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INTERNAL-COMBUSTION ENGINES.

The Design and Construction of Internal Combustion Engines. A Handbook for Designers and Builders of Gas and Oil Engines. By Hugo Güldner. Translated from the second revised edition, with additions on American engines, by Prof. H. Diederichs. Pp. xix+672. (London: Constable and Co., Ltd., 1910.) Price 42*s.* net.

THIS work is the most complete and elaborate treatise on the gas-engine which has ever been published, as will be realised when it is stated that there are 664 pages of comparatively small-type letterpress, 728 figures, and 36 folding plates. There is a certain amount of the usual padding, namely, photographic reproductions of large and small gas-engines of various makes, as well as records of tests, but there is also a large amount of original work and practical information which, owing to the position of the author, viz., chief engineer and director of the Güldner Motoren Gesellschaft, must be regarded as of great value. In the preface to the first edition, the author states:—

"Germany's gas-engine industry justly enjoys an international reputation . . . everything that has served to lay the foundation of the industry and that has helped to make it vital and important is either the product of German thought, or was first practically realised on German soil."

It is not surprising, therefore, that the work reflects German practice.

The book is translated into English by Prof. H. Diederichs, of Cornell University, and he has entirely omitted the first part of the German edition, which treats of the history of the gas-engine, and has substituted therefor descriptions of, and information relating to, American gas-engines. The author says that his principal object in writing this book was to make it "serve as an every-day working guide to the designer and constructor," and to follow out this object he has adopted the somewhat unusual feature of giving dimensioned drawings, not only of complete engines or producers, but of various parts. These drawings will undoubtedly be found to be of the greatest use to many designers and also to purchasers of engines who may wish to verify whether a proposed engine is correctly designed or not.

The work is divided into four parts and an appendix. The first part deals with the various methods of operating gas-engines and the gas-engine cycles; the second part with the design and construction of internal-combustion engines; the third with the erection and tests of modern internal-combustion engines; the fourth with gas-engine fuels and combustion in gas-engines; and the appendix with various theoretical matters relating to thermodynamics and thermochemistry, as well as with certain details derived from practice.

In dealing with the constant-volume cycle, the author investigates the question of the maximum compression that should be practically adopted, taking into consideration the theoretical thermal efficiency based on comparatively recent data of the variation of specific heat with temperature, as well as the efficiency ratio and mechanical efficiency, and finds that the economic limit of maximum compression lies between 210lb. and 280lb. per square inch, a conclusion which, although these pressures are somewhat higher, is substantially in agreement with the experimental work of Prof. Burstall.

A critical comparison of the four-cycle and two-cycle engines is made, and the author comes to the conclusion that the four-cycle engine can only be considered "as a makeshift until an efficient and trustworthy two-cycle machine appears on the market"; he also discusses the question of compounding, and states that "it will remain without promise in gas-engine construction." The design of the various parts of gas-engines is gone into in the very fullest manner, and numerical examples are worked out in great detail; some interesting photographs are given showing the effect of weak frame construction and of imperfectly designed crank-shafts. A great deal of information respecting the type of material to use for the various parts of gas-engines is given, and in the matter of connecting-rods, while stating that soft steel is usually employed, the author says that the use of cast-steel is on the increase. The design of inlet and exhaust valves is given in great detail, and the various methods of water-cooling are described. Amongst the latter is an interesting arrangement designed by Pawlikowsky, in which the water-pipe is stationary and the water is led through the valve spindle, which is large enough to be bored out to admit the inlet pipe with a space around it through which the hot water can find its way back. The design of fly-wheels is discussed at considerable length, and numerous tangential effort diagrams for various types and designs of gas-engines are given, and the results of various calculations are embodied in a series of curves by which the required weight of rim of a fly-wheel can be ascertained under various conditions occurring in practice.

In respect of gas-producers, the author appears to favour the suction-producer in preference to pressure-producers, and says that the former have almost entirely displaced the older form. This statement is made without any reference to the size of the engine to be supplied with gas, and cannot, therefore, be regarded as conforming with present practice, in which the large gas-engines are supplied with gas from pressure-producers. Numerous designs of suction-producers are described, none of them larger than 600 b.h.p., and there is only a passing reference to pressure-producers.

At the beginning of part iii., much detailed information is given in respect of the capital cost and cost of erection and running of gas-engine installations, and all this information is collected together in a tabular form, giving all the various heads of expenditure for engines varying from 5 b.h.p. to 200 b.h.p., both when using illuminating gas and suction gas. It is interesting to note that the total operating costs for 5 b.h.p. are the same for both kinds of gas, but after that the suction gas is much the cheaper. At 200 b.h.p. the suction gas is nearly one-third the cheaper.

There are some very interesting folding plates showing the pipe-work necessary for various designs of gas-engines; the various kinds of pipes—gas, water, and exhaust—are shown in different colours, and thus the matter is made very clear.

Nearly ninety pages of the book are devoted to descriptions of American gas-engines, made by Westinghouse, Allis Chalmers, the Snow Engine, and many others. Many of the drawings are dimensioned, and the results of numerous tests are given.

In part iv. various fuels available for producing gas are described, and there is an extensive table on American coals, giving for each full analysis and the calorific value per pound; there is also information with reference to blast-furnace gases and coke-oven gas, also with regard to various oils, alcohol, &c. There is an important table giving the explosive range of various gases. The remainder of the book consists of the theory of the gas-engine and producers, and in the appendix the fullest particulars are given of the methods of testing gas-engines prescribed by the American Society of Mechanical Engineers and by the German Society of Engineers. This information is of great importance, especially as at the present moment there is nothing of the kind issued by any society of British engineers in connection with gas- or internal-combustion engines.

STRUCTURE AND DISTRIBUTION OF ORE DEPOSITS.

Lehre von den Erzlagerstätten. By Dr. R. Beck. Dritte Auflage. Band i., pp. xii+540+1 map; Band ii., pp. x+542. (Berlin: Gebrüder Borntraeger, 1909.) Price, two vols., 32 marks.

PROF. BECK'S "Lehre von den Erzlagerstätten" is one of those works which disarm criticism. The predominant feeling in the mind of the geologist when using it must be of gratitude to its author for this comprehensive and up-to-date account of the structure and distribution of ore deposits. The previous edition was published in 1903, and an American version, translated and edited by Weed, was issued in 1905. The new edition has been so much enlarged that it now appears as two volumes, each almost equal in size to the original.

