forest, leaving them exposed to the hot sun and hot winds so that the undergrowth becomes scorched and withered. The deer and some other mammals have to quit these shelterless tracts.

"The termite has its uses in the Indian forest, for it rapidly disposes of the vast amount of refuse branches and dead fallen stems which without its aid would accumulate on the forest floor and greatly add to the risk of fires and increase their intensity when they took place, in addition to making progression impossible for man or beast."

The red ants are a source of great trouble to man, though he does make a paste of them which is eaten as a condiment with curry!

"The red ant lives in the trees and builds nests of the leaves. Such nests are a common sight in the sál forests. The nests are constructed in an ingenious manner, the edges of the green leaves being gummed together. The mature ant does not possess any material with which to perform this work. His gum bottle he finds in the immature ant, which has glands secreting a sticky substance. Several of the adult ants hold the leaves together, whilst another seizes a youngster between its mandibles and uses him as the brush of the gum bottle. It shows either a high form of civilisation or a low form of sweating to thus make the children share in the labour of house-building."

The second part of this interesting book deals with the means to be taken to preserve the forest game animals from poachers and unsportsmanlike sportsmen, and this in turn leads to the larger question of the preservation of the Indian land fauna as a whole. Some of the finest game animals are now within measurable distance of extinction, and the creation of game sanctuaries has been commenced with the view of affording protection to certain animals, such as the bison, rhinoceros, and deer. Apart from game, many components of the fauna are of economic value, and zoologically all are interesting. Mr. Stebbing pleads convincingly for large permanent sanctuaries, from which sportsmen, collectors, exploiters, and the like would be barred. One almost feels as if Mr. Stebbing had seen St. Hubert's vision in the course of his book, for he becomes steadily less sanguinary and more of a naturalist. Nevertheless, it is very good reading through and through.

Elementary Pure Mathematics.

(1) *The School Geometry: Matriculation Edition.* By W. P. Workman and A. G. Cracknell. Pp. xi+348. (London: W. B. Clive, University Tutorial Press, Ltd., 1919.) 4*s.* 6*d.*

(2) *Modern Geometry: The Straight Line and Circle.* By C. V. Durell. Pp. x+145. (London: Macmillan and Co., Ltd., 1920.) 6*s.*

(3) *The Elements of Analytical Conics.* By Dr. C. Davison. Pp. vii+238. (Cambridge: At the University Press, 1919.) 10*s.* net.

(4) *An Algebra for Engineering Students.* By G. S. Eastwood and J. R. Fielden. (With answers.) Pp. vii+199+xv. (London: Edward Arnold, 1919.) 7*s.* 6*d.* net.

(5) *Elements of Vector Algebra.* By Dr. L. Silberstein. Pp. vii+42. (London: Longmans, Green, and Co., 1919.) 5*s.* net.

(6) *Graphical and Mechanical Computation.* By Dr. J. Lipka. Pp. ix+264. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) 18*s.* 6*d.* net.

(1) THIS book is in reality sections i.–iv. of the authors' "Geometry: Theoretical and Practical," adapted to the requirements of students preparing for the matriculation and similar examinations. It combines the theoretical with the practical. After an introductory course of practical geometry based on intuition, there follows a series of propositions and theorems amounting, roughly, to "Euclid," Book I., Book III., Book II., and Book IV. The presentation and treatment call for no special comment; they are clear and concise, in the well-known style of the University Tutorial Series. There are many exercises of all kinds and of all grades of difficulty; many of the riders are provided with hints as to which theorems they are based on, and the student is thus led on to discover for himself the best methods for dealing with such exercises.

A few points deserve special mention. The definition of space on p. 34 is not likely to convey anything very clear or even intelligible to the average matriculation candidate. The theorem that the sum of the interior angles of a polygon of n sides is $(2n-4)$ right angles is unnecessarily restricted to convex polygons. Another figure is required on p. 85. Some misprints and one or two bad diagrams are but minor blemishes on this excellent guide for matriculation candidates.

(2) Mr. Durell's book on the modern geometry of the straight line and circle was intended as a new edition of his "Course of Plane Geometry for Advanced Students, Part I.," published in 1909. There have been, however, such considerable changes that the author has preferred to issue the book under a new name. It contains a pleasant and useful account of the geometry required by scholarship candidates at public and secondary schools, giving the usual work on rectilinear figures, similar figures, harmonic ranges, quadrilaterals and quadrangles, poles and polars, inversion, etc. There is a chapter on vector geometry with statical applications, while in dealing with inversion and coaxial circles the author very wisely makes use of analytical methods and notation. The treatment is sound, and the exercises are numerous.

(3) Many books exist dealing with analytical conics, and presumably every author of such a book aims at making the student interested in this eminently important branch of pure mathematics. Nevertheless, new books on the subject will continue to be scanned with anxiety by teachers of mathematics, because there can be no doubt that many students find the subject difficult, and the existing books scarcely afford them the help they need. One must say at once that Dr. Davison's book is no exception to the rule. It is a clear and sound investigation of the ordinary analytical theory of the straight line, circle, and conic sections, carried out on the orthodox principles and in the orthodox manner. The student who is desirous of learning the subject, and is intellectually and mathematically capable of following the argument, will no doubt study the book with profit, for there are very many examples, revision exercises, and a number of problem papers on the subject. The book is well produced and printed in the clear and interesting style that we have learnt to associate with the Cambridge University Press.

For a possible second edition we would recommend a few corrections and slight additions. In dealing with the distance of a point from a straight line, something should be said about the somewhat difficult question of the sign of the distance. There are *two* tangents to a circle, ellipse or hyperbola, having a given direction. The author assumes that the equation of a circle or conic is of the second degree; this assumption is not good pedagogics in a course of the kind he has produced. Is there any particular reason for putting the equation of an ellipse in the form $b^2x^2+a^2y^2=a^2b^2$? The classical form with a^2, b^2 in the denominators looks simpler and is easier to remember. The director circle of a hyperbola appears to be subject to various vicissitudes, depending upon whether the real axis is greater or less than the imaginary axis; this should be mentioned. There are several misprints; the worst occurs where the co-ordinates of a point on a circle are called $(a \cos \phi, b \sin \phi)$.

(4) "An Algebra for Engineering Students" aims at giving all the knowledge of algebraic principles and processes that engineers should possess before commencing the calculus as applied to engineering. As a particular class of student is catered for, theoretical proof is in places made to give way to illustration and verification, and no one who has any experience of teaching mathematics to engineers will quarrel with the authors on this account. The subject-matter is the ordinary elementary algebra up to and including quadratic equations, and, in addition, indices, surds, logarithms, arithmetical progressions, ratio and variation are dealt with. Graphs and graphical methods are discussed in a competent manner, and the elementary use of the slide rule is explained. A few nomograms are included, but not in such a way as to afford the reader any real insight into their construction or use. The examples are of a practical type, but one cannot help remarking that the worked example on p. 3 is as artificial as any to be found in the "dry" theoretical books.

(5) Dr. Silberstein is an acknowledged exponent of vectorial methods, and anything that he writes on vector algebra bears the stamp of authority. The present book, although intended for optical computers who wish to use vector methods in optical computation, is equally useful to all who wish to read a clear and easy account of the elements of the subject. The ordinary processes of addition and subtraction, and of scalar and vector multiplication, with extensions, are dealt with first; then follows an account of linear vector operators, leading up to dyads and dyadics. Hints on the differentiation of vectors complete a useful little volume. The division of the book into chapters, and the addition of some examples of a practical nature, would increase its value manifold.

(6) Computation and graphical methods of calculation are assuming an increasing importance in mathematical teaching, especially for such students as are preparing to use their mathematics in some industrial or vocational application. Several universities and university colleges have instituted mathematical laboratories, and a book like Dr. Lipka's "Graphical and Mechanical Com-

putation" should be welcome to both students and teachers in such places.

The author has put into book form the course of lectures he has been giving to engineering classes in the mathematical laboratory at the Massachusetts Institute of Technology. It is a comprehensive course, including a discussion of various kinds of scales and the slide rule, networks of scales for several variables, nomographic charts, empirical formulas (with the method of least squares), periodic curves, interpolation, and approximate integration and differentiation (with various kinds of planimeters, integrators, integraphs, etc.). Each part of the subject is dealt with in some detail, with the result that the book is a mine of useful information on practically all the processes that occur in computative or graphical work. One may, perhaps, think that the subject-matter is too condensed both in treatment and in actual print, but as a foundation for a course in a mathematical laboratory the book can be recommended without hesitation; it should find a place in every mathematical and engineering or technical library, and serious students will find it a continual help in their industrial or research work.

A particularly exhaustive treatment from the practical point of view is given of nomography. Perhaps it would be better if the author had laid more stress upon explaining exactly how nomograms are to be constructed and used than upon the reproduction of so many nomograms. This is, however, a matter of taste, and what the author has put into this section of the book is on the same standard of excellence as the remainder. There are numerous examples, many of them worked out numerically in full. The book also contains accurate charts of uniform and logarithmic scales, as well as of square roots.

S. BRODETSKY.

Our Bookshelf.

Creative Chemistry: Descriptive of Recent Achievements in the Chemical Industries. By Dr. Edwin E. Slosson. (The Century Books of Useful Science.) Pp. xvi+311. (London: University of London Press, Ltd., 1921.) 12s. 6d. net.

THIS book is written by an American journalist with some knowledge of chemistry. It is intended for lay readers who wish to make themselves acquainted with some of the recent developments of applied chemistry, including nitrogen fixation, fertilisers, dyes, sugar, rubber, poison gas, and other subjects likely to be of interest to the average reader. The facts, which appear to be accurate and selected with care and discretion, are presented clearly and forcibly, with a certain native humour. Gerhardt should not (p. 6) be described as a German chemist, while the account of the origin of Kekulé's theory of the benzene nucleus (p. 66) differs somewhat from that usually accepted. It is also interesting to know (p. 33) that "we might have expected that the fixation of nitrogen by passing an electrical spark through hot air would have been an American invention [it was discovered by the English chemist Cavendish], since it was Franklin who snatched the lightning from the heavens as well as our sceptre from the tyrant, and since our output of hot air is unequalled by any other nation."

A Little Book on Map Projection. By Mary Adams (Dr. William Garnett). New and revised edition. Pp. viii+112. (London: George Philip and Son, Ltd.; Liverpool: Philip, Son, and Nephew, Ltd., n.d.) 5s. 6d. net.

THE second edition of this useful book differs little from the first, which was published in 1914, but the author's identity is now revealed. Most books on map projection are either severely mathematical or, at the other end of the scale, so trivial as to have little value. Dr. Garnett strikes a happy mean, and contrives to give within a modest compass practically all that a student of geography requires to know of this difficult subject. He wisely takes nothing for granted, and as he develops his subject gives ample explanation at each step. About half the book is concerned with the principles involved, and the remainder with the consideration of the principal projections. The subject is treated with a freshness and lucidity which result in a most readable book. The treatment of Sanson-Flamsteed's, Mollweide's, and Mercator's projections may be specially noted. There are a number of clear diagrams and a short bibliography. The book should make a strong appeal to teachers and students.

Proceedings of the Aristotelian Society. New Series, vol. xx. Containing the papers read before the society during the forty-first session, 1919–20. Pp. iv+314. (London: Williams and Norgate, 1920.) 25s. net.

THE original papers included in this volume have already been noticed in the reports of society meetings. The present volume contains, in addition to the papers read at the ordinary meetings of the society, two of the symposia contributed to the Oxford Congress last September, in which the members of the French Philosophical Society took part. Of particular interest in this volume is Prof. J. A. Smith's sympathetic account of the philosophy of Giovanni Gentile, an Italian philosopher, the originality of whose speculation, already acknowledged in his own country, is beginning to be recognised universally. We may also mention as of special scientific interest Mr. A. F. Shand's article on "Impulse, Emotion, and Instinct," and Dr. Beatrice Edgell's article on "Memory and Conation." The volume is well up to the high level of the proceedings of previous years.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Separation of the Isotopes of Chlorine.

THE method outlined in our letter of September 30, 1920 (NATURE, vol. cvi., p. 144), and used for the partial separation of the isotopes of mercury, has enabled us to accomplish a partial separation of the isotopes of chlorine. When about half of a strong solution of hydrochloric acid cooled down to about $-50°$ C. was evaporated in a high vacuum, the mixture of water and hydrogen chloride being condensed on a surface cooled with liquid air, the condensed part of the hydrochloric acid was found richer, and the remaining part poorer, as regards the lighter constituent of chlorine than the ordinary HCl.

Starting from about 1 litre of 8·6 mol. solution, we obtained, by repeated separations, about 100 c.c. of the lightest, as well as of the heaviest, fraction, the difference of which was examined by two different methods after transforming the acid into sodium chloride. In the first method the density of the two saturated NaCl solutions was determined. The salts were precipitated several times by alcohol from their aqueous solutions, and density measurements carried out after each precipitation. We found uniformly a higher density of the solution prepared from the residual acid, the mean values at 20° C. being

$$d_d = 1{\cdot}20222$$
$$d_r = 1{\cdot}20235$$

from distilled and residual acid respectively. On the assumption of equal atomic volume of the two isotopes these figures correspond to a difference of 0·024 unit in the atomic weight of chlorine, or 6·5 per cent. in the atomic ratio of the isotopes.

In the second method equal quantities (5·7500 g.) of the molten isotopic sodium chlorides were dissolved in water and each precipitated with accurately the same volume of 0·2 n. silver nitrate. The latter was added in a slight excess. After precipitation and dilution to 2000 c.c. the approximate concentration of the filtrate was determined by titration with potassium rhodanide, and the ratio of the silver concentrations of the two solutions measured by combining them to a concentration cell. From the concentration $c=0{\cdot}00040$ n. and the electromotive force of the cell, 0·0011 volt at 18°, we calculated that the difference in the atomic weight of the two samples was 0·021 unit, in close agreement with the result of the first-mentioned method.

The hydrochloric acid used in these experiments was thoroughly purified with potassium permanganate in order to remove bromine contingently present. Moreover, the repeated precipitation of the sodium chloride by alcohol would have given decreasing values for the estimated separation of the isotopes if any bromine should have been present. We think ourselves justified, therefore, in regarding the above-mentioned results as conclusive.

J. N. BRÖNSTED.
G. HEVESY.
Physico-Chemical Laboratory of the Polytechnic Institute of Copenhagen, June 29.

A Novel Magneto-Optical Effect.

PROF. ELIHU THOMSON'S explanation of the interesting magneto-optical effect which he describes in NATURE of June 23, p. 520, is supported by some experiments we have made recently on various oxides dispersed in air. When the vapour of zinc ethyl diluted with carbonic acid gas is mixed rapidly with a large volume of air, a fine fume is produced the particles of which when examined with the ultramicroscope exhibit rapid Brownian motion. In a short time the motion becomes slower and the particles brighter, but fewer in number. This continues until the fume has aggregated into a number of loose complexes formed of irregular chains or strings of particles. These chains are flexible and whirl and twist about under molecular bombardment in a striking manner, but fall under gravity at a surprisingly slow rate. In an electrostatic field the complexes straighten out and arrange themselves parallel to the lines of force, and on reversal of the field rotate through 180°.

When caught on a slide and examined with a high-power objective the same structure is seen more clearly. The individual particles are not in contact, but appear to be held together by invisible threads, consisting probably of strings of molecules or fine molecular aggregates. The zinc oxide fume given off from a zinc arc in air behaves in a precisely similar way. When a dense cloud is produced initially the particles agglomerate to large and irregular masses. By transmitted light the connecting hairs are invisible, but by a strong beam of reflected light of short wave-length obtained by suitable screens the particles appear to be surrounded by a nebulous haze. That the particles in these large complexes are really linked together can be demonstrated in another way by allowing a drop of immersion oil to flow slowly across the slide on which the deposit has been caught; the particles as they are lifted up by surface tension are seen to be attached to constellations of others, and drag these with them from a considerable distance in front of the advancing oil. The individual particles are about $100\mu\mu$ in diameter, and the complexes about 30μ. Even after several hours these clouds always contain a number of single particles.