The book follows the same general lines as the previous editions, but there are many important changes which indicate the trend of current opinion as to ore classification. Prof. Beck divides ores into two primary divisions, the epigenetic and syngenetic, those formed respectively later and simultaneous with the rocks in which they occur. These divisions are, however, practically abandoned in the work. The author divides ores into eight groups, in which the first, seventh, and eighth in order of treatment are mostly syngenetic; the intermediate groups are epigenetic, but include some ores which are admittedly syngenetic. The term syngenetic, though it appears in the introduction, is not much used, but epigenetic recurs frequently. That term is not altogether satisfactory, as most of the epigenetic ores are subterranean, and some of them are very deep seated in origin. Hence epigenetic ores are not epigene, but hypogene, to use two old and well-established geological terms.

The ores first treated are those attributed to direct segregation in molten rocks. They are the truly igneous ores. Prof. Beck recognises fourteen types, of which all but four were included in the previous edition. The only new type of oxide ores amongst these is that of magnetite in granite, described by Vogt, from the Lofoten Islands. Prof. Beck, however, in a note added to the proofs, remarks that Sjögren's recent paper confirms his own opinion that these granitic ores are due to contact metamorphism, and not segregation. The whole chapter on magmatic segregation shows that less importance is attached now than formerly to this process of ore formation. The author includes the nickel ores of Sudbury in this chapter, but recognises that they are mainly due to secondary processes. He also quotes Loewinsen Lessing's interesting work on the famous iron ores of the Urals, which are thus shown to be contact deposits and not segregations, as has been usually maintained; and as Prof. Beck points out, the great Lapland ores, which have also been claimed as igneous segregations, must be regarded as of the same origin as those of the Urals.

The group of ores which came second in the previous edition, included those deposited by direct sedimentation and precipitation. These aqueous ores were placed next after the igneous, because both groups are syngenetic. Description of the sedimentary ores is now postponed till near the end of the book, and the ores due to contact metamorphism take their place. This significant change is a great improvement, as many of the ores now assigned to igneous segregation will probably be found to be contact deposits. The bulk of the work is occupied with a description of the epigenetic ores, which include ordinary mineral veins and certain ores in stratified rocks, due to the same process as ore veins. The author includes here the banket of the Transvaal. He gives an excellent judicial summary of the arguments in favour of the rival theories as to the origin of that ore without here expressing any very definite preference. He obviously still favours the infiltration theory which he has elsewhere supported. In reply to the suggestion that much of the pyrites in the banket is altered "black sand," he asks what has become of the ilmenite that is usually associated with magnetite in such deposits. There is, however, plenty of titanic oxide in the banket which has probably been derived from decomposed ilmenite. Little stress is laid on the old arguments in support of the infiltration theory, and according to Prof. Beck the weightiest argument in its favour is the dependence of the gold contents of the banket on its dip. This may be questioned as a matter of fact, and it is at any rate an indefinite and unconvincing argument. The author includes the West African banket as also epigenetic, though he accepts its gold as alluvial in origin. It is not surprising to find this ore described immediately after that of the Rand, for those who know both deposits regard them as of the same origin, though the iron ores of the West African banket still mainly occur as magnetite. It seems difficult to regard the West African banket as a modified placer, and the South African as an ore due to infiltration.

The feature in Prof. Beck's arrangement of ores which seems most improbable is his reference of so many metalliferous sandstones and conglomerates to the epigenetic group. He includes there, for example, the Katanga quartzite, which contains small nuggets of gold and platinum. In fact, the only pre-Cainozoic alluvial gold deposits which are included in the chapter on detrital ores are those of the Cambrian of the Black Hills of Dakota, a few occurrences of no economic value in the Carboniferous rocks of Australia, Nova Scotia, and France, and in the Mesozoic of California, New Zealand, and Saxony. Alluvial gold must have been deposited in pre-Cainozoic times, but whenever ancient gravels are of much economic value their gold is attributed to infiltration. While in some cases Prof. Beck may be disposed to underrate the extent of ancient alluvial ores, he includes the tin deposits of Mt. Bischoff in Tasmania as alluvial, having apparently overlooked a short note upon that mine, explaining its tin-bearing sands as decomposed gossan in which a pseudo-stratification has been produced by the settling of the decaying rock.

Prof. Beck's work shows remarkably thorough acquaintance with recent literature on economic geology, and his statement of rival hypotheses is always given with scrupulous fairness. This greatly enlarged edition will become even more indispensable as a work of reference than its predecessors, and is worthy of the high traditions of the Freiburg Mining School.

J. W. G.

THE SUGAR-CANE AND ITS PRODUCTS.

The Manufacture of Cane Sugar. By Llewellyn Jones and F. I. Scard. Pp. xix+454. (London: Edward Stanford, 1909.) Price 12*s.* 6*d.* net.

A NOTEWORTHY feature in tropical agriculture is the new lease of life taken recently by the cane-sugar industry. A few years ago it appeared not improbable, to say the least, that the sugar-cane was doomed to be forced into a position permanently inferior to that of the beet as a source of the world's supply of sugar. Originally possessed of a practical monopoly, the cane had lost so much ground that in the opening years of this century the beet supplied about two-thirds of the sugar which came into the world's markets. It is true that a great deal of cane-sugar is consumed in countries where it is produced and escapes record; so far as the world's commerce was concerned beet was the chief contributor. Within, however, the last five years, the output of cane-sugar has markedly increased, whilst that of beet has slightly diminished, and a little more than one-half of the sugar of commerce is now derived from the sugar-cane.

This period of activity in the industry has been marked by the issue of various books. One of the most useful is that now under review. The authors have wide practical experience of sugar-making, as engineer and chemist respectively; with the aid of numerous illustrations they present the results of their experience in an exceedingly simple manner.

A marked feature of the book is the explanation of practical matters in clear, non-technical language, and a reader with no special engineering knowledge and no experience of sugar-making should easily understand and be able to follow the whole chain of processes by which the ripe sugar-cane is converted into sugar and the various by-products.

No pretence is made to deal with cultivation. There is in chapter i. an illustrated account of the structure of the cane (the references on pp. 3 and 4 to the figures are not accurate), and notes on the chief varieties, diseases, chemical composition, &c.; but the subject-matter proper of the book opens with crushing, in the next chapter. Whilst the novice will read this easily, the mature planter will find much worthy of consideration, as, for example, in the excellent presentment of the *pros* and *cons* of improved methods of extraction. In dealing with the boiling or concentration, the evolution of the modern vacuum pan, capable of yielding 40 tons of sugar at a single operation, is traced from the simple open pan still in use in many parts of the world. Equally here, whether dealing with the simplest or the most complicated processes, the authors have contrived to preserve a conspicuously clear and direct style.

The volume is one which should be of great value to non-technical readers who wish to obtain information regarding one of the best-organised and most scientific of the great industries of the tropics. The practical sugar-maker will appreciate the exposition of the theory underlying various processes, the clear description of methods, and also doubtless derive assistance from the useful practical hints with which the book abounds.

W. G. F.

THE PSYCHOLOGY OF THE WILL.

Ueber den Willensakt und das Temperament: eine experimentelle Untersuchung. By Prof. Narziss Ach. Pp. xii+324. (Leipzig: Quelle and Meyer, 1910.) Price 6.50 marks.

TO the layman an act of volition is one of those obvious things, such as gravity or growth, which present no difficulty and suggest no problem. Their mechanism is so smooth in its working that the mind never dreams of the presence of a mystery. Add to which the fact that it is impossible to go through the process of willing and at the same time to contemplate and observe the process. Yet at least one difficulty has been noted by the crudest philosophy for ages past—the power of choice, the so-called freedom of the will. This, however, as Prof. Ach observes, is a function not of the will but of reason. He also well insists that the judgment "I can do that which I will," has two distinct meanings, which have often been confused. The one meaning is positive, "I have the capacity to carry out what I will"; "can" being equivalent to *posse, pouvoir, vermögen.* The other is negative, "It is my wish to do what I will." Psychologists are only too well aware that "In no department of the science of mind does there prevail greater confusion and uncertainty than in that of Volition."

In the present volume Prof. Ach continues the records and results of his prolonged investigation into will-psychology; the former instalment being his 1905 treatise, "Uber die Willenstätigkeit und das Denken." An account is given of the experimental method employed, which is largely a combination of those of Ebbinghaus and G. E. Müller. He employed eighteen subjects who were practised on reproduction of syllables, rhymes, and the like components of methods well known in laboratories.

As his main result, the author claims to have shown that the act of will is a specific psychic experience. The positive phenomenal characteristics of a primary volition are (1) the perceptive moment—sensations of tension; (2) the objective moment—ideas of reference and end, purpose, and means; (3) the actual moment—the acoustic—kinesthetic, "I will actually"; (4) conditional moment—consciousness of effort. Of these the chief is (3), and he explains why it has hitherto been so often ignored. None of these moments, of course, is independent; they are sides of one fact. Great spectacular results are not expected from the minute laboriousness of experiments like these; but they are latent, and, as Weber's Law, for instance, has done, will emerge in due time. Yet light is thrown on a score of "little problems." Not the least interesting, and the most detailed, discussion is that on weakness of will. A close study of this chapter in connection with the tabulated results of the investigation which occupy the first half of the volume would be a fruitful piece of book-work for the learner. Prof. Ach rightly censures the use of such examples, as the famous "How we get up in the morning" of Prof. James, for illustrating the mechanism of volition. Trained or habituated will is precisely that form of the process which is least original. Here, by the way, in the relation between habit and will—a relation of practical, no less than theoretical, importance—is a fruitful field for investigation. Another fruitful area is the connection between will and temperament. Prof. Ach ends his volume with a few suggestive pages on this subject.

The material supplied by the author's investigation is probably rich enough to yield further results if re-studied. So far, the author has been led towards a reaction against the prevailing view of will-processes. Without doubt this and similar work is clearing the ground for a new psychology, both of feeling and of will.

A BOOK OF CHARACTERISTIC FOSSILS.

Leitfossilien: ein Hilfsbuch zum Bestimmen von Versteinerungen bei geologischen Arbeiten in der Sammlung und im Felde. Lief. I.: Kambrium und Silur. By Prof. Georg Gürich. Pp. 95. (Berlin: Gebrüder Borntraeger, 1908.)

PROF. GEORG GURICH has prepared a well-illustrated handbook of characteristic fossils which is now in course of publication in eight parts. It is intended for elementary students and amateurs who are occupied with geological work and desire an exact knowledge of those fossils which are of special value in determining the relative ages of rock-formations. It is not a treatise on common fossils, and those who seek in it an account of so familiar a brachiopod as *Atrypa reticularis,* for example, will be disappointed; but it deals with those species and genera which, whether common or not, happen to be restricted in their geological range, and are thus of service as unerring time-markers. The fossils of each successive period are taken in order, beginning with the earliest; and the twenty-eight plates included in the first part of the book are devoted to those of the Cambrian and Silurian formations. The figures are not original, but judiciously selected from standard works, and all are beautifully reproduced by a half-tone process. The accompanying text consists chiefly of brief definitions of the various groups, families, genera, and species, in systematic order under each geological formation. There are also useful synoptical tables, both of the formations themselves in different parts of the world and of the fossil species which are characteristic of each special stage. Occasional text-figures are added to explain structural features and the more important anatomical terms employed. In the first part, the figures illustrating the structure of trilobites and graptolites are especially good.

Dr. Gürich does not recognise an Ordovician system, but classifies the formations from the Tremadoc to the Caradoc inclusive as Lower Silurian. His work is also unusual among stratigraphical handbooks in paying special attention to fossil plants and vertebrates when they can reasonably be claimed as of value. His first reference to vertebrates, however, in the Upper Silurian is unfortunate, for it takes no account of Dr. Traquair's important discoveries, and repeats an old error in supposing that the shagreen named Thelodus belongs to the same fish as the fin-spines named Onchus. In view of present rapid progress and specialisation this oversight is not surprising, and Dr. Gürich is to be congratulated on having made an excellent beginning of a useful and trustworthy student's manual.

METALLOGRAPHY.

Metallographie: Ein ausführliches Lehr- und Handbuch der Konstitution, und der physikalischen, chemischen und technischen Eigenschaften der Metalle und metallischen Legierungen. Erster Band, Die Konstitution, Hefts. i. and ii. By Dr. W. Guertler. (Berlin: Gebrüder Borntraeger, 1909.)

THE number of investigations in metallography published up to 1902 amounted to about one thousand, but to-day reaches three times that number. This fact alone makes the appearance of a complete text-book on the subject most welcome.

The work is appearing in parts, the first two of which consist each of eighty imperial octavo pages, and it is expected that seven or eight more similar instalments will complete the first volume, which is devoted to the constitution of metallic alloys. A second volume, dealing with the physical and chemical properties of the alloys and with their technical applications is to follow.

The subject is to be treated from the technical as well as from the theoretical standpoint, and is to be made intelligible to a beginner without forfeiting its character of a complete text-book and work of reference.