The particles in clouds obtained by the arc discharge between electrodes of other metals form complexes of varying structure. The tendency to aggregation seems weakest with the oxides of Pb, Cu, Mn, and Cr. It is slightly greater with Fe, whilst the oxides of Mg, Al, and Sb give similar results to zinc oxide. The particles of CdO show a great tendency to aggregate in strings of a remarkable length, which under the microscope look like beads strung on a thread. Clouds of this structure might be expected to show in a strong electrostatic field an optical effect analogous to that described by Prof. Thomson, but so far we have not observed it. The work is being continued.

R. WHYTLAW-GRAY.
J. B. SPEAKMAN.
Eton College, Windsor, July 4.

IN the former account of this novel effect (NATURE, June 23, p. 520) it was pointed out that a microscopic examination of the iron arc smoke deposited on a glass surface gave evidence of the existence of fine particles of iron compound arranged in short chain sections of bead-like relation.

It is now thought that this peculiar formation may have its origin in the outer envelope of the arc flame where the particles are formed and where they are lined up around the arc stream by the circular magnetism surrounding the current conducted by the hot vapour stream of the arc. The particles, being magnetic, would tend to form chains or rings surrounding the arc. These would not be stable, however, but would float away as they became shattered by gas currents, and remain only as short lengths of particles held together. To throw light on this possibility, a small vertical, hollow cylinder of plaster of Paris open above was arranged with iron electrodes (for forming an arc) passing through its sides and meeting in the centre. By passing the current of a storage battery giving about 50 volts through them in contact and separating them, an iron arc could be produced at will within the plaster cylinder. The dimensions of the cylinder were such that a microscope slide 3 in. by 1 in. could rest across the open upper end of the plaster cylinder, only partly closing it, the slide lying horizontally above the arc electrodes at a distance of about 3 cm. Such a slide could receive a layer of smoke on its under-surface when the arc was formed below it. The microscope in that case showed only a confused deposit.

When, however, there was placed above the slide a strongly excited electromagnet with its poles resting on the upper sides of the slide or close thereto, such poles being about 3 cm. apart, a smoke deposit of a remarkable character was produced. Even as examined by the unaided eye in diffused light there was decided evidence of a structure or striation. When the microscope was used, with even comparatively low powers of about 300–400 diameters, there was disclosed a decided striation seemingly composed of brownish particles in strings extending over the slide and following the direction of the field. There was noted a surprising regularity in the distribution or spacing of the striæ, as if the surface was covered with fibres laid on systematically side by side.

There were, however, curious objects composed of small spheres (evidently globules of iron) strung together in a line of two, three, four, or more, such spheres having no uniform size. Most of these iron globule groups lay, of course, in the field direction, and were very large relatively to the particles in the striation covering most of the surface of the slide. But each of these straight settings of globules possessed a singular appendage, generally at one end only, but sometimes at both ends. It consisted of a brush-like tail composed of the brown filamentous chains of particles like those covering the slide as noted above. They gave the appearance of tufts, suggesting a growth of fine beaded fibres from the end of the string of globules. By focussing, these tufts or tails could be seen as projecting outward (upward) in an inclined direction. This means that the tufts did not lie on the slide surface, but sprang outward from the globule which carried it. The globule at the other end of the short chain (generally the largest in the line) was often to be seen as having a convergence upon it of the usually parallel striæ of the other parts of the slide, indicating clearly that the globules strung together were acting as small magnets with poles at each end, towards and from which poles the convergence and divergence of the magnetic lines were indicated by the fine striæ of particles taking their direction.

The polariscope showed that the striated smoke layer caught on the slide has the same property of scattering or diffusing light (as plane polarised light) that the smoke oriented in the air by a magnetic field has, but, of course, the slide preserves the orientation, and needs, to produce the results, no magnetic field after its formation or deposition. The slide covered with the striated smoke film is, in fact, a polariser.

Examination between crossed Nicol prisms (dark field) discloses the fact that the tufts of fine fibres carried by the rows of globules show as luminous spots on the black field, clearly indicating that the groups or tufts have a polarising effect if they are in proper relation to the rays passing through.

As was to be expected, any hollow vessel or enclosure capable of retaining the smoke from an iron arc can be used in demonstrating the original luminous phenomenon. A glass flask of from 1 to 2 litres is readily sensitised, as it were, by holding its mouth over an iron arc for a short time, allowing smoke from the arc to enter, and then corking the flask. It may then be used to show the effects by allowing a beam of light to traverse it while held in the field of a current-carrying coil. While this was being done it was noticed by Dr. Hollnagel (of the laboratory) that when the coil was traversed by an alternating current of twenty cycles the flask, when near the coil, gave the usual effect of increased luminosity of the smoke in its interior. When, however, the flask was removed from the coil a distance of several feet the steady luminosity was replaced by a flickering which kept pace, not with the alternations of current in the coil, but with the cycles only. The flickering was, as it appeared, at the cyclic rate. This flickering was noted even at a distance of 12 ft. from the coil, although the coil was but 7 in. in diameter and about 2 in. in axial direction. The flickering is a curious effect, and it is difficult to explain, especially the fact that it appears to keep time with the cycles, and not with the alternations, of current. It points to some sort of magnetic retention or polarisation of the iron particles of the smoke. They may even rotate or oscillate in obedience to the field fluctuations, but there is needed much more work of investigation as to the cause of the peculiar behaviour. The experiment clearly shows that a very moderate field intensity suffices for lining up the particles in the air, and so producing the luminous effect.

Emphasis is again given to the fact of the extremely small amount of iron particles suspended in the air capable of giving a decided effect.

ELIHU THOMSON.
Thomson Laboratory, Lynn, Mass., June 17.

The Japanese Artificially Induced Pearl.

THE subject of artificial pearl induction, I venture to suggest, affords an excellent example of comparative pathology. Dr. Lyster Jameson's diagram in NATURE of May 26, p. 396, might well pass as an illustration of "pearls" frequently found in the human body. Such "pearls" are commonly seen in papillomata of the skin and at muco-cutaneous areas, but they can also be demonstrated in the tonsils, brain-coverings, thymus and thyroid glands, etc. Those which are epidermal become keratinoid, but others of deeper origin are often calcified.

All "pearls," whether ostreal or human, start in columnar cells and undergo metaplastic changes. Those of a wart become horny; those of the oyster calcified. The histological changes in the oyster are simply a matter of degree, and not difference.

The diagram fully illustrates this. The "blister" if seen in horizontal (transverse) section would present the same features as seen in the "pearl"—a concentrically laminated core surrounded by a single layer of cubical cells, embedded in mesoblast if growing, but when growth stops the cubical layer would be no longer seen.

"Islands" or "rests" of epithelial elements are common in man. In the oyster such an inclusion may become the true pearl and grow like a wart. Artificial induction or grafting merely imitates the natural process, and its later history is simply a matter of slight change in degree. In either case the pearl must be viewed as a morbid structure due to focal irritation. It is held that a wart may become malignant. In other words, it may grow too fast and eventually kill the host.

Do the pearl elements ever behave so in the induced variety?[1] Should any positive evidence of this be available, it would throw much valuable light upon the ontogeny of cancer.

The view that warts, and even cancers, are transplantable is strongly supported by the artificial induction of pearls.

WYATT WINGRAVE,
Consulting Pathologist, Central London Throat and Ear Hospital.
Lyme Regis, Dorset, July 8.

I DIRECTED attention in my 1902 paper (Proc. Zool. Soc., March 4, 1902) to the resemblance between pearls and "the structures sometimes found in epidermoid tumours and atheroma cysts." A pearl might be compared to the concentrically deposited ball of desquamated epithelial cells characteristic, I believe, of the latter, except for the fact that the pearl (like the normal molluscan shell-substance, and unlike the outer layer of the skin, and the nails, horns, hair, etc.,

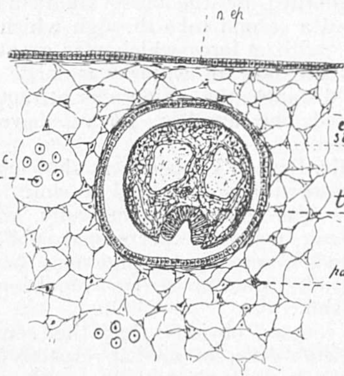


FIG. 1.—The pearl-inducing trematode *Gymnophallus dapsilis* or *G. bursicola* in the sub-epidermal connective tissue of Mytilus, surrounded by an epidermal sac which becomes the pearl-sac: *o. ep.*, outer shell-secreting epidermis; *ep. sac.*, epidermal pearl-sac; *par.*, parenchymatous connective tissue; *bl. c.*, blood-cells; *trem.*, trematode. The sac is usually about 0·4 to 0·5 mm. in diameter.

in mammals) is not composed of cells, but secreted at the surface of cells.

I cannot agree that the difference between a blister and a pearl is one of degree and not of kind, as Dr. Wingrave seems to suggest; in spite of the fact that the nature of the secreting cells, and of the substance they secrete, is identical. The blister is the normal response of the outer shell-secreting epidermis to the mechanical stimulation of any body that comes in contact with it. In this sense it resembles a corn on the human foot, or the thickenings of the skin on a navvy's hands. On the other hand, recent evidence goes to show that the sac, or "island," of epidermis in which the pearl is formed arises only in certain quite *specific* circumstances. In the case of the edible mussel the "circumstance" is probably the specific stimulation (quite likely of a chemical nature) of the trematode *Gymnophallus dapsilis* or *G. bursicola*. These worms normally become surrounded by such a sac in Mytilus (Fig. 1), and when the worm dies, or leaves the sac, a pearl is formed in it. A smaller trematode, which I have not identified, also occurs in the sub-epidermal connective tissue of the mussel; but this species, which is surrounded by a cyst, probably secreted by the worm itself (Fig. 2), and not by an epidermal sac, does not, in my experience, give rise to pearls. Similarly the cestode larva (*Tylocephalum ludificans*), which was wrongly identified by Herdman, Shipley, and Hornell as concerned with pearl formation in the Ceylon pearl oyster, is surrounded by the oyster with a fibrous con-

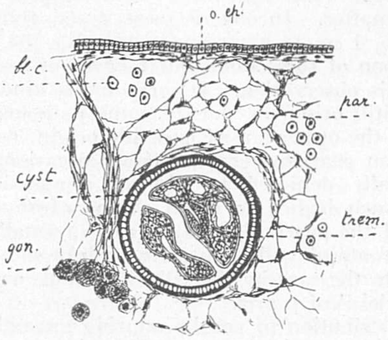


FIG. 2.—A smaller (unidentified) trematode in the sub-epidermal connective tissue of Mytilus which is surrounded by a cyst, probably secreted by the worm itself. The mollusc does not surround the worm with an epidermal sac, and there is no evidence that this species of trematode ever becomes the centre of a pearl: *gon.*, gonad. Other letters as in Fig. 1. The cyst is about 0·15 mm. in diameter.

nective tissue capsule (Fig. 3), and does not appear to possess the power of provoking the mollusc to produce the epidermal sac in which alone a pearl can be formed.

In the case of the Mikimoto pearls and of the pearls artificially produced by Alverdes, the special "circumstance" is the performance of a particular transplantation of tissue.

One of the facts which have favoured the survival

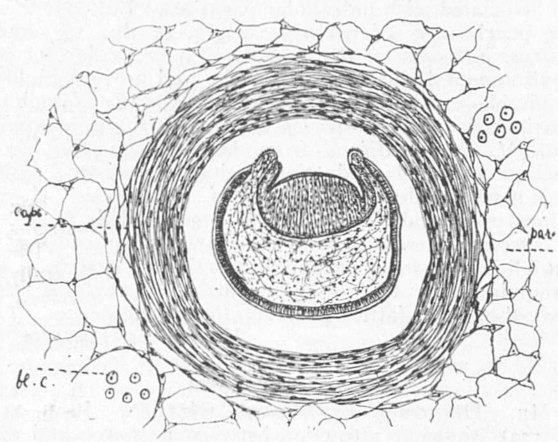


FIG. 3.—Solex of the cestode *Tylocephalum ludificans* in the connective tissue of the Ceylon pearl oyster. The mollusc surrounds this worm with a capsule (*caps.*) of fibrous connective tissue instead of with an epidermal sac. In spite of statements to the contrary, no satisfactory evidence has been adduced that this worm is associated with pearl formation. Letters as in Fig. 1. The entire capsule may measure as much as 2 or 3 mm. in diameter.

of the theory that the same kind of mechanical stimulation that produces a blister can produce a pearl-sac and a pearl is the occasional presence in fine pearls of grains of sand and other foreign bodies. I recorded and figured several such instances, from Ceylon pearls, in my 1912 paper (Proc. Zool. Soc., 1912, pl. xlii., Fig. 38; pl. xliii., Figs. 44, 45; pl. xlv., Figs. 54, 54*a*; pl. xlvi., Figs. 55, 56). I suggest the following possible explana-

[1] The step from a "pearly" wart to a "pearly" or nested epithelioma is a very short one.

tion of the presence of these bodies. One or two writers have recorded the occurrence of sacs with watery contents in different molluscs. The most notable instance known to me is that of *Modiola modiolus*, which, in the Barrow Channel, opposite the Lancashire and Western Sea Fisheries Laboratory at Piel, frequently contains leathery periostracum pearls in the mantle margin, and, associated with these, cysts lined with epidermis, containing watery or mucoid matter. In one of these cysts, some twenty years ago, I found what appeared to be the spores of a protozoon of some kind, but I have not been able to repeat this observation. If sacs of this kind, whether of parasitic origin or due to some pathological condition of the oyster not of parasitic origin, occurred in the Ceylon pearl oyster, and either occasionally burst or normally dehisced to liberate a parasite or its spores, such bodies as small grains of sand, or (as in one of the pearls figured by me) a small quantity of mud containing diatoms, etc., might sometimes be swept into the sacs by the ciliary current and become the "nuclei" of pearls.

The distribution of pearl-producing examples of the various species of molluscs points to the conclusion that the presence of pearls—in other words, the development in the tissues of the mollusc of pearl-sacs—is associated either with parasites which are peculiar to certain localities, or with pathological conditions, following upon particular environmental conditions, which are strictly local in their occurrence. Thus the Ceylon pearl oyster, which produces pearls abundantly in the Gulf of Manar, rarely produces them in Trincomalee Harbour, while the distribution of pearl-producing beds of *Margaritifera maxima* and *M. margaritifera* is still more striking. We find the same local distribution of pearl-producing individuals in the fresh-water pearl mussel Margaritana, and more noticeably in Anodonta.

Personally I am inclined to anticipate that in many of these cases pearl formation will yet be shown to be associated with unicellular parasites. But, whether the pearl-sac is of parasitic origin, or due to some obscure response of the mollusc to a particular set of environmental conditions, it might well prove a highly profitable enterprise to transplant young examples, particularly of such species as *Margaritifera maxima* and *M. margaritifera* from beds where the percentage of pearl production is low, or where pearls are never produced, to some of those beds where almost every individual contains pearls. This process, if successful, would bring the production of pearls into line with the relaying of edible oysters on grounds where the conditions are such as to secure that they will fatten properly for market.

H. LYSTER JAMESON.

Sources and Sinks.

MR. DUFTON'S experiment (NATURE, June 23, p. 522) showing attraction between a source and an equal sink illustrates forcibly a remark by Mr. A. Mallock in the issue for August 19, 1920, p. 777: "In most problems relating to the actual phenomena exhibited by fluids in motion, the simple assumptions on which the hydrodynamical theory of text-books rests are insufficient, and experiments are required." At my suggestion Mr. R. Schlapp has recently been making some experiments on the forces between sources and sinks. The vertical limb (about 80 cm. in length) of a **T**-shaped glass tube dipped into a tank of water, and the horizontal portion rested on **V** supports. One end of this horizontal part was sealed, the other was connected by rubber tubing either to a high-pressure water supply or to a water pump, so that the end of the tube in the tank acted as either a source or a sink. Three types of orifice were used: (*a*) the open end of the glass tube (internal diameter 0·4 cm.)—this worked well as a sink, but was unsatisfactory as a source; (*b*) a hollow brass sphere (diameter 2 cm.) with numerous perforations; (*c*) a short length of rubber tube having the lower end plugged and perforations over about 2 cm. On the whole the last arrangement proved the most convenient, but care had to be taken to ensure that no movement arising from lack of symmetry in the size and spacing of the perforations took place when using an isolated source.