Part i., after a short history of the development of metallography, deals with the "nature" of metallic alloys, the application of the phase-rule to the consideration of the various types of freezing of binary alloys, and also with solid solutions and chemical compounds of two metals. The remaining fourteen pages of the first part and half of part ii. deal with the "Zustandsdiagramme" of all the possible binary alloys of the metals manganese, iron, cobalt, nickel, copper, silver, gold, palladium, and the metals of the platinum-group. The second half of part ii. is devoted to internal kinetics, embracing such subjects as crystal growth and transformation, diffusion in metals, &c.

Whether all the objects aimed at will be achieved by the author cannot be predicted from a perusal of the first two instalments, but it may be safely asserted that a very promising beginning has been made on what can truly be described as a colossal task. The subjects already discussed are treated clearly and in a masterly style, and the arrangement (which is a matter of great importance in metallography) is excellent. The work will constitute the only complete text-book on the subject, and will undoubtedly rank as a classic.

EXERCISES IN PHYSICAL GEOGRAPHY.

(1) *Manual of Physical Geography.* By Dr. F. V. Emerson. Pp. xvii+291. (New York: The Macmillan Company; London. Macmillan and Co., Ltd., 1909.) Price 6*s.* net.

(2) *A Laboratory Manual of Physical Geography.* By Prof. R. S. Tarr and O. D. von Engeln. Pp. xvii+362. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 6*s.*

(1) THE purpose of the first of these books would have been made clearer if it had been entitled "Manual of Exercises in Physical Geography," for the 273 pages of which the body of the book is composed are almost entirely made up of questions and directions to students. The manual is divided into eighteen chapters, the first on the earth as a planet, the next four on climate and others on common minerals and rocks, on the contour map, on weathering streams and stream valleys (a long chapter, in which prominence is given to the cycle of erosion and all that that involves), on land forms (three chapters), on glaciation, lakes, the ocean, shore lines and forms, harbours, and soils, the final chapter being devoted to studies of typical areas.

Now there can be no doubt that teachers of the subject could hardly fail to get many a useful hint from an examination of this volume, but, on the other hand, it is scarcely conceivable that any teacher, at least in this country, would ever try to make use of it as it stands. For this there are several reasons. In the first place, the manual is not self-explanatory. Among the questions of which the bulk of the book is made up, some are childishly simple (though, it may be admitted, not without justification in the author's way of presenting his subject), others assume that the teacher is well versed in his subject, and has either already given the necessary explanations to his students or is prepared to do so when the student is required to answer them. Some of the questions are, unfortunately, confusing and misleading. Moreover, the teacher who is sufficiently well versed in his subject to be able to use the book will be too independent to submit his mind slavishly to the lead of another in presenting the subject to his class. The author says that the exercises have for the most part grown out of his class-room experiences, and it may fit in very well with the rest of the author's teaching of the subject, but it is not likely to fit in with the method of anyone else. Finally, the exercises set in this volume must involve the consumption of a great deal of time, and the doubt cannot but suggest itself whether the result in trained intelligence will be at all proportionate to the amount of time and labour expended.

(2) The work by Prof. Tarr and Mr. von Engeln is similar in design to that of Dr. Emerson, and its distinguishing features may be best given by the following extracts from the preface:—

"The feature which will first attract attention is the leaving of space after each question for the student to write the answer. This serves a double purpose. It ensures the student's following the argument of the outline and the appreciation of every point by personal observation and deduction . . .

"Another feature which we feel sure will meet with general approval is the insertion of all maps, figures, diagrams, and tables at the exact place where they are needed." (These maps, &c., it should be stated, are all likely to be very useful.)

The authors claim, moreover, as the most marked pedagogical departure in their manual, their orderly method of presenting the physiography of the lands. We may note further a feature which is likely to attract attention even before that just mentioned. The loose-leaf construction of the manual makes it a very simple matter for the teacher to change the order or introduce other work. The pages are all perforated to allow of their being detached, and pierced with two large holes to allow of their being refixed in another arrangement, this being done because

"the authors feel that teachers who are progressive, capable, and enthusiastic over the subject should be given the greatest latitude in carrying out their own ideas."

Finally, with reference to the present reviewer's remark at the end of his notice of Dr. Emerson's work, it is only fair to say that the methods of this manual,

"are not to be regarded as experiments. The senior author has had over fifteen years' experience and the junior author four in the laboratory teaching of physical geography."

They tell us, too, that the results in their own classes have been very gratifying, and that the students pursue the work with keen interest. The reviewer, therefore, would have his "doubt" taken as no more than a doubt, and he is sure that such systematic efforts towards the improvement of teaching are entitled to sympathetic consideration. G. G. C.

OUR BOOK SHELF.

The House-fly, Musca domestica, Linnaeus: a Study of its Structure, Development, Bionomics, and Economy. By Dr. C. Gordon Hewitt. Pp. xiv+196+10 plates. (Manchester: University Press, 1910.) Price 20*s.* net.

IN this volume the student will find, in a convenient form, the three valuable papers on the common house-fly which Dr. Hewitt contributed to the *Quarterly Journal of Microscopical Science* in 1907, 1908, and 1909. In the first the author deals with the anatomy of the fly, in the second with the habits, development, and anatomy of the larva, and in the third with the bionomics, allies, and parasites of the insect, and its relations with human disease. The volume opens with a brief introduction, and concludes with three short appendices, comprising some facts ascertained since the issue of the original papers.

The first part is noteworthy for a full and original description of the tracheal system of the fly. In his account of the proboscis, Dr. Hewitt agrees with most recent students of the jaws of Diptera in regarding the palps as maxillary and the sucking organ as labial; in this, as in some other interpretations, he differs from the opinions expressed in Lowne's well-known work on the blow-fly. In the second part, especial attention has been paid to the muscular system of the larva, which is described and figured in detail. The rate of development is very rapid, and there are only three larval instars. While horse-dung is the most usual food of the house-fly maggot, the female fly may lay her eggs in a wide variety of unclean and decaying animal and vegetable substances, in any of which the larvæ can be successfully reared. Hence it follows that house-flies must frequently carry disease germs which they have abundant opportunity of introducing into human food, and the name "typhoid fly," which some American entomologists are trying to affix to *Musca domestica*, might be justified from certain unpleasant but instructive records which Dr. Hewitt quotes of the proximity of typhoid-infected privies to dairies.