When a single source was in the neighbourhood of a fixed vertical wall, attraction was observed. The attraction was very distinct at small distances, even with a small flow of water. At greater distances and with a stronger source the motion was irregular. Attraction was found also between a sink and a wall.

When two sources were employed it appeared as if they were under the influence of two forces, one attractive and the other repulsive, the former being predominant at distances less than about 2 cm. At such small distances the sources were drawn together and remained in contact as long as the water flowed. Additional evidence for the existence of a repulsive force was afforded by the observation that a fixed source repelled a second tube through which no water was flowing with a force which was greater or less according as the flow of water was large or small; but at small distances the action was attractive. Two sinks attracted one another, no repulsive tendency being observed.

Although Mr. Dufton's experiment showing apparent attraction between a source and a sink in a Winchester bottle was repeated successfully, experiments in an open tank, using the perforated rubber tube as a source and a similar arrangement or an open tube as a sink, showed strong repulsion between source and sink.

It is, of course, obvious that the conditions in such experiments differ in several respects from those assumed in the hydrodynamical theory of sources and sinks in an infinite mass of fluid. H. S. ALLEN.

The University, Edinburgh.

Helicopters.

MR. MALLOCK, in his letter in NATURE of June 30, p. 553, omits the chief reasons for the non-success of helicopters so far.

The first and, to the engineer, most obvious difficulty is the extra weight of moving as compared with fixed wings, and this applies to ornithopters equally.

The second, demonstrated conclusively by Riabouchinsky at the Koutchino laboratory in 1909, and recently rediscovered by ourselves, lies in the phenomenon of mutual and self-interference of the blades of an airscrew, now commonly called the cascade effect.

Each blade blows down the next following in the spiral path, then the other blades in turn, then again itself and the others, the effect becoming fainter as the axial distance from the "image" of itself and the others becomes greater.

In aeroplanes and helicopters, as in all structures which are kept geometrically similar, the weight increases as the cube and the lifting surface as the square of the typical dimension, and though some fining down of large structures can be made in comparison with small, this physical law limits the size alike of the vulture, the elephant, the whale, and the aeroplane. In helicopters the limit comes sooner than in the aeroplane, for the two reasons given above.

If this fundamental relation is ignored, the aeroplane or helicopter will be fortunate if it meets no

worse fate than the ostrich, and merely fails to leave the ground.
A. R. LOW.

The Library, Air Ministry,
Kingsway, W.C.2, July 1.

A Prehistoric Cooking-place in Norfolk.

COLLECTORS of Stone-age implements are well acquainted with the calcined flints known as pot-boilers, which are found sparsely strewn over the sites of most prehistoric settlements. As the sun-baked pottery of the kitchen utensil would not stand the fire, heated flints were thrown into the vessel to bring the water to the boil.

My attention having been directed by Mr. Baldry, of Cranwich, to a mound in Buckenham Tofts Park, Norfolk, where the moles were throwing out a remarkable number of these pot-boilers, with the kind permission of the owner, Mr. Underdown, I started excavations on the spot in May last with the view of discovering their origin.

Owing to numerous springs taking their rise at a somewhat high level in the park, the old chalk land surface has been carved out by water action into a series of large natural folds, which at first sight might appear artificial. On one of these, where the burnt stones are found in great profusion, we commenced operations, running a trench from the west side up the slope, a distance of 66 ft., and another near the starting-point at right angles to it. About 8 ft. from the base of the fold, and in close proximity to a stream, on removing about 3 in. of surface-grass and mould, we at once came upon a compact mass of pot-boilers. These continued to a depth of $2\frac{1}{2}$ ft., resting upon blackened earth, which when dug through was found to be lying on the chalk. Tracing the calcined stones from the base of the mound upwards, many thousands came to light, ever decreasing in numbers as they approached the summit, as though thrown out from the spot on which they had been used.

The finding of remains of what appeared to be a great communal kitchen was extremely puzzling, and only when I got into communication with Mr. Cantrill, of the Jermyn Street Museum, did a possible clue present itself. Mr. Cantrill had published in *Arch. Cambrensis* accounts of his investigations of similar stone-boiling sites in Wales. His papers also refer to quite a number of these prehistoric cooking-places, known as "deer roasts" or "giants' cinders," in Ireland, and I am now informed by Mr. Crawford that they are not unknown in Scotland. In England, Mr. Cantrill tells me, they have never yet been examined.

These accumulations are supposed to have been the large cooking-hearths where the flesh of the red deer or other big game was boiled. The finding of hollowed tree-trunks in some of these mounds in Ireland suggests that a trough of this kind was sometimes used to contain the water. Mr. Cantrill suggests that another alternative would have been to dig a hole in the chalk and line it with a raw hide to serve as a cooking vessel. To boil such a great amount of water heated stones in large quantities would have been ladled into the vessel.

So far no satisfactory evidence as to the date of these places appears to have been forthcoming. A general opinion, however, seems to prevail that they are of Neolithic origin. This view may be substantiated by our finding among the pot-boilers quite a number of humanly struck flint flakes showing bulbs of percussion. Still more interesting was the discovery of what appears to have been a small circular pit dwelling within a few yards of the heap of pot-boilers. It measured 11 ft. in diameter. Opening this out, we came upon a hearth of quite normal appearance—flints reddened by the fire, with a few pot-boilers strewn about, and an area of blackened earth. Here it was evident that some individual had sat and fashioned his flint tools, for flakes lay about in profusion, with spalls and a fine core. A scraper of unusual form, but strongly reminiscent of some of those found at Whitepark Bay, in Ireland, lay among flint knives and other small tools, while an arrow-point, worked on both sides and with one barb already punched out, may possibly by its workmanship give the required date to these mysterious sites. Further examination of the Buckenham Tofts mound will, it is hoped, be made in the near future under the auspices of the Percy Sladen Trust.

NINA F. LAYARD.

Science and Civilisation.

MAY I venture, as a citizen, to make an appeal to men of science and to urge that the time has come when they should no longer stand aside from the social and political questions that vex the world? Science is itself dependent upon favourable social conditions: that these conditions can abruptly cease has been clearly shown in the case of Russia. Scientific workers have therefore the strongest class interest in the social conditions under which they live. They have, however, more than a class interest. Science has made civilisation possible for mankind. It must now provide civilisation with that authority the lack of which is causing such waste of human energy to-day. Men of science alone have the power; they alone are above suspicion.

This is no place for details. An international amalgamation of existing scientific organisations would provide the world with an intellectual aristocracy, independent of the vote, which by the development of knowledge and the control of new weapons, lethal and industrial, would soon acquire the necessary influence.
B. J. MARDEN.

Stodham Park, Liss, Hampshire, June 30.

Measurement of Small Inductance.

THE method of suspending a loop of wire in a uniform alternating magnetic field, as used by Fleming and Elihu Thomson for the construction of A.C. galvanometers, can be applied with advantage to determine the self-inductance of loops in absolute measure, and it would seem that we can go considerably lower in this way than can conveniently be done otherwise. Low-frequency measurements are inaccurate, but with a triode at wireless frequencies I have measured inductances from 20 cm. to 50,000 cm. with an average error of $1\frac{1}{2}$ per cent. without special precautions to obtain sensitiveness. The details of the experiment will appear shortly in the *Philosophical Magazine*.
F. B. PIDDUCK.

Queen's College, Oxford, July 2.

A New Acoustical Phenomenon.

THE phenomenon described by Dr. Erskine-Murray in a letter under the above heading in NATURE of June 16 (p. 490) is particularly well heard when one is standing near a cliff or rock-face and listening to the sound of a waterfall or of the waves breaking on the seashore. The phenomenon is, of course, familiar to physicists, but it may not be so well known that use can be, and indeed often is, made of this effect in avoiding obstacles when one is walking in the dark. No doubt blind men, consciously or unconsciously, use it in this way; and it must have been so used from remotest antiquity by man and any other animals which happened to have the necessary discriminating power in hearing.
G. A. SHAKESPEAR.

The University, Birmingham, July 8.

Large-scale Chemistry at the Imperial College of Science and Technology.

IT is now generally recognised that a student in chemistry who wishes to rise to any position of prominence in his profession, either in the industry or in academic life, must first obtain a thorough grounding in his subject by passing through a recognised honours school, and that he must then devote one or two years to training in the methods of research. It is usually during the third year of his honours course that the student first comes in contact with the realities of organic chemistry, and a considerable portion of his time during this period is devoted to a series of preparations in the organic laboratory. The organic laboratory is generally fitted with every type of glass and porcelain apparatus necessary for the student's needs, and he learns here the usual operations and requirements involved in the preparation of a number of typical organic substances. This training is undoubtedly of the greatest value, yet, because someone at some time ordained that there should be two kinds of chemistry, namely, that carried out in glass vessels and that effected in vessels of metal, the unfortunate student, who must needs satisfy a board of examiners who have passed through the same course as he, is instructed in the former kind of chemistry, and left either to imagine the fundamental conditions underlying the latter kind or to learn them in sorrow and tribulation under the more exacting conditions of the factory.

Owing possibly to his early training as an engineer, the present writer has always felt acutely the anomaly of this position, and has sought for an opportunity to erect a laboratory which should contain, like the ordinary small-scale laboratory, types of appliances suitable for all purposes—reduced replicas of those used on the industrial scale, but sufficiently large to render the usual industrial operations essential. This opportunity has now arisen owing to the generosity of an old student of the Imperial College of Science and Technology, Mr. W. G. Whiffen.

A laboratory of this kind will serve several purposes. It will, for example, enable the student, and especially the research student, to familiarise himself with operations carried out in vessels into which he cannot see and the contents of which he cannot transport by hand. He will become acquainted with factors, such as heat transference, cost of production, etc., fundamental in large-scale work, but which are of minor importance in ordinary laboratory practice and usually ignored. He will learn, moreover, in the small fitting-shop attached to the laboratory how to make the necessary metal connections and to erect plant of metal in the same way as he is taught to build up apparatus of glass in the small-scale laboratory. Knowledge of this kind cannot fail to be of the greatest service both to students intending to enter industry and to those who have decided to follow an academic life. Indeed, the laboratory is not a "technical laboratory" in the strict sense of this much misused term, but rather the logical outcome of any adequate system of training in chemistry, and ought, therefore, to find a place in the equipment of every chemical school of university standing.

Again, the advantage to the research student will be very great, because he will be able to prepare his initial material on the large scale, and it will be possible for him to carry out, if necessary, any new preparation which he may have discovered on a scale approaching that required for its commercial production.

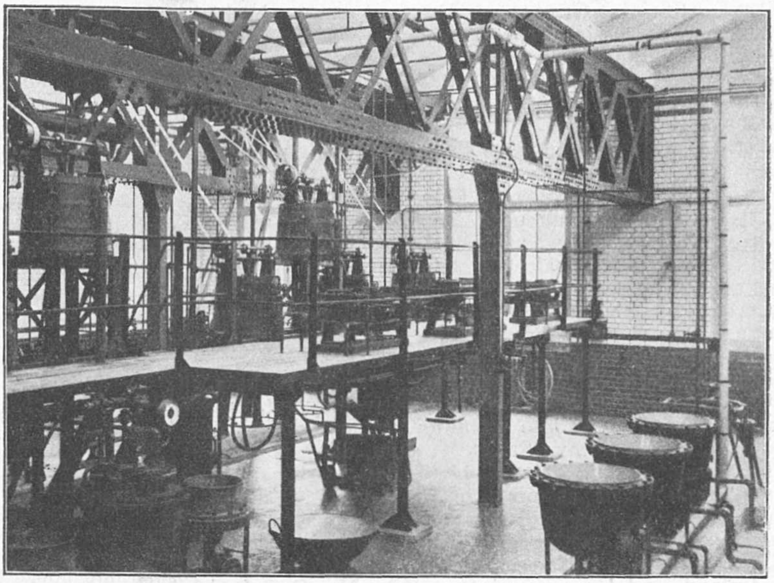


FIG. 1.—Staging showing filter presses and mixing tubs.

Two questions have frequently been asked, namely: (1) How will it be possible to initiate a large number of students into operations such as those which it is proposed to carry out in this laboratory? and (2) How can the material prepared be disposed of? The answer to the first question is that the third-year students will work in batches of six or eight under the direction of one student as foreman, and, of course, under the general control of the demonstrator in charge of the laboratory. Each batch will carry through one complete preparation, say nitrobenzene—aniline—acetanilide—*p*-nitroacetanilide—*p*-nitrophenol, and will obtain the pure product. It will be possible, if necessary, for five or six such batches to work at the same time, and it can be arranged that students from the main laboratory will, during their organic course, pass for a week at a time into the larger-scale laboratory.

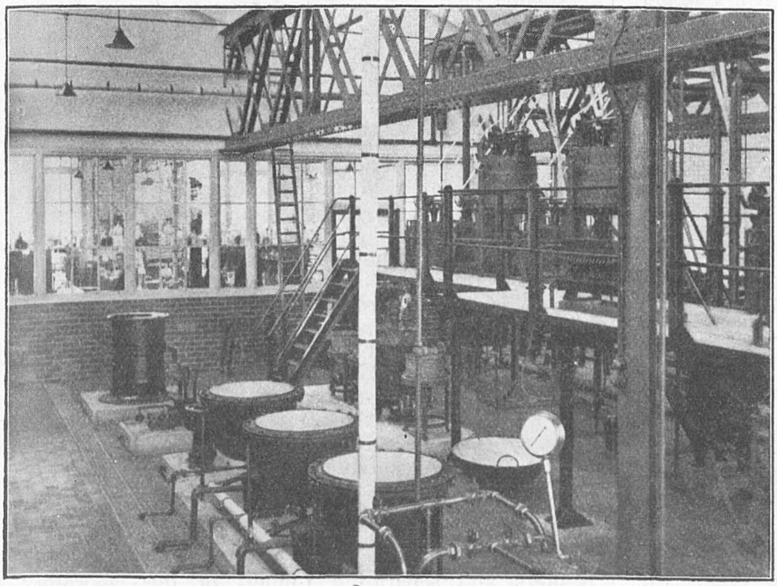


FIG. 2.—View towards S.E. showing evaporating pans, centrifuges, and box filters. Research laboratory through screen.

Regarding the second question, the operations carried out will lead to the production of material which can not only be used for further work on the intermediate scale, but will also be utilised in the small-scale laboratory for the ordinary students' preparations. It is more, however, in connection with the preparation of initial material for research that the new laboratory will be of the greatest service from both instructional and utilitarian points of view. No one who has conducted a school of research containing twenty or more research students can have failed to realise the waste of time entailed by having to go back to the beginning every time the supply of material is exhausted. It is evident that much time will be saved if large quantities of the initial material can be prepared as soon as the conditions for its preparation have been ascertained. The general design of the laboratory has been worked out in conjunction with the late Dr. J. C. Cain, after consultation with Mr. F. H. Carr, then in charge of Messrs. Boot's research laboratories at Nottingham. The general erection of the plant has been due to the skill and interest of Mr. James Robinson, of Messrs. Mather and Platt, Ltd.

Description of the Laboratory.

The laboratory occupies a floor-space 50 ft. by 47 ft., exclusive of the adjoining fitting-shop and research laboratory. It is 22 ft. high, and is covered by an asphalted ferro-concrete roof arranged for semi-indirect north lighting, the light being transmitted through safety (armoured) glass and reflected from the white ceilings and from the white glazed surface of the walls. The advantages of this type of lighting are well known, and in the present instance the success of the arrangement is complete, a clear, steady light being obtained throughout the day. The floor is water-tight and acid-proof. It is paved with red tiles laid in such a way as to shed into the two main drains (Figs. 1 and 2), which run parallel to each other throughout the length of the room. With this arrangement—a most necessary one in a laboratory of this kind—it is a simple matter to give the floor a wholesale wash-down with fire-hoses, six of which are situated at various convenient points.