The hygienic bearing of the insect's relations with mankind is seriously and temperately discussed by the author, who pleads for such protection or destruction of substances in which the eggs are laid as may effectually reduce the numbers of the species, and for the covering of food substances, like milk and sugar, on which the flies habitually alight. The book affords an excellent illustration of the amount of original and useful work that may be done on the commonest and best known of animals. G. H. C.

The Science of Happiness. By Dr. H. S. Williams. Pp. vi+350. (London and New York: Harper and Brothers, n.d.) Price 7*s.* 6*d.* net.

THIS might well be given the still wider title of "The Art of Living," for it concerns itself with human activity of all kinds. It is a pleasantly written series of papers on such topics as how to eat, how to sleep, how to think, and even how to die, and, though a trifle diffuse and flat—revealing the fluent writer with not much that is original to say—it contains much wisdom of an everyday kind, and many apt quotations to spice up the text.

Dr. Williams is not a food faddist, and almost his only criticism on this head is that most of us eat too much. But he would not cut down the number of meals to anything below three per day, for he believes that, on the whole, experience endorses that number. He condemns alcohol, tobacco, and—less vehemently—tea and coffee. Exercise ought to be gentle and regular, and we may sleep eight hours per night if we want to, but must not doze off for another forty winks after a good night's rest. An interesting point is that Dr. Williams believes the stunted growth of the Latin races to be the result of the habit of wine-drinking.

As to the mind, the author counsels the strenuous life, as befits a good American, and stimulative examples are quoted. Mezzofanti learned fifty-seven languages. Pliny (the elder) never left off studying except when asleep or in his bath, and after the latter he had a book read to him while he was being rubbed dry. As to opinions, religious or political, think them out for yourself. Ask yourself why you believe this or that. Do not be content to inherit opinion as you inherit the colour of hair or eyes. Work your way to rational conviction.

It is all very chatty, pleasant and sensible; and we do not mean any cheap satire when we say that the book is beautifully bound and produced.

Rinaldo's Polygeneric Theory: a Treatise on the Beginning and End of Life. By Joel Rinaldo. Pp. 123. (New York: 206 West 41st Street.)

To Mr. Rinaldo, "evolution" is like the red rag to the proverbial bull; and, like most violently biased people, he has not given sufficient study to the object of his attack. For example, in arguing for the special creation of man, he says it is "ridiculous" to explain by migration the similarities found in widely separated countries. But evidently he does not realise the length of duration in past time of a being justifiably called man, for, even if we assume that duration to go back no further than the Miocene period, there is ample scope for almost unlimited migration (*e.g.* there was land at this period probably across the North Atlantic); and, indeed, human migration is not essential to the theory; migration of lower animal forms, in still more remote periods, would do nearly as well. Mr. Rinaldo seems to think that evolution implies an Adam and Eve from whom all mankind are descended. As a matter of fact, the theory of biological evolution would not be invalidated if it were proved that man appeared on various parts of the earth's surface at the same time, for these primitive human beings would be descended from other and less complex forms of life—animals of anthropoid but not yet human structure.

Mr. Rinaldo, though an amateur, is well read in some directions, but he has not studied Darwin and Huxley thoroughly, not to mention more recent biologists, and his judgment is warped, like Carlyle's, by mistaken notions of the "monkey damnification of man." The wish being father to the thought, he asserts that "Darwinism is already dead." If he will read a book reviewed in NATURE, July 14, he will see that one of our greatest authorities—Sir E. Ray Lankester—thinks it is still very much alive. But we hardly expect that he will be converted.

Letters from High Latitudes, being Some Account of a Voyage in 1856 *in the Schooner-Yacht "Foam" to Iceland, Jan Mayen, and Spitzbergen.* By Lord Dufferin. With an introduction by Dr. R. W. Macan. Pp. xxxvi+261. (London: Henry Frowde, Oxford University Press, 1910.) Price 1*s.* net.

THESE entertaining letters were first published in 1856, and are so well known that any words of praise are unnecessary. The master of University College, Oxford, in his introduction, says:—"The letters are, or ought to be, a *World's Classic*; Mr. Frowde's happy enterprise has made that concept a reality." It may be noted that the volume is the hundred and fifty-eighth to be added to the series of "The World's Classics."

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.*]

Wiltshireite: a New Mineral.

THE dolomite quarry near Binn (Valais) affords such a large variety of grey sulpharsenites, mainly of lead and copper, that a new one is received with much hesitation; but a crystal recently obtained at Binn gives results which leave little doubt as to its independent character. The specimen consists of a number of very small crystals aggregated together in parallel orientations, and a single well-defined image is obtained from several minute end-facets.

The crystal belongs to the oblique system. The zone of pinakoids consists of smooth faces, 201, 302, 101, 001, and $\bar{1}01$, which give good images. Two other important zones are placed symmetrically on opposite sides of the symmetry-plane; they show the forms 522, 211, 111, 122, 011, $\bar{1}11$, and others. The faces, placed vertically, are striated parallel to their zone-axis, and give very imperfect images, save when they are obtained across the zone; the forms are 100, 310, 320, 010, and some others. The elements adopted are:—$100:001=79^\circ\ 16'$; $100:101=48^\circ\ 47\frac{1}{2}'$; and $011:001=46^\circ\ 25\frac{3}{4}'$.

I propose for it the name wiltshireite, after the late Prof. Wiltshire, who was a most generous benefactor to the Cambridge museums of mineralogy and of geology.

Cambridge, August 13. W. J. LEWIS.

The Nomenclature of Radioactivity.

A FEW years ago I wrote to NATURE (vol. lxxvi., p. 638) protesting against the proposal of Prof. Boltwood to call the member of the uranium-radium series, which he had just discovered, by the fanciful name of "ionium" instead of by a name based upon the system of nomenclature started by Sir William Crookes and extended by Prof. Rutherford. Prof. Rutherford replied (p. 661) that the time had not yet come for the establishment of a definite system of nomenclature, but that he hoped that some day "physicists and chemists would meet together to revise the whole system." After such a decision from the first authority on the subject I could do nothing but collapse; but there are three reasons why the present moment seems to me suitable for a renewal of vitality.

First, Prof. Rutherford said that he thought it undesirable (I did not agree with him) to fix a method of naming until nearly all the products to be named appeared to have been discovered. I believe it is about two years since the last new member was added to any of the series previously known. Second, there is at hand an admirable opportunity for the meeting together of physicists and chemists which he suggests—the congress at Brussels next month. Third, it appears to me that reform has been made urgent by a particularly disastrous attempt at unsystematic nomenclature. In a recent number of the *Comptes rendus* Sir William Ramsay, after determining more certainly the molecular weight of radium emanation by a beautiful experiment, and finding the result to confirm his suspicion that this substance belongs to the group of inactive gases, proposes that it should henceforward be called "niton." (By a curious oversight, he suggests that the symbol should be "Ni," which is, of course, already appropriated.)

The purpose of a systematic nomenclature is to express relations between the objects named. So long as elements were regarded as wholly independent objects, the practice of naming them, as if they were dogs, on purely sentimental grounds was more or less justifiable, for there were no relations between them to express. As soon as the first general relation between the elements, the periodic "law," was discovered, a systematic nomenclature was desirable, and some feeble steps towards it were taken. With the discovery of the radio-active elements, the whole importance of which lies in their relations to each other, a complete system becomes a necessity.

Let me take an analogy. If Sir William Ramsay takes a house in the country, where buildings are scattered at random, nobody will care what he calls it. But if he takes a house in the street of a city and proposes to replace the number on the door by "Bellevue," or "Glencoe," or "Chatsworth," or any other of the names dear to lodging-house proprietors, he will meet with scant sympathy from the postal and municipal authorities. His case will not be much better if, like Prof. Boltwood, he builds a house where there was none before, instead of merely improving one that existed already.

The only defence Sir William Ramsay can offer for his proposal is that it is in accordance with chemical, if not with radio-active, nomenclature. If this were true, the question would arise whether the chemical or the radio-active properties of the element were more important; I cannot conceive that anyone would doubt the superior interest of the latter. But it is not true. The name which he proposes, interpreted according to chemical usage, suggests (1) that the substance is non-metallic, and (2) that it is not an inactive gas. It suggests (1) because it ends in -on; it suggests (2) because the root is Latin. The only names of elements ending in -on which are not those of inactive gases—carbon, boron, silicon—all have Latin roots; all the names of inactive gases have Greek roots. By the choice of a Latin name, radium emanation is placed in the former and not in the latter group. Surely, also, when in the names of the argon group we have a rare instance of terms, invented recently, which are linguistically correct, it is a crime to spoil the group by the intrusion of one of those philological barbarities the toleration of which does so little credit to the general intelligence of men of science. I do not know whether Sir William Ramsay has been troubled by the fact that the most familiar Greek word for "bright," ἀργός, is clearly inadmissible, but I am sure that any classical scholar could provide a suitable synonym.

I am not going to propose a system of radio-active nomenclature, for, if I succeeded in attracting any attention, people would then confine themselves to abusing my system, and not to considering whether any system is desirable. But I should like to point out the faults of the present method, and direct attention to two possibilities for a new method.

The faults of the old system are (1) that it does not permit of interpolation; (2) that it separates systems which are now known to be connected, such as uranium and radium; (3) that it lays far too much stress on the accidental fact that some of the elements are gases at ordinary temperatures; and (4) that it is anomalous in making X precede A.

The first possibility for a new system is to order the elements by numbers, and not by letters. Such a system admits of indefinite interpolation; between 1 and 2 there can be interpolated, first, the 9 terms 1·1–1·9, then the 90 terms 1·01–1·99, and so on. The second possibility lies in the fact that the rays emitted by the elements are distinguished by single letters, so that the radiation from an element might be expressed by the terminations -o (for no rays), -a (for α rays), -ob (for β and γ rays only), -ab for all kinds of rays. Of course, the form "radiob" would have to be avoided on account of prior rights (NATURE, vol. lxxii., p. 79), and modification would be needed if the additional termination -g were rendered necessary by a discovery that β and γ rays could occur separately.

A scientific system of names need not displace completely such well-known terms as "radium" any more than the appropriate name, according to the excellent system of organic chemistry, has displaced that of (say) "indigo." But I maintain strongly that every radio-active element ought to have a name discoverable from its properties, and a name from which, conversely, its properties may be discovered. Such a plan would not help greatly those who are so accustomed to radio-active work that the association of a fanciful name with definite properties is intuitive, but it would be an inestimable boon to those who now, when they hear of "mesothorium," have to trust an imperfect memory or else search laboriously through original memoirs.

Leeds, August 2. NORMAN R. CAMPBELL.

Perseid Meteoric Shower, 1910.

THE only night really good for witnessing the Perseid shower near its maximum this year was August 10, when the clear state of the sky afforded every facility for securing observations.

I began watching at 9h. p.m., and up to 11h. 45m. p.m. there were fifty-two meteors, so that the horary rate was nearly twenty, of which about three-fourths were Perseids. The finest specimen appeared at 10h. 6m.; it had a long and slowish flight from $328^\circ+37^\circ$ to $301^\circ+8^\circ$, and left a bright streak just above the small stars of Delphinus for fifteen seconds. The meteor itself was much more luminous than Venus, and was also observed by Mr. *T.* K. Jenkins at Nantyglo. From a comparison of the recorded paths, I find the height 75 to 48 miles over Wiltshire, and the end point near Blandford, Dorset.

The velocity was decidedly slower than that of the ordinary Perseid, its observed speed being 27 miles per second.

I saw brilliant Perseids also at 11.34 and 11.46, the former shortening towards α Andromedæ and the latter just under Polaris, and at 11.34½ there was a beautiful slow-moving Draconid falling from $303\frac{1}{2}^\circ+33^\circ$ to $311^\circ+19\frac{1}{2}^\circ$. Its pear-shaped nucleus threw off a tail of yellow sparks as it sailed down the sky.

I think the display of August 10 was better than it was last year, and gave promise of a pretty abundant shower on August 11 and 12, but I cannot speak as to its actual character, the firmament being cloudy on those dates at Bristol.

There were a few breaks in the clouds on August 12, and I happened to notice a fine meteor at 11h. 49m. shooting upwards from $355^\circ+40^\circ$ to $338\frac{1}{2}^\circ+50^\circ$. It was as bright as Jupiter at least, and left a train, but it quickly disappeared. The meteor was not a Perseid, but apparently belonged to a shower with radiant lying eastwards of α Andromedæ, or at $9^\circ+27^\circ$. The meteor was also seen by Mr. G. Powell at Aberdare, and I find its height 89 to 53 miles. It was nearly over Bath at end point. Velocity 40 miles per second, and certainly more rapid than the Perseid alluded to above, though it should have been the swifter of the pair.

Several observers have written me describing the Perseid shower as fairly rich on August 10, though the maximum was not due until the morning of, or night following, August 12. Some large meteors were also recorded on August 5, which was a very clear night, and the Perseid display was in pretty strong evidence even at that early date.

W. F. DENNING.

Brilliant Meteor of July 31.