The centre of the laboratory is occupied by a platform (Figs. 1 and 2), approximately 6 ft. by 40 ft., supported on stanchions 5 ft. above the floor. On and above this, fixed on suitable steel structures, are types of apparatus, such as open-top tubs, which, in general, are most conveniently emptied through a bottom run-off by gravity.

All fixed chemical apparatus, except that on the central platform, is set in concrete foundations carried to a height of 6 in. above the floor-level, whilst the motor, air compressor, and vacuum pumps are bedded in concrete blocks raised to 15–18 in. above the floor.

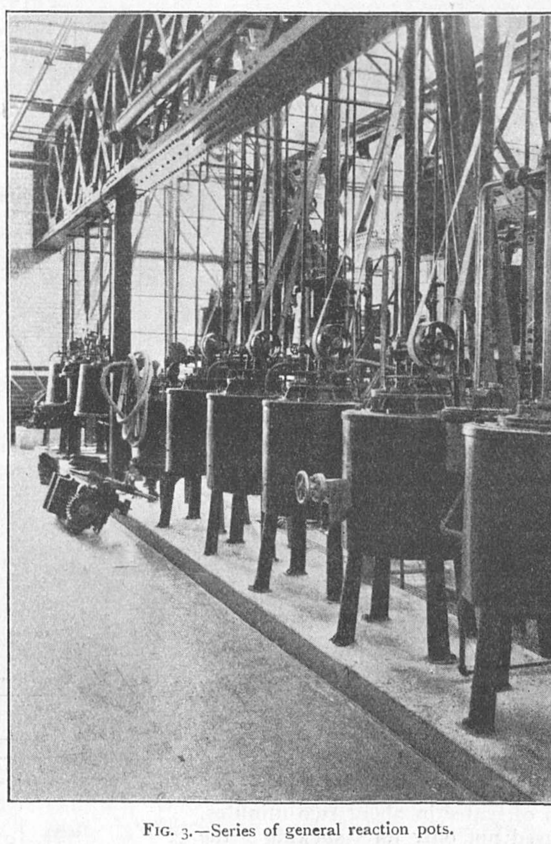


FIG. 3.—Series of general reaction pots.

The power for stirring, air compression, etc., is obtained from a 15-b.h.p. totally enclosed and ventilated acid-proof motor, and is transmitted by two parallel lines of shafting hung in ball-bearings along the whole length of the laboratory and in the fitting-shop beyond. Resting on the shaft-brackets are the main pipes (showing through the lattice girder in Fig. 4) of the seven principal services:—Steam, 80-lb. air, 10-lb. air, vacuum, hot and cold water, and gas.

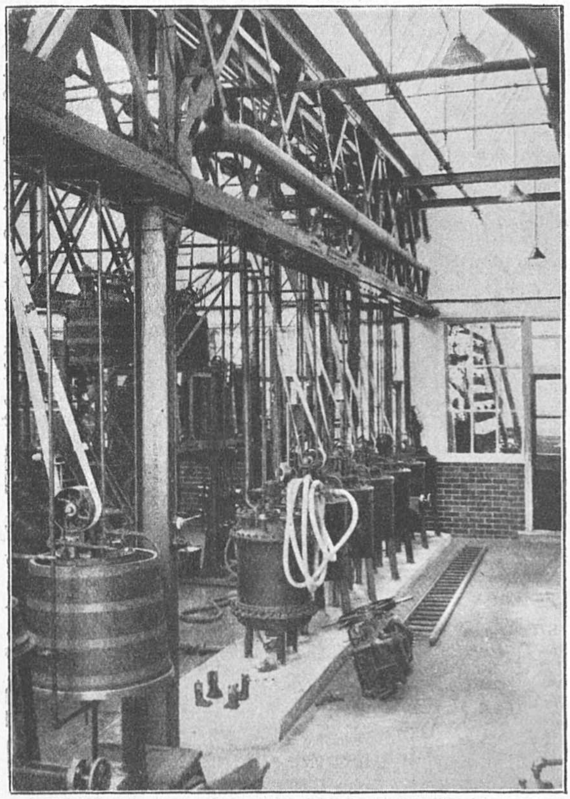


FIG. 4.—View showing distribution of high- and low-pressure air, hot and cold water, steam, vacuum, and gas services, with fitting-shop at back.

Both high- and low-pressure air are obtained from the same compressor (Fig. 5), which, by an appropriate arrangement of blow-off and reducing valves, delivers into two separate receivers at the required pressures. From these the air is led through high- and low-pressure mains to all parts of the laboratory, the former main being in permanent connection with the mild steel (lead lines) liquor receivers from which the filter-presses are charged, and the latter with most of the other apparatus in the laboratory; for it is the low-pressure air which is put to such general uses as blowing liquor from one vessel to another, stirring where mechanical stirring is inconvenient, blowpipe work, and so on.

The main vacuum pump (Fig. 5, at back), which exhausts a 40-gallon vacuum chamber to the vapour tension of water in about two minutes, is used not only for "sucking" the contents of open-top vessels into the liquor tanks, but also for vacuum distillation and for exhausting the vacuum drying ovens, which, however, are connected in addition to a small pump capab'e of maintaining a vacuum, once established in the ovens, for any length of time.

Steam, gas, and cold water enter the laboratory from without. Hot water is obtained by passing water and steam through Mather and Platt unit heaters, which raise the water to the boiling point as quickly as the pressure in the mains is able to force it through the delivery pipes.

The types of apparatus permanently fixed in the laboratory are intended to render possible on the greater scale all ordinary chemical operations. The digestors, for example (Figs. 3 and 4), include vessels suitable for nitration, sulphonation, fusion with alkalis, acid and alkaline reduction, acid and alkaline hydrolysis, esterification—in fact, almost every operation which in an ordinary laboratory one associates with a flask on a sand-bath. Heating under pressure is performed in gas-fired heavy mild steel autoclaves. The stills include an apparatus for distillation in a current of saturated or superheated steam, a gas-fired still with a Young's column, a vacuum still with an arrangement of receivers equivalent in its use to the Perkin triangle, and a pan for vacuum evaporation. The redwood tubs on the platform are fitted with stirring gear, and arranged suitably for such operations as diazotisation and coupling and for washing solid precipitates and oils; they are the beakers and separating funnels of the laboratory. Apparatus for the three chief methods of filtration, under pressure by filter-presses (on platform, Fig. 1), by vacuum in box-filters (Fig. 1, left), and by centrifuging (one small and one larger machine appear on the left in Fig. 2), is installed, and the principal operations involved in the later treatment of a filter-press cake—for instance, squeezing in a hydraulic press (Fig. 2) or in a screw press (Fig. 4, lying on floor), drying in evacuated steam-ovens, and grinding in an edge-runner mill (not shown)—are all provided for.

A word should be said regarding the steps which have been taken to solve the problem of ventilation. General ventilation is provided by a 36-in. fan working in an aperture in the wall. In addition, however, a main draught trunk, operated by a separate

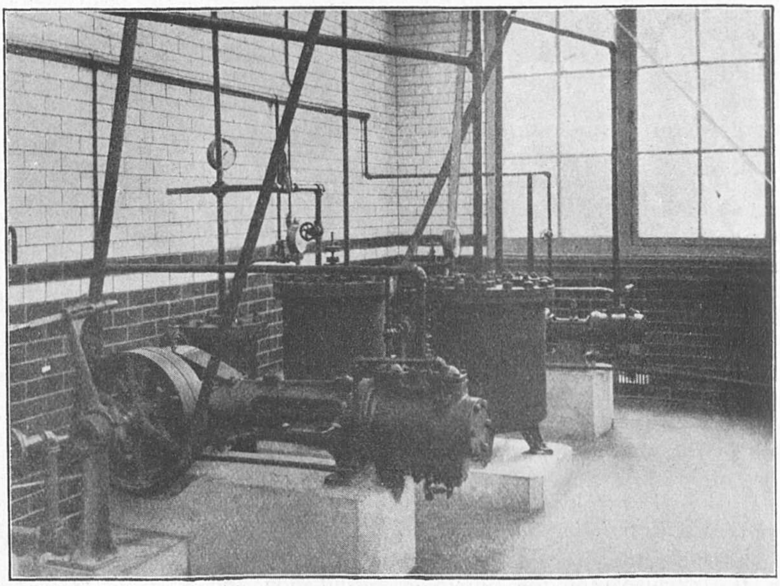


FIG. 5.—Vacuum and air-pressure services.

fan, has been arranged to pick up vent-pipes and gas-flues from all digestors, as well as the exit pipes of the counterpoised draught-hoods which are pulled down over the evaporating pans when evaporations are in progress.

The surroundings of the laboratory are shown in some of the photographs. In Fig. 2 appears the adjoining research laboratory, whilst Fig. 4 shows a corner of the fitting-shop and engineering store. This invaluable adjunct contains a stock of pipes, fittings, and tools, some small power-driven machines, including a screw-cutting lathe, and working places for carpentering, fitting, and soldering. The chemical store, which is arranged to contain casks, drums, and carboys, as well as Winchesters, does not appear in the photographs.

With regard to the question of slinging and heavy work generally, the numerous overhead principals provide so many points from which a lifting block may be hung that it was not considered necessary to install a travelling crane. Two rubber-tyred bogeys, one of which has been specially designed, suffice for the carriage of all the heavier objects which we are likely to have to handle. J. F. T.

Great British Droughts.

By CHAS. HARDING.

It is fortunately seldom that such persistent dry weather has to be chronicled as that which has now continued for several months. A more complete history of the drought will doubtless be written when all possible facts have been collected.

At Greenwich Observatory the records show that the rainfall has been less than the normal for nine consecutive months, from October, 1920, to June, 1921. The total measurement for the whole period is 9·78 in., which is 7·74 in. below the average for the 100 years ending 1915, and only 56 per cent. of the normal. This is the driest period from October to June in the last 105 years; the next driest corresponding period occurred in 1879–80, when the measurement was 10·50 in. There is only one longer period at Greenwich—November, 1846, to January, 1848, a period of fifteen consecutive months—with the rainfall below the normal. The controlling factors of the weather have commonly been a low barometer in the north of the British Isles, and a relatively higher barometer with anticyclonic conditions in the South of England.

In addition to the Greenwich observations, those at Eastbourne have been chosen to represent the more southern portion of the kingdom. The drought at Eastbourne is scarcely so severe, since the rainfall for each of the months December, 1920, and January, 1921, was in excess of the average for the period of thirty-five years ending 1915, chosen as the normal by the Meteorological Office. The total rainfall for the nine months from October, 1920, to June, 1921, inclusive, is 15·62 in., which is 7·95 in. in defect, and 66 per cent. of the average fall. This is 10 per cent. of the average more than at Greenwich.

Attempts have been made from time to time to detect a weather cycle, but so far these have not been very successful. The favourite cycle with meteorologists is that corresponding with the periodicity of solar activity; but, so far as the general weather is concerned, it does not yield satisfactory results. Prof. Brückner, of Berne, has discussed the subject of periodic variations and changes of climate in detail, and his discussion is conducted on lines which perhaps might well be followed by others. For the fluctuations of rainfall he has made use of observations at 321 points on the earth's surface, and of these no fewer than 198 are in Europe. Prof. Brückner deals with averages for five years, and the period found for the cycle is thirty to thirty-five years. Continuing the cycle to the present time, a period of deficiency of rainfall is shown for the years 1921–25; the previous period of deficiency was 1891–95. The next period of excess should occur in 1936–40. The present deficiency of rain seems decidedly a fulfilment of Prof. Brückner's cycle.

An absolute drought is reckoned as more than fourteen consecutive days wholly without rain, and a partial drought is a period of more than twenty-eight consecutive days the aggregate rainfall of which does not exceed 0·01 in. per diem. No absolute drought has occurred at Greenwich this year, and the only partial drought was from February 1 to March 5, a period of thirty-three days during which the total rainfall was 0·24 in. The spring drought of 1893 is probably the most severe of recent years; the absolute drought continued for forty-four days, whilst the partial drought at Dungeness lasted for 127 days, and at North Ockenden, Romford, Essex, for 128 days. The abnormal summer of 1911 experienced three absolute droughts at Greenwich—April 11 to 24, fourteen days; July 1 to 23, twenty-three days; and August 2 to 18, seventeen days. There was an exceptionally long partial drought continuing for fifty days, from June 30 to August 18; the aggregate measurement of rain during the period was 0·33 in. As many as three absolute droughts occurred in London in the years 1868 and 1887, and four in the year 1858. In 1880 there was an absolute drought for twenty-eight days—from August 9 to September 5. In the year 1716 it is recorded that, in consequence of a long drought and a south-west wind, the River Thames became so low that thousands of persons passed across on foot under the arches of London Bridge.

There is a great diversity in the periodicity of rainfall, and two consecutive summers often differ widely from each other, as shown by the rains in 1920 and 1921. In 1903, a remarkably wet year, the aggregate measurement of rain at

Greenwich for the six months April to September was 22·21 in., whilst for the following summer, 1904, it was 8·69 in. "British Rainfall," dealing with observations from 1726 to 1891, shows that during the first forty years the rainfall in only nine years reached the average, and from 1738 to 1762, a period of twenty-five years, there is only one year above the average; this is a more persistent drought than has occurred in the nineteenth or twentieth century. There was a succession of wet years ending with 1882, and this was followed by a very dry period. In the twenty years 1883 to 1902 the Greenwich observations show an aggregate deficiency of rain amounting to more than 40 in. During this period there were sixteen years with a deficiency, one year with the average fall, and three years with an excess. Each year from 1895 to 1902 had a deficient rainfall, the total deficiency in the eight years amounting to 25·5 in.

The question of interest is now: When will the exceptional heat and drought of the present year cease? The absence of rain is continuing well into July, and each week the drought is becoming more serious over the whole country. The increased interest in meteorology, brought about by the late war, has added much to the staff and efficiency of the Meteorological Office. Every effort is being made to improve our knowledge of the weather changes, and probably in a few years it will become possible to predict the chief characteristic features of a season.

The Scarcity of Swallows.

By DR. WALTER E. COLLINGE.

FOR some years past certain ornithologists have directed attention to the decreasing number of swallows seen in the British Isles during the months from April to September. This diminution was particularly marked in 1918 and 1919, less so in 1920, but is still more apparent in the present year. For a time the scarcity was denied by many, or stated to be only of local occurrence, but the condition of affairs during the present season is sufficiently well marked to convince the most sceptical.

The swallow economically is one of our most valuable birds, its food consisting practically entirely of insects, and any scarcity of these birds removes a most important factor in the destruction of injurious insects. The causes which have led to this scarcity are not at present all known, but there are some which have been operating for a considerable time past, and their effects are now making themselves felt.

First, there is the deplorable mortality of migrants which takes place around our coasts in connection with the lighthouses and lightships, and, as has previously been pointed out, a considerable percentage of these birds might be saved. Something towards minimising this danger has already been done, but the swallow is a day-migrant, and so largely, if not entirely, escapes this danger.

The enormous increase of the house-sparrow during recent years has undoubtedly had much to do with the decrease of the swallow. Not only do the sparrows take up their abode in the swallows' nests, but they molest and persecute the birds during the whole period of incubation. In the United States there has of recent years been a very serious decrease in the number of house-martins due to this cause.

There are, however, other causes for the present scarcity which do not arise in this country. In 1918 and 1919 the continuous waves of June migrants were unobserved or of very short duration, and during the present season they have been still fewer, all of which clearly indicates a diminishing immigration. Moreover, in 1919 and 1920 the majority of the swallows commenced their southern migration early in August.

In view of the importance of the swallow economically, the question is one calling for immediate attention and investigation, and until we know more about the matter it might be well to place this bird and its eggs under stricter protection.

The King George V. Dock, London.