AN exceedingly beautiful meteor, one of the finest I have seen, was observed from this vessel, while at sea, on the night of July 31. The time of observation was 10h. 0m. ship's apparent time, or 13h. 0m. G.M.T., the position of the ship at the time of observation being latitude 43·34° N., longitude 43·37 W. The duration of the flight was between fifteen and twenty seconds, and the meteor was much more brilliant than Venus. It pursued an almost horizontal course, about 8° above the horizon, passing below the constellations Ursa Major, Perseus, and Aries, in all traversing an arc of about 135°.

At first the meteor appeared as a brilliant steel-blue ball, with a short tail of the same colour. It disappeared at a point about 90° from its first position, reappearing almost immediately, and exploding and dividing into three or four parts, with a luminous tail some 3° in length, and of a vivid red and blue colour. Its motion was slow, and it conveyed to all who witnessed it, officers and passengers alike, the impression of being at no great distance from the ship when it exploded.

The night was very fine; and the chief officer, who was on the bridge at the time, reports that when it disappeared it left a small black cloud in the sky. At the time of seeing this meteor we were in wireless communication with the U.S.N. *Texas*, and it is hoped that other observations may be forthcoming from other vessels at sea. A. L. CORTIE.

On Board S.S. *Cymric*, August 3.

ON COLOUR VISION AT THE ENDS OF THE SPECTRUM.

IT is half a century since Maxwell[1] investigated the chromatic relations of the spectral colours and exhibited the results on Newton's diagram. The curve "forms two sides of a triangle with doubtful fragments of the third side. Now, if three colours in Newton's diagram lie in a straight line, the middle one is a compound of the two others. Hence all the colours of the spectrum may be compounded of those which lie at the angles of this triangle. These correspond to the following—scarlet, wave-length (in Fraunhofer's measure), 2328; green, wave-length, 1914; blue, wave-length, 1717. All the other colours of the spectrum may be produced by combinations of these; and since all natural colours are compounded of the colours of the spectrum, they may be compounded of these three primary colours. I [Maxwell] have strong reason to believe that these are the three primary colours corresponding to three modes of sensation in the organ of vision, on which the whole system of colour, as seen by the normal eye, depends."

Later observations, such as those of König and Dieterici,[2] have in the main confirmed Maxwell's conclusions. The green corner is indeed more rounded off than he supposed. It is with regard to the "doubtful fragments of the third side" that I have something to say. According to Maxwell's results with both of his observers the extreme red deviates from the less extreme by a tendency towards blue. Neither my friends[3] nor I can perceive anything of this. When the extreme and the less extreme red are seen in juxtaposition in the colour-box, no difference whatever can be perceived after the brightnesses are adjustèd to equality. I have not any precise measurements of wave-length, but the extreme red passed a cobalt glass while the less extreme was stopped. Observations at the ends of the spectrum are more difficult than elsewhere. Owing to deficiency of illumination at these parts there is more danger of false light finding access. To get satisfactory results I found it desirable to supplement the action of the prisms by placing red glass over the slits. It is probable that Maxwell was misled by some defect of this sort, since the differences he found would appear to lie outside the errors of observation. The German observers, it should be added, also found the colour constant at the red end.

At the other extreme the tendency of the violet towards red is, to my vision, not in the least doubtful. Some remarks made a few years ago by Dr. Burch, who speaks of violet in terms which I could not possibly use, were the occasion of a more particular examination. Although, so far as I remembered, I had never made the trial, I was confident that I should be able to match violet approximately with blue *plus* red, and full blue with violet *plus* green. And it seemed further that this must be the general estimation, as there is no widely spread protest against describing the upper extreme of the spectrum as "violet"—a name which would be quite inappropriate in the absence of an approach towards red.

[1] Phil. Trans., 1860.
[2] Helmholtz, "Phys. Optik," 2nd edition, p 340.
[3] Mr. Gerald Balfour included.

The light which the flower of that name sends to the eye undoubtedly includes red rays.

The apparatus employed is on the model of the first described in an early paper,[1] the only difference worth mentioning being that the side upon which the movable slits are disposed is made oblique, to meet the variation in focal length along the spectrum. By this means any desired mixture of spectrum colours can be exhibited in juxtaposition with any other. For example, the violet can be shown alongside the blue, and any addition can be made to either. A few trials in 1907 confirmed my anticipations, an approximate match being easily attained by addition of *red* to the blue or of *green* to the violet. The slits by which the light entered were protected with suitable coloured glasses, cobalt glass being used for the blue and violet slits. In this way, as already mentioned, the danger of false light is obviated. I do not affirm that the mixture of blue and red looked *exactly* the same as the violet. I thought that I could recognise the violet as being more saturated, but the difference, if real, was very small and certainly a mere fraction of the original difference between blue and violet. Needless to say, the blue chosen was a full blue, showing no approximation to green.

The point of greatest interest lies in the contrast between my observations and those of Mr. Gerald Balfour, who was with me at the time. Mr. G. Balfour is one of the three brothers whom I found in 1881 (*loc. cit.*) to make anomalous matches of mixtures of red and green with spectrum yellow. To effect the match they use much smaller amounts of red than is required by normal eyes. But their colour vision is as acute as usual, and the abnormality is quite distinct from what is called colour-blindness. To Mr. Balfour's vision the violet of the spectrum is *not* redder than the blue, and such addition of red to blue as I required to make the match gave, in his estimation, a "reddish purple." Curiously enough, Mr. Enock, who was my assistant at that time, bore similar testimony, no addition of red on either side improving the match, which was indeed nearly complete as it stood. It is probably not a coincidence that Mr. Enock is also abnormal in his red *plus* green=yellow match, coming perhaps about half-way between myself and the Balfours.

When a few months ago I commenced to write out an account of these observations, it occurred to me that it would sound strange if I described my own judgments as normal and those of two other male observers as abnormal, and I sought to confirm my own judgment by that of others, especially of women. As to this, there was no difficulty. I usually showed first the simple blue and violet with about equal illumination[2] and asked the observer to describe them. In nearly every case the names blue and violet were correctly given. Can you describe one as redder than the other? was the next question. In most cases the answer came, "the violet is the redder"; but in some others all I could get at this stage was a negative. When, however, the same addition of red light that I require was made to the blue, every female observer that I have tried agreed that now the difference had practically disappeared. I can say with confidence that in this matter my own vision is normal.