A FUNCTION of special interest and importance in the history of the Port of London was performed on Friday last, when the King visited North Woolwich for the purpose of opening and naming the new dock of the Port of London Authority which has been under construction since 1912.

The addition to the enclosed water area of the port amounts to 64 acres, and as the depth of the dock is 38 ft., the new accommodation will prove extremely useful for large ocean-going vessels of the present day. The dock is entered by a lock 800 ft. long and 100 ft. wide, having a depth of 45 ft. over its sill at high water, and 20 ft. less at low water. The capacity of the chamber can be increased to a maximum length of 910 ft. by placing a *caisson* in a special recess instead of using the innermost pair of gates. The dock averages 600 ft. in width, but tapers from east to west. On the north side there is a concrete quay wall of the ordinary type. On the south side a somewhat novel arrangement has been adopted. Projecting into the dock, and parallel with the quay line at a distance of 54 ft. there-from, is a series of seven jetties, 22 ft. wide, leaving an intervening space of 32 ft. in width between them and the quay. The object of this is to enable barges to pass on the inner side of the jetties, so that vessels may simultaneously discharge their cargoes into barges on both sides and, at the same time, land goods on the quay. The jetties are equipped with cranes which are able to command the vessel's hold, the inner barges, and the quay. It should be pointed out that a high proportion of the goods brought into the docks at London is conveyed by barge or lighter to their ultimate destination.

The north quay is to be flanked by double-story sheds, of which so far only one is constructed. These are designed in reinforced concrete, with brick panelling. On the south side seven single-story sheds of steel framing with corrugated-iron covering have already been provided.

At the western end of the new dock is a dry dock 750 ft. long with an entrance 100 ft. wide and a depth of water over sill of 35 ft.

Connection between the new dock and the adjoining Royal Albert and Victoria system is made by means of a passage 100 ft. in width.

The King graciously acceded to the request that the new dock should be called the King George V. Dock, and named it accordingly.

Notes.

THE Osiris prize of 100,000 francs has been awarded by the Academies of the Institute of France to Gen. Ferrié, C.M.G., Director-General of French Military Telegraphs, in recognition of his work in the development of wireless telegraphy for war purposes. Gen. Ferrié has been well known as an acknowledged authority on wireless matters for many years, and as the head of the French military wireless telegraph services it fell to him to initiate the whole organisation of the wireless arrangements in the fighting forces of France during a period when greater advances were being made than at any other time in its history. He was responsible for the equipment and working of the famous Eiffel Tower station and for the installation of the powerful station at Lyons in 1917, as well as for the completion of the still more powerful station near Bordeaux commenced during the war by the American Army. Gen. Ferrié had much to do with reducing the thermionic valve from a laboratory appliance to a piece of everyday wireless apparatus and in devising wireless equipment for aircraft, and in earlier days was one of the first successful experimenters with the electrolytic detector. In recognition of his work the honorary degree of D.Sc. has been conferred upon him by the University of Oxford.

SIR ROBERT HADFIELD has expanded his reply to the American deputation of engineers who attended in London to present him with the John Fritz medal into an address of thanks, which has just been printed in the form of a substantial pamphlet with numerous illustrations. The address sketches the services rendered by British and American engineers to the Allied cause during the war, outlines the record of the Institution of Civil Engineers, and gives an account of the members of the American deputation. The movement which has resulted in the establishment of the United Engineering Society of the United States is commended as having brought together a large number of distinct technical institutions, housed them in a common building, and provided a common library, so furnishing an excellent object-lesson in the organisation of scientific and technical effort. A description is then given of Sir Robert's own metallurgical research work, especially in regard to the invention of manganese steel, the alloy which possesses such an unusual combination of mechanical and magnetic properties, and of the alloy of iron and silicon, now so widely employed under the name of "low hysteresis steel" in the construction of transformers and other electrical appliances. The concluding sections of the address deal with the growth of science and the value of research to civilisation, the subject being illustrated by an account of the history of the Royal Society and of some of its more famous fellows. The present occasion is a good one for directing attention to the close bonds which unite men of science and technologists in our own country and in the United States, and to the advantages which are to be derived from an even closer co-operation in the future.

THE council of the Royal Society of Arts has decided that in future the Colonial section of the society shall be known as the "Dominions and Colonies Section."

MR. A. J. BALFOUR has been elected president of the British Academy in succession to Sir Frederic Kenyon. M. Henri Pirenne, past-president of the Belgian Academy, has been elected a corresponding fellow, and Bishop G. F. Browne, formerly Disney professor of archæology in the University of Cambridge, an honorary fellow of the academy.

THE following have been elected as officers and members of council of the North-East Coast Institution of Engineers and Shipbuilders for the session 1921–22:—*President:* Sir William J. Noble, Bart. *Vice-Presidents:* Mr. C. W. Cairns, Mr. A. Laing, Mr. C. D. Smith, and Mr. R. Wallis. *Members of Council:* Mr. B. C. Browne, Prof. C. J. Hawkes, Mr. R. Hinchliffe, Mr. H. Laing, and Dr. J. E. Stead. *Hon. Treasurer:* Mr. R. H. Winstanley.

IN accordance with the provisions of section 2 (6) of the Dyestuffs (Import Regulation) Act, 1920, the President of the Board of Trade has appointed a Committee to advise the Board with respect to the efficient and economical development of the dye-making industry. The members of the Committee are:—Mr. W. J. U. Woolcock, M.P. (chairman), Mr. Percy Ashley, C.B. (Board of Trade), Sir Henry

Birchenough, Mr. W. H. Dawson, Mr. G. Douglas, Mr. E. V. Evans, Dr. M. O. Forster, Mr. L. B. Holliday, Dr. Herbert Levinstein, Prof. G. T. Morgan, Mr. J. Morton, Mr. Max Muspratt, Mr. T. Taylor, Mr. N. Thomas (Admiralty), and Mr. G. S. Witham (War Office). An additional representative of dye-using interests is to be appointed shortly.

THE Royal Asiatic Society has decided to celebrate the centenary of the birth of the late Sir Richard F. Burton by the institution of an annual memorial lecture and a medal bearing his effigy. Burton was a pioneer and an explorer of the first rank who studied his fellow-men profoundly, and by his wonderful knowledge of the literature and life of the Arabs did much to bridge the gulf between East and West. His journeys to the forbidden cities of Mecca and Harer will long be remembered as exploits as full of daring as they were of scientific importance. A fund, to be known as the Burton Memorial Fund, has been opened and a national appeal for subscriptions is being made. The hon. secretaries of the memorial fund committee are Dr. F. Grenfell Baker and Mr. N. M. Penzer, and subscriptions should be dispatched to the Manager, the National Provincial Union Bank of England, Union Bank Branch, Oxford.

EMPHATIC corroboration of recent correspondence in our columns upon the supply and cost of German publications is provided by a letter addressed to the *Times* signed by the Vice-Chancellors of the Universities of Liverpool, Sheffield, and Manchester and the Principals of Armstrong College, Newcastle, and Birmingham University. At each of these institutions the librarians have found it impossible to obtain current German scientific literature by reason of the operation of the Reparations Act. There has been a complete stoppage of delivery through the Customs of books of German origin, while books which have been ordered direct from agents in Germany are delayed for an indefinite period. Even when it has been proved that the order was placed before the present Act came into operation and the 50 per cent. Customs charge has been paid under protest, books are still undelivered. The writers of the letter emphasise the fact that it cannot be regarded as patriotic to cut off from this country all knowledge of scientific progress in Germany; on the contrary, it is to the advantage of our trade and ultimate prosperity to know without delay every addition to knowledge made in Germany as in other countries. German journals of science and other publications devoted to the advance of knowledge cannot be regarded as entering into competition with British journals and books, and vigorous protest is made against the interpretation of the Act by the Board of Trade to include such articles.

THE University of Calcutta has published, as the first of its series of anthropological papers, an essay by Mr. Panchanan Mitra on the prehistoric arts and crafts of India. Beginning with stone implements, Mr. Mitra traces their development in the Palæolithic and Neolithic types. Then follows a chapter on cave paintings and carvings, containing much information which will be novel to English readers. These are held to indicate an Indo-Australian culture-contact from the late Palæolithic up to Neolithic times. On the general question of prehistoric arts and crafts the author accepts the view of Dr. Coomarswamy that "to this Mykenean facies belong all the implements of wood-work, weaving, metal-work, pottery, etc., together with a group of designs, including many of a remarkably Mediterranean aspect, others more likely originating in western Asia. The wide extension and consistency of this culture throughout Asia in the second millennium B.C. throw important light on ancient trade intercourse at a time when the eastern Mediterranean formed the western boundary of the civilised world." Thus the veil which has hitherto concealed the origins of ancient Indian culture is being gradually lifted, and the University of Calcutta is to be congratulated on its efforts to extend this knowledge by the aid of native scholars like Mr. Panchanan Mitra.

THE second part of Mr. Rhys Jenkins's paper, read before the Newcomen Society, on "The Rise and Fall of the Sussex Iron Industry" deals at some length with the technical aspects of the subject, although the historical material available is somewhat scanty. The ore most commonly used was a clay ironstone occurring in nodules and thin beds towards the bottom of the Wadhurst Clay. It was worked mainly by means of bell pits about 6 ft. in diameter at the top, which widened towards the bottom and were generally shallow, being rarely more than 20 ft. deep. These beds have been worked from Roman times onwards. Mr. Jenkins quotes in full the description of the process of iron-making published by John Ray in 1674. From this it is clear that the ironmasters always mixed together different kinds of ore. The roasting process is first described, and afterwards the method of charging and operating the blast-furnace. The period of six days was called the "Founday," and about eight tons of iron were made in this time. The methods of working the iron at the forge or hammer in the Finery and Chafery are also described. Mr. Jenkins concludes that the industry began to decline during the Commonwealth period, and became extinct about the end of the eighteenth century. He discusses possible reasons for this decay, and concludes that it was due neither to the competition of mineral fuel nor to a failure in the supply of charcoal. He appears to think that it may have been connected with the question of power used for working the bellows of the blast-furnace and the hammer of the forge. Water-power was used for this purpose throughout the country, and the Weald was inferior to, for instance, Shropshire as regards both rainfall and the head of water which could be utilised. The author also considers that foreign competition was more acutely felt in the Weald than in the northern districts.

THE June issue of the *Decimal Educator*, a quarterly publication of the Decimal Association, contains much interesting information respecting the progress of the metric system. The introduction of metric weights on the Chinese railways, which is now an accomplished fact, was effected without trouble and has given rise to no complaints. A notice issued recently by the Government of Malta announced that the metric system was to come into force on July 1. It has been made obligatory in dealings with the Customs Department as a preliminary to enforcing its use in general trade in the island. The unsatisfactory manner in which decimals are taught in the United Kingdom is the subject of an instructive article in which it is stated that, although teachers as a body are supporters of the metric system, the accepted methods of teaching arithmetic place the decimal fraction in an unfavourable light by giving unnecessary prominence to conversion sums, and in this way seriously handicap decimal reform. It is urged that so far as possible all reference to vulgar fractions should be omitted from the teaching of decimals, and that the examples necessary to explain the meaning of decimals should be drawn from the metric system and decimal coinage, with an occasional sum involving such British measures or coins as are connected by decimal relations. A useful chart illustrates the progress made in the adoption of the metric system during the last hundred years. The consistently upward trend of the curve and the particularly sharp rise during the past ten years are noteworthy, and indicate that as each new country joins in the competition of international trade its national weights and measures are abandoned and the metric system adopted in preference.

THE National Institute of Agricultural Botany, which was organised with the object of improving the seed supply in the United Kingdom, is now making arrangements to conduct a comprehensive series of yield and quality trials of wheat, oats, and barley, to commence during the season 1921–22. The trials will be carried out on a uniform and scientific system in several parts of the country, and final reports, on which the granting of certificates of merit will be based, will be issued after the harvest of 1924. The trials will be open to all who can show that they have in their exclusive possession new or improved varieties or strains of any of these cereals, and undertake to refrain from placing them on the market previous to the issuing of the final report on their merits, except with the institute's consent. The testing fee will be limited to the actual cost of the trial. Full particulars of the scheme can be obtained from the Secretary, National Institute of Agricultural Botany, 10 Whitehall Place, London, S.W.1.

NOS. 1–9 in vol. vi. (1920) of the Entomological Series published by the Agricultural Research Institute, Pusa, are devoted to a series of papers on the life-histories of Indian Microlepidoptera by Mr. T. B. Fletcher. It is mainly within the last fifteen years that any serious attempt has been made to acquire a knowledge of the species of the small moths which occur in India. In 1889 only 225 had been enumerated, while at the present time 2422 species contained in about 458 genera are known. In spite of this large number, Mr. Fletcher remarks that we are merely beginning to learn what kinds exist in the Indian Empire, where there are still enormous areas absolutely unknown so far as Microlepidoptera are concerned. In this series of papers a great deal of scattered information is brought together in a convenient form, and short accounts are given of the life-histories of a very large number of species. Many of the latter, together with their larvæ and pupæ, are well figured in a series of sixty-eight plates which accompanies the letterpress.

DR. MARJORIE O'CONNELL (Bull. Amer. Museum Nat. Hist., vol. xlii., p. 643, 1920) describes Jurassic ammonites from Viñales, western Cuba, which prove the beds containing them to be of Oxfordian age. The author points out that in a recent paper by Dr. M. S. Roig previous descriptions of Mexican species have become included as though they came from Cuba. More may be expected, however, from Dr. Roig's extensive collections, and Dr. O'Connell will, no doubt, pursue her studies in this almost untouched field.

IN Bulletin 597 of the U.S. Geological Survey, with its large geological map on the scale of 1 : 250,000, Mr. B. K. Emerson provides a handbook to "The Geology of Massachusetts and Rhode Island," a region associated with Boston Bay, one of the most famous natural gateways of North America. Students at Harvard and citizens of Providence in the drowned valley of the Blackstone River, or of Pittsfield across the picturesque and dissected uplands of Berkshire, will welcome this record of the geological history of their States. Fascinating reproductions of the early Dinosaurs of Triassic times are given from models, including Stegomus, known from its armour only, and the bipedal Anchisaurus. The reader requires geological training, but this should not be lacking in the abundant secondary schools of Massachusetts.

SPECIAL interest attaches to a recently published Bulletin of the U.S. Geological Survey on "The Iron and Associated Industries of Lorraine, the Sarre District, Luxemburg, and Belgium," by Messrs. Alfred H. Brooks and Morris F. La Croix. The bulletin gives an exhaustive description of the position in these districts and of their future possibilities, and is full of valuable statistical information most carefully collected. At the moment the following passage, written with reference to the Sarre coalfield, is perhaps the most interesting for British readers:—"It has long been recognised in Germany that the Government mines were less efficiently operated than those in private hands. Evidence of this difference is found in the reported cost of production. The average cost per ton of coal mined in the years 1906 to 1910 was 11.54 francs for the private mines and 13.50 francs for the Government mines. This ratio of cost appears to have continued for 1913, when the average profit, as reported, was 2.50 francs per ton for private mines and 2.15 francs per ton for Government mines, in spite of the fact that the private operators sold their coal cheaper than the Government. . . . Further evidence of the better practice in the private mines is afforded by the annual coal recovery per miner, which in 1913 was 261 tons for private mines and 229 tons for Government mines."

PERTHSHIRE has been fortunate in that on two occasions when there was a fall of meteorites specimens and data of a trustworthy nature have been obtained.

In the latest issue of the Transactions and Proceedings of the Perthshire Society of Natural Science (vol. vii., part 2, 1919–20) Mr. Henry Coates describes fully all the data regarding the occurrence of the meteoritic fall in December, 1917, and the paper contains appendices regarding the fall of 1830, records of distances contained in tabulated form, and a report by Mr. W. F. Denning on the path of the meteor. The author has added eleven illustrations from photographs taken at the time and some diagrams. This part of the number also contains a short paper on the occurrence of the horned pond-weed (*Zannichellia palustris*, Linn.) in Keltie Loch, near Dunning, by Mr. J. R. Matthews.

ACCORDING to an article in *La Nature* for June 25, the French Navy, during the recovery of materials from many of the vessels sunk during the war, has greatly improved the oxy-acetylene torch of Picard so that it can be used under water. The addition which has rendered this possible is a small bell-shaped vessel surrounding the oxy-acetylene flame, which is kept supplied with compressed air. After the flame is alight and the stream of compressed air established the torch may be plunged into water without being extinguished. If by any accident it was extinguished, it was necessary for the diver to ascend to the air to light it again. Under the auspices of the French Department of Scientific and Industrial Research, M. Corne has recently made a further addition to the torch which makes it unnecessary to ascend to relight it. A tube containing an alkaline metal and an oxidiser is attached to the torch and can be moved to the mouth of the bell. On removing the cap from the end of the tube the chemical action of the water on the mixture produces a flame which relights the torch. The addition has greatly increased the number of underwater uses to which the torch can be put.

THE Journal of the Washington Academy of Sciences for April 4 contains two communications which deal with the steps taken by the United States to acquire a better knowledge of the properties and behaviour of the oceans which wash its shores. Under the auspices of the National Research Council a conference of representatives of the nations around the Pacific Ocean was held in Honolulu in August, 1920, to consider what knowledge with regard to that ocean was available and in what directions there was most urgent need of its extension. As a result, it is expected that during the present year several volumes dealing with the scientific exploration of the Pacific will be published. The opportunity afforded by the Ice Patrol of the Atlantic in 1920 was utilised by Mr. A. L. Thuras, of the Bureau of Standards, to test the trustworthiness of the method of determining the salinity of sea-water on board ship by measuring its electrical conductivity. It was found both trustworthy and convenient, and it is proposed to set up a self-recording apparatus based on the method which will give the temperature, density, and salinity of the water.

IN a paper read to the Physical Society on June 24 Mr. S. Butterworth discusses the errors due to capacity and eddy-current effects in inductometers. At low frequencies these errors are negligible, but at telephonic frequencies they have to be considered, and in radio-telegraphy the corrections which have to be applied are of the same order as the quantities measured. Making the assumption that the capacity effects in two coils having one end in common can be represented by two condensers shunting each coil and by another condenser joining their free ends, the author obtains formulæ which are in good agreement with experiment. When the secondary e.m.f. induced in a secondary circuit is in exact quadrature with the current in the primary the mutual inductance is "pure." This assumption is made in the proof of the Heaviside and Carey-Foster inductance bridges. The author works out the theory of these bridges on the assumption that the mutual inductance is not pure, but varies with the frequency. Experimental verifications of the theory are given.

IN the Journal of the Franklin Institute for May last L. W. Austin describes experiments made to determine the directions from which the atmospheric disturbances noticed in radio-telegraphy appear to come. The main observations were made in the West Indies, California, and Washington. The author concludes that on the Atlantic coast of the United States the disturbances come either from the direction of Mexico or from that of the Allegheny Mountains. On the Pacific coast the disturbances are much weaker and their direction is more variable. They seem to come from centres at much shorter distances, and generally in the direction of mountains. At Bremerton and Astoria most of the disturbances come from the direction of Mount Ranier, a lofty and isolated peak. In Porto Rico the disturbances were mainly of local origin and very diffuse. When they came from the sea there was generally land at no great distance in that direction. When the disturbances increase with increase of wave-length, as at Washington, they come from distant origins; when they vary little with wave-length, as at San Francisco and San Diego, the focus of the disturbance is near at hand. The origin of the disturbances seems to be in the upper atmosphere, probably between masses of air at different potentials. The results obtained indicate that a world-survey of these "static" disturbances would lead to important results.

IN electroculture it is customary for the high potential wires to be placed horizontally and parallel to one another above the growing crop. As the number of wires is limited the question arises as to how far the electric force at the ground level is uniform. In a paper to the Physical Society read on June 24 Dr. Chree gives simple formulæ showing how the potential gradient at the surface of zero potential (generally the ground level) depends on the height and spacing of the wires. These formulæ will be of use in practical work. It is probable that a high potential gradient is injurious, and a low potential gradient beneficial in certain cases. It is important therefore to obtain uniformity of conditions, for this should at least make it easier to draw conclusions as to the merits of electroculture. An immediately useful deduction from the author's formulæ is that a very uniform set of conditions can be secured at crop level if the distance between adjacent wires does not exceed the height of the wires above the crop. It has to be remembered, however, that when there is an appreciable excess of ions of one sign in the atmosphere the values of the electric forces will be affected.

IT is well known that Hooke's law of proportionality of force applied and deformation produced holds for solids only so long as the deformation is not large. The same may be said with regard to the corresponding law for the deformation of viscous liquids. In order to discover some more satisfactory form of relation between deformation and force in either case, Dr. P. G. Nutting has made observations of the shear of various materials between parallel plates 5 cm. by 10 cm. in area and 0·2 cm. apart; his results are given in the May issue of the Journal of the Franklin Institute. He finds that in all cases the deformation at a given temperature is proportional to a power of the force which varies for different materials from 0·74 to 3·5. Further, it is proportional to a power of the time of application of the force, which varies for different materials from 0·2 to 0·91, the low value being characteristic of solids and the high one of liquids. Dr. Nutting finds that the new law is applicable in other than mechanical fields. In a dielectric, for example, the electrical displacement is proportional to a power of the applied electric field, which varies from 0·54 for paper to 1·16 for xylene, and also to a power of the time of application of the field, which varies from 0·74 for bakelite to −0·2 for mica. For the best technical insulating materials the power of the force is nearly 1·0 and the power of the time nearly zero.

ABOUT six months ago Lüppo-Cramer published his discovery that phenosafranine has the remarkable property of desensitising photographic plates without interfering with the developable image that has been impressed on them, as in the course of ordinary exposure. We have already referred to this and to the solution that Messrs. Ilford have put upon the market that enables the most sensitive plates to be developed with no more precaution as to the safety of the light than would be necessary if the plates were one two-hundredth, more or less, as sensitive as they are. In the *British Journal of Photography* for June 17 and 24 Messrs. A. and L. Lumière and A. Seyewetz give details of experiments they have made on this subject. They have examined the desensitising action of a large number of other safranines, and find that while several are comparable in this matter to phenosafranine, none show any appreciable advantage to it, except that cresosafranine is more easy to wash out of a gelatine film. Many other organic bodies show a notable, and even useful, degree of desensitising effect, but for general purposes phenosafranine is superior to them all. There appears to be no well-defined relation between the constitution of dyes and their desensitising properties. Phenosafranine does not act merely as a light-filter, for it transmits red and violet, for both of which it desensitises. But if the plate is washed after treatment with the desensitiser, as the dye disappears the original sensitiveness is restored. It is therefore assumed that the dye forms an adsorption complex of much lower sensitiveness than the original silver bromide, and that this complex is unstable enough to be gradually decomposed by water. The authors have also examined plates treated with various typical desensitisers by exposing them in a spectrograph and estimating the loss of sensitiveness to light of different wave-lengths.

THE summer meeting of the Association of Science Teachers was held at Cambridge on July 9. In the afternoon Dr. Aston gave a lecture at the Cavendish Laboratory on "Atoms and Isotopes." Early ideas of the structure of matter, leading up to the formulation by Dalton of the atomic theory, were reviewed, and it was shown that the progress made in chemistry during the nineteenth century, which depended on the exact work done in the determination of atomic weights, had been inspired by Dalton's postulates. In order to explain fractional atomic weights, Crookes had suggested that an element might be a mixture of atoms of varying weight, but this was regarded as unlikely until in 1910 Sir Ernest Rutherford's work on radio-activity showed that various forms of lead obtained by radio-active changes had slightly different atomic weights, though their chemical properties were identical. To these substances Prof. Soddy gave the name of "isotopes." The method of positive-ray analysis due to Sir J. J. Thomson was then utilised. By this means it was found that neon—atomic weight 20·2—was probably a mixture of two isotopes of atomic weights 20 and 22 and after much labour a gas was obtained differing in density by 0·7 per cent. from the original, the experimental error being 0·2 per cent. This was not conclusive, but more exact methods of positive-ray analysis have shown that neon is made up of two constituents of atomic weight 20 and 22 in the ratio ot about 9 to 1. Similarly, chlorine has been shown to consist of at least two isotopes of weights 35 and 37, and quite recently they have been separated. The work done shows clearly that the important property of an element is the atomic number or the positive charge on the nucleus of the atom, and it is this alone which determines the chemical properties of the element.

THE Journal of the British Science Guild for June contains an article by Sir Richard A. S. Redmayne on the world-position in relation to coal. Great Britain has been unfortunate in her recent experiences. Prior to the war she exported about 73,000,000 tons of coal *plus* 21,500,000 tons shipped as bunker coal, making 94,500,000 tons, or 32 per cent. of her total output. But in 1919 this total was only 47·3 million tons, 20·6 per cent. of the production. In the present year the figures will doubtless be still more unsatisfactory. Other countries have also produced less coal. The entry of China as a competitor in the coal markets of the West is significant. Oil, it is stated, cannot become a real menace to the coal trade, as the amount available is only one-sixteenth of that needed to displace coal, and much of this is required for other purposes. A summary of addresses delivered at the annual dinner of the Guild by Field-Marshal Sir William Robertson, Col. Sir Ronald Ross, the Very Rev. Dean Inge, the Right Hon. Lord Rayleigh, and the Right Hon. Lord Bledisloe is also included in this issue of the Journal. Sir William Robertson made some illuminating comparisons between military experience of the past and the scientific warfare of the present day. He remarked that the day of the amateur is past, and that those who aspire to exercise Ministerial control over the destinies of this country should attach greater importance to the value of science. The administrative activities of the Guild fill a considerable portion of the issue. Special importance attaches to the report of the Committee on the Utilisation of Science in Public Departments, attention being directed to the position of scientific research workers in regard to tenure of service, salary, superannuation, etc. The attitude adopted by the Scientific Research Department of the Admiralty towards the individual university worker whose researches bear on Admiralty requirements is spoken of with approval.

A FAVOURABLE opportunity of obtaining books in general literature and on scientific subjects in new condition at prices considerably below those at which they were published is presented by Messrs. W. Heffer and Sons, Ltd., Cambridge, in their "Remainder" catalogue (No. 201), which has just been issued. It contains 485 titles, and is worthy of perusal.

THE most recent catalogue of Mr. F. Edwards, 83 High Street, Marylebone, W.1, is No. 416, entitled "Australasia and the South Seas." It gives particulars of some 813 works relating to Australia, New Zealand, Tasmania, New Guinea, and the islands of the Pacific. Some very choice and rare volumes are included.

Our Astronomical Column.

RECENT METEORS.—Mr. Denning writes:—"On July 5 there were two showers in prominent activity, supplying large, slow-moving meteors. The radiants were at 243°+65° and 228°+58°. These positions are some distance east of the radiant point computed for Pons-Winnecke's comet, but it is possible the comet and meteors may be associated, the discordances having been brought about by perturbations. Fireballs were observed at Bristol on July 5 11h. 40m. G.M.T. from radiant 243°+65°, on July 9 11h. 54m. from radiant 238°+18°, and 12h. 47m. from radiant 343°+12°. A well-defined shower of swift, streaking meteors was observed from the latter position on the night of July 9."

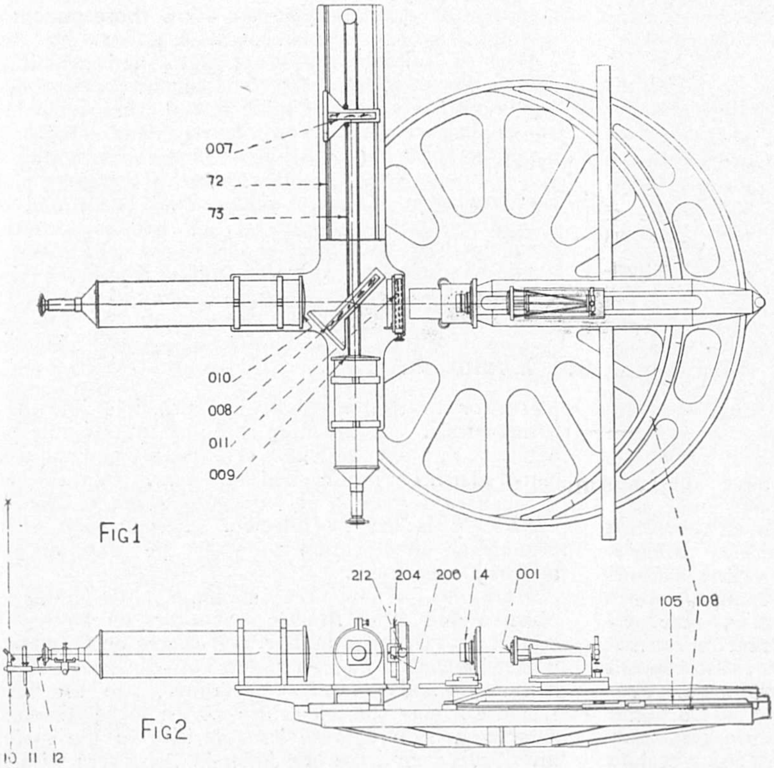
ANOTHER PLAN OF CALENDAR REFORM.—Prof. René Baire (Dijon) contributes an article to *Revue Scientifique*, 1921, No. 9, in which he points out several drawbacks (chiefly from a statistical point of view) attaching to the proposal to place certain days in each year outside the weekly and monthly reckoning. His plan of evading the difficulty is bold and novel, and consists in shortening the greater number of weeks to six days. A Saturday would occur only on the thirty-first day of the month—that is, five times in the year or six times in leap-year. The months are left nearly as at present, but the missing days of February are supplied. The following is the suggested table:—January 30, February 30, March 31, April 30, May 31, June 30, July 30, August 31, September 30, October 31, November 30, December 31. In leap-year July has 31 days.

The 1st, 7th, 13th, 19th, and 25th days of each month would be Sundays; there would thus be sixty Sundays in the year instead of the present fifty-two or fifty-three. The author seeks to disarm ecclesiastical criticism by pointing to this increased number; he also notes that the feasts of January 1, November 1, and December 25 would always occur on Sunday, while if Easter were fixed to the date April 1 it would be preceded by a Saturday. It is proposed that the additional Sundays should take the place of the present Bank Holidays, thus making the number of working days in the year much the same as at present. While the scheme has some obvious advantages, it is doubtful whether public opinion could be brought to sanction such a revolutionary change.

THE VARIABLE NEBULA IN CORONA AUSTRALIS.—Bulletin 20 of the Helwan Observatory contains a photographic research by the director, H. Knox Shaw, of the variability of this nebula and the neighbouring star R Coronæ Australis. The star magnitudes were deduced by comparison with standard fields at the same altitude, the incidental result being derived that the graph connecting magnitude with diameter of image shows decided curvature in the direction of enlargement of the image of the fainter stars. There are five variables in the field besides R Coronæ, viz. S and T Coronæ, C.P.D. −37·8450° (shown by Mr. Innes to be an Algol variable with period just under twenty-six days; a minimum of this star was observed at Helwan in 1915 August 9) and two other stars. Except for the Innes star, the variations appear to be irregular, and Mr. Knox Shaw conjectures that they may be due, wholly or in part, to the absorbing medium which he assumes to cover the whole region, as its star density is distinctly less than that of the neighbouring sky. The variability of the nebula is next discussed. Its structure is shown to be made up of a series of rings and knots, which apparently remain *in situ*, but alter in relative brightness. This is analogous to the behaviour of the nebulosity round Nova Persei, and Mr. Knox Shaw has examined the results to see if there is any connection between the changes of the star R Coronæ and those of the nebula. There is suspicion that the nebular changes follow those of the star at a ten-day interval, but the interruptions of the series of photographs by moonlight render it difficult to confirm this. If correct, and if it be due to an emanation travelling from the star with the velocity of light, the distance of the object would be about 100 light-years. It is pointed out that Hind's and Hubble's variable nebulæ are also near variable stars, and in regions of the sky that give evidence of the intervention of absorbing matter.

An Interferometer for Testing Camera Lenses.[1]

INTERFEROMETERS for the testing and correction of prisms and of lenses (for axial pencils) have been described in the *Philosophical Magazine* (vol. xxxv., January, 1918, p. 49). In its simplest form the instrument resembles the well-known Michelson interferometer, the essential optical difference being that the two interfering beams of light are brought to a focus at the eye of the observer. The principles of the prism interferometer have been applied to photographic lens testing in the camera lens interferometer recently constructed by Messrs. Adam Hilger, Ltd. A plan of the instrument is shown in Fig. 1, and a side elevation in Fig. 2. Light from a suitable source is reflected by a mirror 10 into the interferometer. A convex spherical mirror 001 is so disposed that its centre of curvature coincides with the focus of the lens 14 which is under test. In these circumstances, a beam the wave-front of which is a plane perpendicular to the axis of the lens will, after passage through the lens, be reflected back on its own path by the convex mirror, and if the lens be free from spherical aberration the reflected beam will, after passage through the lens, once more have a plane wave-front. If it has not, then the departure from planeness will produce interference bands which form a contour map of the corrections which will have to be applied to the lens to make its performance perfect.



FIGS. 1 and 2.—Plan and side elevation of lens interferometer.

An apparatus which will test for axial pencils only is, of course, of little use for testing camera lenses. The modifications essential for the latter purpose are (1) means of rotating the lens about a line at right angles to the axis and passing through the second principal point, and (2) mechanism whereby, simultaneously with the above rotation of the lens, the convex back-reflecting mirror is automatically moved away from the lens in such a way that its centre of curvature always falls on the plane, perpendicular to the axis of the lens, on which the lens is desired to form its image. The rotation of the lens carriage is effected by means of a bar 105 parallel to the axis of the lens and extending to the outer edge of the interferometer. The second requirement is fulfilled by a flexible connection being led from the carriage on which the mirror is adjustably mounted and over a pulley to a weight, and by there being upon the carriage a roller which by the action of the weight is retained in contact with a cross-bar mounted on the axial bar 105 and at right angles to it.

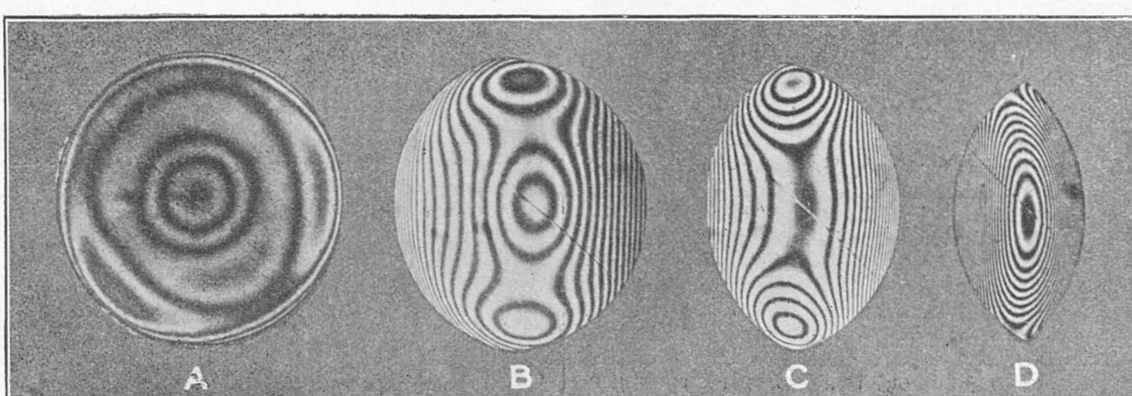


FIG. 3.—Interferograms of a photographic lens for axial and oblique beams.

[1] Abstract of a paper read before the Optical Society on April 14 by F. Twyman.

Adjustments are provided for bringing the second principal point of the lens under test on to the axis about which it is rotated by the bar, and also for bringing the centre of curvature of the mirror exactly on the axis of the roller above-mentioned and on the optical axis of the lens. The distance from the centre of the roller in the axial position to the axis of rotation of the lens is measured by a vernier. When all adjustments have been made, this vernier gives the focal length of the lens to an accuracy of about 0·001 in.

The apparatus measures the degree to which the wave-front, impressed by the lens on light from a distant point source, differs from a spherical wave-front. The indications are given in aberrations of wave-front to a scale of wave-lengths, the aberration shown being in every case twice that present in the once transmitted beam which normally forms the image of a distant point. The form in which the indications are presented is that of a series of interference fringes which are lines of equal aberration of wave-front. These interferometer pictures can be translated into terms of geometric optics by an observer who has had a little practice with the instrument. The various types of aberration and their chromatic variations produce characteristic interference patterns, and thus they can be readily differentiated and measured in terms of wave-length. By means of the pair of deflectors 011 a measurement of the distortion can also be obtained.

With a suitable source of light and a suitable camera the interference patterns can be photographed, and a complete photographic record can be obtained of the performance of any camera lens. Fig. 3 is a photographic reproduction of the interferograms of a well-known lens of high repute for the green mercury radiation ($546\mu\mu$) for the axial beam and for obliquities of $5°$, $10°$ and $15°$. It will be seen that even the best photographic lenses—of which this is a fair example—are very far indeed from perfection.

Mutations and Evolution.

IN the series of articles by Dr. Ruggles Gates appearing under the above title in a *New Phytologist* Reprint (No. 12), published by Messrs. Wheldon and Wesley, Ltd., we have the most recent attempt to present a reasoned and comprehensive statement of the problem of evolution. As the author tells us, his aim has been to show that though germinal (by which apparently we may understand chromosomal) changes are of importance in the evolutionary process, they cannot be considered as all-sufficing; that only from the Neo-Lamarckian point of view is it possible to explain a large class of organic phenomena. From this point he sets out to show how the Darwinian doctrine and Mendelian conceptions in combination may furnish us with a solution. To this end, however, it scarcely seems necessary to maintain, as the author is at pains to reiterate, that in the application of Mendelian principles we are merely putting into use a refinement of the theory of natural selection. Nor does any point appear to be gained by this insistence on accord, since, by the author's own showing, the underlying difference between Darwinism and Mendelism—the difference, namely, between the idea of continuity and discontinuity—is profound enough to have divided biologists into two opposite camps. One feels that what is common ground might more easily be made apparent if an attempt were made to define more strictly, or else to abandon, terms which are used to cover an ever-increasing complex of ideas. It will be obvious, for example, that a fresh analysis of evolutionary processes should be couched in terms which clearly differentiate the causes (=true factors) to which variation is presumably due from the mechanism by which variations, once having appeared, are perpetuated, and from conditions which permit or limit the occurrence of variation. That the author evidently has in mind the necessity for precision in this connection appears from the fact that he is careful to point out that isolation due to geographical barriers must be regarded as a *condition,* and not as a *factor*, yet he fails to draw this distinction when dealing with natural selection.

The important point which Dr. Gates seeks to establish is that a new character may arise in *two* different ways: (1) as the result of what we have still to term *spontaneous* nuclear (=karyogenetic) mutations; (2) from a so-called organismal change, *i.e.* a change due either to environmental effects on the cytoplasm or to the morphological principle known as orthogenesis. In the first case the mutation is perpetuated through the *whole* cell-lineage, and the associated character is inherited as a unit. In the second *a localised region or a particular stage in the life-cycle* only is usually affected. Perpetuation of an organismal modification connotes the inheritance of acquired characters.

Mutations.—The more striking observations of Morgan and other American workers on Drosophila and of de Vries, the author, and others on Œnothera, which indicate a direct relation between chromosomal behaviour and somatic appearance, are set forth. Definite zygote characters are shown to be constantly associated with definite irregularities in the meiotic division, as, *e.g.*, the *lata* habit in Œnothera with the presence of an extra chromosome. The author brings forward evidence of independent sporadic appearances of this form, and a parallel mutation has been obtained in cultures of other Œnothera species. In every case the number of chromosomes was found to be 15 instead of the typical complement 14. The occasional occurrence of an 8–6 instead of a 7–7 separation of the chromosomes in another mutant form supplied the clue to the mode of origin of these 15-chromosome forms. In another instance a particular strain of Drosophila, indistinguishable in general from the normal but showing an aberrant type of inheritance, led Bridges to infer the duplication of a sex-chromosome—a prediction which later investigation proved to be correct. These forms with an extra chromosome are found seldom, if ever, to breed true. Their importance, according to the author, lies in the support which they give to the conception of the origin of a zygotic character from a nuclear mutation rather than in their significance in evolution. It is held to be otherwise, however, when the whole chromosomal equipment is duplicated (tetraploidy) and associated with a characteristic giant habit as in Primula and Œnothera.

The separate class of Mendelian mutations is regarded as due also to a nuclear change (in this case possibly chemical) which is presumed, however, to affect only a particular locus or element in the chromosome. It is clear, however, from Bridges's observation cited above, and from Heribert-Nilsson's work on Salix (which the author does not discuss), that, on one hand, duplication of chromosomes *need not* be accompanied by any gross change in the organism, and, on the other, that a Mendelian mutation *may* produce an alteration in habit as marked as that which characterises the Œnothera forms with an extra chromosome. This being so, what becomes of the author's scheme of classification?

Organismal Characters.—The conception of organismal characters has been developed primarily, apparently, to account for the phenomenon known as recapitulation, *i.e.* the appearance in the individual of ancestral structures in a reduced or functionless form. In his treatment of this part of the subject the author is not easy to follow. Much of the argument advanced appears, and is admitted, to be inconclusive. The reader is left wondering why the "species cell" concept which has sufficed as a basis of explanation for karyogenetic mutations is here abandoned, and why physiological considerations are ignored. The essence of the conception of the "species cell" is, we are told, that when a new form arises it does so in consequence of some antecedent change in a (germ) cell unit. The individual derived from such a mutated germ-cell will exhibit the associated character in all its parts. The reasoning from this point onwards seems to be as follows:—If organisms were entirely composed of such cell units, then germinal mutations might supply the whole basis for evolution. But regions or structures occur in the organism in which the cell unit is ill-defined or non-existent, therefore some other type of evolution must take place [!] It does not appear, however, that it is in these regions or structures that the postulated environmental effect is felt. In fact, the line of argument now seems to lose touch with the cell altogether, and to work backwards from the other end, thus:—Recapitulation occurs, therefore at some point a lengthening of the life-cycle must have taken place. This can have come about only through additional cell-divisions taking place either at the end or in the course of the original cycle. Having laid it down that a *germinal* mutation is required to produce a new character, the author is driven to conclude that this extension of the life-cycle cannot be due to a change in a cell unit, "but must rather be the result of the organism, as it were, overcoming its cell-shackles and by its own energy [not, be it noted, through an environmental effect, as by the definition we are led to expect] producing new developments, though such novel additions are themselves cellular in structure." Somewhat earlier in his argument the author chides those who "desert science for obscurantism," but what are we to call this?

Though it may be that the reader will not feel that the author's conceptions of evolutionary processes materially advance the position, he will, nevertheless, find in these articles a useful collection of pertinent data.

University and Educational Intelligence.

LIVERPOOL.—Following the recent transfer of the Port Erin Biological Station to the University (Department of Oceanography), Mr. Herbert C. Chadwick, who has been curator under the Liverpool Marine Biology Committee for the last twenty-four years, has now resigned, but remains on the staff of the institution as research assistant. Mr. J. Ronald Bruce has been appointed naturalist-in-charge, and official letters should be sent to him.

ST. ANDREWS.—The following honorary degrees were conferred at the annual graduation ceremony on July 12:—*LL.D.:* Prof. W. M. Bayliss, professor of general physiology in University College, London; Sir William Henderson, chairman of Dundee Technical College; Emeritus Prof. D. MacEwen, Dundee; and Prof. A. N. Whitehead, professor of applied mathematics in the Imperial College of Science and Technology.

AMONG the bequests of the late Dr. H. Barnes, vice-president and a former president of the British Medical Association, are his medical books to the Royal Society of Medicine, and, conditionally, 2500*l.* to Edinburgh University for a scholarship for clinical medicine and 1500*l.* to Epsom College for a similar scholarship.

THE Paton-Figgis scholarship, value 50*l.* for a year and renewable, is being offered by the South-Eastern Agricultural College, Wye, Kent. Candidates must be reading for the B.Sc. (Agric.) degree, and reside outside the counties of Kent, Surrey, and Sussex. The latest date for applications to reach the Principal of the college is August 14.

THE following appointments have been made at the University College of Swansea:—Mr. F. A. Cavenagh to the chair of education; Dr. Florence A. Mockeridge, lecturer in botany and head of the department of biology; Mr. L. B. Pfeil, assistant lecturer in metallurgy; Mr. A. Stuart, assistant lecturer in geology; and Mr. J. S. Caswell, demonstrator in engineering for one year.

THE Ellen Richards research prize of 1000 dollars (200*l.*) is being offered by the Association to Aid Scientific Research by Women. Theses by women, based on independent laboratory research, are eligible for competition if received by the committee before February 25, 1922. Further information and application forms are obtainable from Dr. Lilian Welsh, Goucher College, Baltimore, Maryland, U.S.A.

TWO Royal School of Mines Frecheville research fellowships, in aid of research in connection with mining, mining geology, metallurgy, or the technology of oil, are being offered by the Imperial College of Science and Technology, South Kensington, S.W.7. The fellowships are of the annual value of 300*l.*, tenable for one year, with a possible renewal for a second year. Applications, giving particulars of the candidate's proposed investigation, his qualifications and references, must be sent to the Secretary of the college before September 1 next.

WE have received from Mr. G. D. Dunkerley, hon. secretary of the Secondary School Teachers' War Relief Fund, the report of the last year's working. The object of the fund is to supplement the pensions and allowances of soldiers, sailors, nurses, and their dependents, and to secure that the families of the fallen and disabled secondary-school teachers shall suffer to the least possible extent in material circumstances. A total of 9874*l.* has been collected, and allowances are now being made to the extent of 481*l.* per annum. Thus the present capital fully safeguards the present allowances, and leaves a margin for additional help. The committee has therefore decided to maintain the payments from capital and interest combined without appealing for further funds, the capital diminishing as the necessity for the allowances ceases. Every opportunity will be taken of helping the children of fallen teachers at future stages in their careers, and although it has been decided to close the subscription list in its present form, the committee will gratefully accept legacies or donations for this special purpose. The chairman of the committee is Mr. A. A. Somerville, of Eton College; the hon. treasurer is Mr. J. Hart-Smith, of the County Secondary School, Battersea, and donations should be sent to him, c/o Barclay's Bank, 835 Wandsworth Road, S.W.8.

Calendar of Scientific Pioneers.

July 14, 1827. Augustin Jean Fresnel died.—An officer in the Corps des Ponts et Chaussées, Fresnel during the last twelve years of his life devoted himself to experimental and mathematical researches in optics. Like Young, he did much to establish the undulatory theory of light.

July 14, 1879. Sir Thomas Maclear died.—Trained as a doctor, through Admiral Smyth Maclear took up astronomy, and from 1833 to 1870 was Royal Astronomer at the Cape of Good Hope. Among other work was his extension of Lacaille's arc of meridian.

July 14, 1907. Sir William Henry Perkin died.—The discoverer in 1856 of the first of the aniline dyes, aniline purple or mauve, Perkin established a factory for its manufacture, and thus became the founder of the great coal-tar colour industry. His success, especially with the manufacture of alizarin, enabled him in 1874 to retire, after which he made important investigations of questions of chemical constitution. He was knighted at the jubilee of his great discovery.

July 17, 1878. Thomas Oldham died.—After holding the chair of geology at Trinity College, Dublin, Oldham in 1850 was appointed by the East India Company the first Superintendent of the Geological Survey of India.

July 17, 1899. Charles Graves died.—The successor of McCullagh in the chair of mathematics in Trinity College, Dublin, Graves contributed mathematical memoirs to *Crelle's Journal,* and served as president of the Royal Irish Academy.

July 17, 1912. Jules Henri Poincaré died.—Born in Nancy in 1854, Poincaré in 1908 was elected president of the Academy of Sciences of Paris, by which time he had written 1300 books and memoirs relating to pure mathematics, mathematical physics, astronomy, and philosophy.

July 18, 1650. Christoph Scheiner died.—A member of the Society of Jesus and an opponent of the views of Copernicus and Galileo, Scheiner was one of the earliest observers of sun-spots. He taught at Freiburg (Baden), Rome, and Ingolstadt, and was rector of a Jesuit college in Silesia.

July 18, 1819. Barthélemy Faujas de Saint-Fond died.—Attracted to natural history by Buffon, Faujas de Saint-Fond became professor of geology in the Jardin des Plantes. He travelled much, wrote a valuable work on extinct volcanoes, and was the first scientific writer to direct attention to the basalt pillars of the Isle of Staffa.

July 19, 1814. Matthew Flinders died.—Known for his important survey of the Australian coast, Flinders made observations on the compass, and to him we owe the "Flinders bar" for neutralising a ship's magnetism.

July 19, 1838. Pierre Louis Dulong died.—Dulong was director of studies at the Ecole Polytechnique, and in 1832 became one of the secretaries of the Paris Academy of Sciences. In 1819 with Petit he enunciated the law connecting the atomic weight of a substance with its specific heat.

July 19, 1882. Francis Maitland Balfour died.—Killed at the age of thirty-one when climbing Mont Blanc, Balfour had just been appointed to a newly created chair of animal morphology at Cambridge. His "Comparative Embryology" appeared in 1880–81.

July 20, 1819. John Playfair died.—An Edinburgh professor, Playfair's principal contribution to science was his "Illustrations of the Huttonian Theory of the Earth."

July 20, 1866. Georg Friedrich Bernhard Riemann died.—Successor of Dirichlet in the chair of mathematics at Göttingen, Riemann was one of the most profound mathematicians of his time. E. C. S.

Societies and Academies.

LONDON.

Geological Society, June 22.—Mr. R. D. Oldham, president, in the chair.—Dr. C. T. **Trechmann** and L. F. **Spath**: The Jurassic of New Zealand. The Jurassic beds of New Zealand comprise an important set of sediments, probably 10,000 ft. in thickness, exposed at certain points extending over the length of the North and South Islands. They follow the Trias with apparently perfect conformity. The affinities of the fossils from the Lower Lias to the Upper Jurassic formations are with those occurring in the Jurassic of the Argentine Andes, Western Australia, the Sula Islands, the Spiti Shales of the Himalayas, and the Jurassic deposits of Kutch. Descriptions of New Zealand ammonites from the British Museum collections, notably a small fauna of typically Mediterranean aspect, which is referred to the Middle Lias, were given.—F. **Dixey**: The norite of Sierra Leone. The norite of Sierra Leone constitutes a complex of which the oldest and most important member is an olivine-norite. The complex forms the mountainous mass which, with a narrow coastal plane of Pleistocene sediments, makes up the Sierra Leone peninsula. The norite was intruded in the form of a huge stock; it has no marginal or basic modifications, while its junction with older rocks is obscured by the Pleistocene sediments. The complex is probably somewhat later than Pre-Cambrian in age. The main intrusion of norite was invaded in succession by minor intrusions of younger norites, norite-pegmatite, beerbachite, norite-aplite, and dolerite. Features of the older norite are well-developed flow-banding, a series of binary and ternary intergrowths of the common minerals, and metamorphism due to the minor intrusions. Iron-ores occur in the norite as small masses, narrow schlieren, and disseminated grains; they are highly titaniferous. Sulphides and other economic minerals are rare or absent.

EDINBURGH.

Royal Society, July 4.—Prof. F. O. Bower, president, in the chair.—C. T. R. **Wilson**: Recent work on lightning and thunderstorms. A thundercloud may be regarded as a great electrical machine, and suggests such questions as the electromotive force developed by the machine, the current which passes through it, and the external distribution of the current. It is at present mainly from a study of the electric force at the ground during thunderstorms that we obtain information on these points. Records were shown of the changes in the electric field due to thunderstorms at a distance, and of the sudden changes produced by lightning discharges. From the results of automatic records of this kind it is concluded that in an average lightning flash a quantity of electricity amounting to about 20 coulombs passes, and that the potential difference required to cause the discharges is of the order of one thousand million volts. In addition to lightning discharges there may be considerable continuous currents maintained by the thundercloud. The electrical energy going to waste in a thunderstorm may amount to a million horse-power. A large part of the current maintained by the thundercloud may pass through the cloud from the ground to the conducting upper atmosphere, or from the upper atmosphere to the ground, and produce effects which are of importance in connection with the atmospheric electricity of fine weather, and possibly with terrestrial magnetism.—Prof. H. **Briggs**: The adsorption of gas under pressure. The author describes a series of experiments with different gases and with different adsorptive substances to ascertain the volume of gas adsorbed at pressures up to 100 atmospheres. The tests show that it is possible to increase the gas capacity of a cylinder, holding the gas under compression, if the cylinder be completely filled with coconut charcoal before the gas is pumped in. The reason for certain sudden outbursts of fire-damp in coal mines is stated to be due to the adsorption of that gas under pressure by the coal. In some cases millions of cubic feet of fire-damp have been suddenly discharged in mines when the equilibrium was disturbed.—Miss Elizabeth **Gilchrist**: The utilisation of solid caustic soda and the absorption of carbon dioxide. The experiments aimed at ascertaining the optimum condition for the absorption of carbon dioxide by solid caustic soda granules, especially with the object of improving that action in mine rescue apparatus. The absorption diminishes at temperatures approaching 0° C. and at temperatures exceeding 100° C. The behaviour of a caustic granule at or near the optimum condition is described, it being shown how the granule swells gradually, eventually becoming a shell of carbonate hollow within.—Miss Augusta **Lamont**: The development of the feathers of the duck during the incubation period. The external appearance and the internal structure of the feather-papillæ are figured and described, and special stress is laid on the distinction between pennaceous and plumaceous feathers during their earliest stages. The work is preliminary to further researches.—A. G. **Ramage**: Note on the conditions for mirage on the Queensferry Road. The surface of the road was remade in the spring of 1919 with road metal and liberal supplies of bitumen, and small pieces of quartz scattered on the top of the bitumen, the whole being rolled by a steam-roller. After this had been done no signs of the mirage, so common on this road the previous summer, made their appearance until August, and then but faintly. During the summers of 1920 and 1921, on bright days, mirage was again much in evidence, showing that a newly made road is not conducive to the appearance of the mirage phenomenon.

DUBLIN.

Royal Dublin Society, June 28.—Dr. F. E. Hackett in the chair.—Prof. T. **Johnson** and Jane G. **Gilmore**: The occurrence of a Sequoia at Washing Bay, Co. Tyrone. The conifer was found in the core of the coal-bore, especially in the zone between 890–930 ft. It is represented by wood, by shoots showing dimorphic foliage, by cones and pollen-grains. The authors find it to agree in all respects with *S. Couttsiae*, Heer, from the upper Oligocene of Bovey Tracey, Devonshire. They have also examined Baily's type material of *S. du Noyeri*, and refer it to *S. Couttsiae* as a possible variety. They describe one specimen showing the two types of foliage on the same shoot. The paper also contains an account of the distribution and characters of the stomata in Sequoias, recent and fossil.—P. A. **Murphy**: The sources of infection of potato tubers with the blight fungus, *Phytophthora infestans*. The results of field experiments in Canada and Ireland on the decay caused by the blight fungus in potato tubers, with particular reference to the rot which sets in after digging, are detailed. When blight rot is found in quantity in the pits in winter it does not owe its origin to the spreading of the disease from a few initially infected tubers. Many tubers not visibly diseased carry the infection with them to the pits. The source of infection has been traced to contact of the tubers at digging time with blighted, but partially living, foliage, and with contaminated surface soil. The conidia live in the soil for at least two weeks after the death of the tops, and such soil may be a dangerous source of infection.

PARIS.

Academy of Sciences, June 20.—M. Georges Lemoine in the chair.—H. **Andoyer**: The direct demonstration of a theorem of Tisserand relating to the development of the perturbation function.—E. **Houg**: The tectonic of the coast region between Saint-Cyr and Hyères.—C. **Richet**, Mlle. Eudonie **Bachrach**, and H. **Cardot**: The alternations between tolerance and anaphylaxy. Studies on the lactic ferment. Successive generations of the bacillus show at first a decrease in activity by small proportions of mercuric chloride in the culture media, then get accustomed and increase in activity (measured by the lactic acid formed), but lose this tolerance later, become sensitive, and are killed. With smaller doses of the poison there is at first an acceleration, then an anaphylactic phase, and finally death of the organism.—C. **Depéret** and M. **Solignac**: The Sahalian of northern Tunis.—M. **de Sparre**: The yield of turbines working with a variable head.—W. **Kilian** and F. **Blanchet**: The presence of a sub-alluvial sheet of thermal or mineralised water in the bed of the Durance, at Serre-Ponçon. These hot springs were discovered in the course of work carried out in connection with the construction of a hydro-electric power station. The water was saline, temperature 47° to 49° C.—B. **Gambier**: The deformation of surfaces and the Laplace equation.—L. **Dunoyer**: The complete chronophotographic determination of trajectories. The method is based on the simultaneous photography from two determined positions of the path of a luminous projectile.—A. **Sanfourche**: The absorption of the oxides of nitrogen by sulphuric and nitric acids.—L. **Guillet** and M. **Ballay**: Critical points due to hardening caused by wire-drawing. The hardened wire has a part annealed, and the electrical resistances of the annealed and unannealed portions are compared at various temperatures; the results are recorded on a differential curve. This electrical method is superior to the dilatometric and other methods in use.—A. C. **Vournazos**: A new magnesian hydraulic cement. A description of the preparation and properties of some cements produced from magnesia (magnesite calcined at a low temperature) and powdered pumice or silica.—M. **Baille-Barrelle**: Contribution to the study of the coking of Saar coals.—A. **Mailhe**: The catalytic decomposition of the polyhalogen derivatives of the paraffins. A study of the reduction of tetrachloroacetylene, tetrabromoacetylene, chlorodibromopropane, dichlorodibromoacetylene, and trichlorodibromoacetylene by hydrogen in presence of reduced nickel and barium chloride as catalysts. The product is always a halogen-substituted ethylene. When there are different halogens the bromine is first removed by the hydrogen.—J. B. **Senderens** and J. **Aboulenc**: The catalytic decomposition of the bromoacetic acids and of mixtures of bromine and acetic acid.—J. **Savornin**: Observations on the Palæozoic of Rabat, Morocco.—P. **Bonnet**: Mesocretaceous volcanic eruptions and their relations with the distribution of the facies in the Caucasian geosynclinals.—J. **Cvijić**: River platforms and erosion steps.—Mlle. Y. Boisse **de Black**: The "frane" of the Cère Valley.—A. **Treuthardt**: Some new measurements of the density of the air at Geneva. Some results of measurements carried out in 1917. The deviations observed are larger than the experimental error, and the values below the average (1·29269) were obtained when the barometric pressure was above the mean pressure for Geneva.—E. **Moles**, T. **Batuccas**, and M. **Payà**: The density of the air at Madrid and its small variations. The results of thirty series of measurements are given, each series comprising two or three observations. The mean is 1·29303, and the deviations are regarded as being outside the experimental error. In agreement with the Loomis-Morley hypothesis, the minima of density correspond with the maximum of atmospheric pressure and conversely. —L. **Blaringhem**: The pollen of flax and the degenerescence of the varieties cultivated for the fibre. The study of the quality of the pollen of isolated pedigrees, followed during several generations, is recommended for the selection of flax grown for the fibre.—C. **Porcher** and A. **Chevallier**: The distribution of the saline substances and the mineral elements in milk.—W. **Mestrezat** and Mlle. S. **Ledebt**: The compensating *rôle* of chlorides in its relations with the chemical composition of the body fluids.—P. **Chailley-Bert**, R. **Faillie**, and J. P. **Langlois**: The "second wind" of runners. Experiments are given showing that the "second wind" is brought about by a diminution in the respiratory exchanges, and that this diminution, the work remaining constant, is the result of a better adaptation of the subject, an improvement in the yield of the human machine.—H. **Piéron**: The importance of the peripheral phase in the margin of the variation of the times of sensorial latency as a function of the intensities of stimulation.—A. **Vandel**: The question of cellular specificity in *Polycelis cornuta*.—F. **Picard**: The determination of egg-production in *Pimpla instigator*. Experiments proving that the sight plays no part in the act of depositing the egg.—P. **Remy**: The action of the vapours of chloropicrin on *Argas reflexus*. This parasite of the pigeon has proved to be extremely difficult to destroy by the ordinary insecticides; it is now proved to be destroyed by the vapours of chloropicrin, the amounts required being small enough for practical use.—A. **Goris** and A. **Liot**: Observations on the culture of the pyocyanic bacillus on artificially defined media.—E. **Sergent** and M. **Béguet**: The mycosic nature of a new disease of the date-palm threatening the Morocco oases.

SYDNEY.

Linnean Society of New South Wales, May 25.—Mr. G. A. Waterhouse, president, in the chair.—T. G. **Sloane**: Revisional notes on Australian Carabidæ, pt. vi. The tribe Bembidiini is reviewed so far as the Australian fauna is concerned. The synonymy is given, and seven species of Tachys are described as new. The tribe, as represented in Australia, consists of five genera, of which only Illaphanus is peculiar to Australia; the five genera comprise fifty-eight species.—Dr. A. J. **Turner**: Revision of Australian Lepidoptera—Hypsidæ, Anthelidæ. Six genera, one of which is new, and fourteen species of Hypsidæ and seven genera and forty-seven species (twelve new) of Anthelidæ are described.—T. **Steel**: Ulmite, a constituent of black sandstone. A black friable sandstone which outcrops frequently on the coast of New South Wales consists of sand grains with a thin, dark-coloured coating. This coating is identical with humus extracted from soil.—W. P. **Hiern**: A new species and a new variety of Diospyros. A new species is described from New Caledonia, and a new variety of *D. samoënsis* from Apia, Samoa.

Books Received.

Power House Design. By Sir J. F. C. Snell. Second edition. Pp. xi+535. (London: Longmans, Green and Co.) 42*s*. net.

The Garden of Earth. By A. Giberne. Pp. xiv+178. (London: S.P.C.K.) 6*s*. 6*d*. net.

Mountain and Moorland. By Prof. J. A. Thomson. (Nature Lover's Series.) Pp. 176. (London: S.P.C.K.) 6*s*. net.

Engineering Steels. By Dr. L. Aitchison. (Reconstructive Technical Series.) Pp. xxxi+348+48 plates. (London: Macdonald and Evans.) 25*s*. net.

The Beloved Ego. By Dr. W. Stekel. Authorised translation by R. Gabler. Pp. xv+238. (London: Kegan Paul and Co., Ltd.) 6*s*. 6*d*. net.

Whitherward? Hell or Eutopia. By V. Branford. Pp. xv+116. (London: Williams and Norgate.) 2*s*. 6*d*. net.

Air Ministry: Meteorological Office. Professional Notes No. 19. Cracker Balloons for Signalling Temperature. By L. F. Richardson. (M.O. 240i.) Pp. 95–115. (London: H.M. Stationery Office.) 1*s*. net.

Diary of Societies.

THURSDAY, JULY 14.

ROYAL SOCIETY OF ARTS, at 8.—Prof. H. E. Armstrong and A. C. Klein: Paints, Painting, and Painters, with Reference to Technical Problems, Public Interests, and Health. (To be followed by a discussion.)

FRIDAY, JULY 15.

INSTITUTION OF PRODUCTION ENGINEERS (at Institution of Mechanical Engineers), at 7.30.—M. Lawrence: Production and the Engineer.

MONDAY, JULY 18.

ROYAL BOTANIC SOCIETY OF LONDON, at 3.—Prof. A. R. Bickerton: The Generic Simplicity and Great Importance of Basic Principles in all Scientific Work. III. The Importance of the Cosmic Theory of the Third Body.

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