Lately I have had another opportunity of repeating the observation with Mr. G. Balfour. It is certain that he sees no colour difference at all between the blue and violet. When to the blue an addition of red (less than I require for a match) is made, he describes the mixture as a reddish-purple, strongly distinguished from the violet. Mr. A. J. Balfour also could see no difference between the blue and violet, but he seemed rather less sensitive to additions of red. A determination of wave-lengths gave for the (mean) violet 415 (above G), and for the blue 440. The red was rather extreme.

That ordinary normal vision is very approximately trichromic cannot be doubted; but a question may be raised as to the possible existence of a very subordinate fourth element of colour. Thus Dr. Burch's descriptions might suggest that in his vision the sensation of violet depended upon such a fourth element. I am speaking here of fundamental sensations, not of such judgments as make yellow appear a distinct sensation to normal eyes, although certainly resolvable into red and green. The only way to get a final answer to such questions is by making matches with superposed colours; but to this method some workers seem singularly averse. In my own case I am certain that there is no fourth element of colour practically operative.

The character of the three primary sensations in normal vision is another and a much more difficult question. Perhaps in recent years we have rather lost sight of the argument which weighed with Maxwell in the passage above quoted. The better to see its significance, let us suppose that the spectrum is *accurately* represented on Newton's diagram by two sides of a triangle, and inquire into the significance of this disposition. The only explanation which does not involve highly improbable coincidences seems to be that in each spectrum colour only two of the three elements are involved. If the third is involved at all, how comes it to be involved in such a way as to make the spectrum straight? And the fact that near the red end variation of wave-length entails no variation of colour, makes in the same direction. That the green corner is rounded off and that (if it be so) the sides are not quite straight, may diminish, but cannot destroy, the cogency of the argument, while the less precise character of the conclusion is not without advantages. RAYLEIGH.

[1] NATURE, vol. xxv., p. 64, 1881: Sci. Papers, i., p. 544.

[2] This adjustment can be made by partially cutting off the light on the side required by means of strips of glass interposed. By varying the number (up to 5 or 6) or inclination, the proportion of light transmitted can be regulated. This procedure was found more convenient than altering the widths of the slits.

MORE ANTARCTIC NATURAL HISTORY.[1]

(1) THE fifth, probably the penultimate, volume of the natural history results of the voyage of the s.s. *Discovery* has followed its predecessors without loss of time, and it resembles them in quality and interest, reflecting great credit on all concerned. The first memoir, by Dr. H. W. Marett Tims, deals with the embryos of Weddell's seal. The author finds in the musculature some additional support for Mivart's suggestion of a lutrine origin for the Phocidæ, and he has discovered in a very early embryo what seems to be the vanishing point of a vestigial external ear. Prof. Herdman deals like an old hand with the small but interesting collection of tunicates, comprising twenty-two species, of which ten are new to science. None of them are very remarkable forms in any way, but they confirm the impression which other collections

[1] (1) National Antarctic Expedition, 1901–4. Natural History. vol. v. Zoology and Botany. (London: British Museum [N.H.], 1910.) Price 30s.

(2) British Antarctic Expedition, 1907–9, under the command of Sir E. H. Shackleton, C.V.O. Reports on the Scientific Investigations. Vol. i., Biology, parts i.–iv. Pp. 1–79, 13 pls., 3 figs. (London: Published for the Expedition by W. Heinemann, 1910.) Price 12s. 6d. net.

(3) Expédition Antarctique Belge. Résultats du Voyage du *S.Y. Belgica* en 1897–8–9. Sous le Commandement de A. de Gerlache de Gomery. Rapports scientifiques. Botanique—Diatomées. By H. Van Heurck. Pp. 128+13 plates (1909). Geologie—Petrographische Untersuchung der Gesteinsproben, 1 Theil. By A. Pelikan. Quelques Plantes Fossiles des Terres Magellaniques. By Professor A. Gilkinet. Pp. 50+2 pls. +6 (1909). Oceanographie—Les Glaces—Glace de Mer et Banquises. By H. Arctowski. Pp. 55+7 pls. (1908). Zoologie—Schizopoda and Cumaceа. By H. J. Hansen. Pp. 20+3 pls. (1908). (Anvers: J. E. Buschmann.)

have suggested, that "the ascidian fauna of the far south is characterised by the abundance and the large size of the individuals of a comparatively few species." In the present collection we have a number of gigantic forms, such as *Styela spectabilis*, of 18 cm.

Mr. T. V. Hodgson, who did so much hard work in collecting from under the ice-sheet, reports on the isopods, and has some very interesting discoveries to relate. Thus seven species, out of the total of twenty-five, have their eyes on enormous peduncles, which rather takes the edge off the "sessile-eyed" character of isopods! Striking also is the sexual dimorphism of one of the Arcturidæ, *Antarcturus franklini*, the male and female of which appear on one of the plates (remarkably fine pieces of work) as two species, and not very like one another either. "It was only when all the specimens of both sexes, or as it was then thought to be, both species, came to be overhauled that the error was noticed." Prof. L. Joubin has made the best of a bad business in his report on the nemerteans, for by misadventure he had only the remains of a collection to work with, which indeed only a courageous enthusiast would have touched.

Mr. Edward T. Browne has a finely executed and beautifully illustrated memoir on the Hydromedusæ and Scyphomedusæ of the *Discovery* and *Southern Cross* expeditions, seventeen species in almost as many genera. All are either new species or have been recently described as new species from the Antarctic. Some of the general results are noteworthy: there is no proof that a single species is common to Arctic and Antarctic; there is definite evidence of relatively primitive features in some Antarctic Medusæ, corroborating the view that evolution lags in the cold; it is doubtful if there are any "deep sea" Medusæ in the usual sense of that term. Among the anatomical results of interest is the discovery that the interior of the stomach in the hydromedusan genus Koellikeria is covered with minute endodermal papillæ, but whether these have the same function as the gastric filaments of the Scyphomedusæ remains to be found out. Very curious, too, is the new species of Sibogita, with its stomach completely converted into a reproductive organ when the gonads are ripe. "The stomach then ceases to function as stomach, and its cavity is filled with endoderm. The gonads are apparently in ectodermal pouches, which are embedded in the endoderm, and the pouches have openings to the exterior for the discharge of their contents." But we must pass from these exciting things to notice that the volume ends with a report by Mr. O. V. Darbishire on a collection of twenty-five species of lichens, of which five are new. As he says, they are "the outposts of plant life," occurring where no other plants at all are met with; *e.g.*, at a height of 5000 feet on the ridge of the Western Mountains. It is interesting also to notice that of four species collected on Mount Erebus at a height of 1500 feet, three are also Arctic.

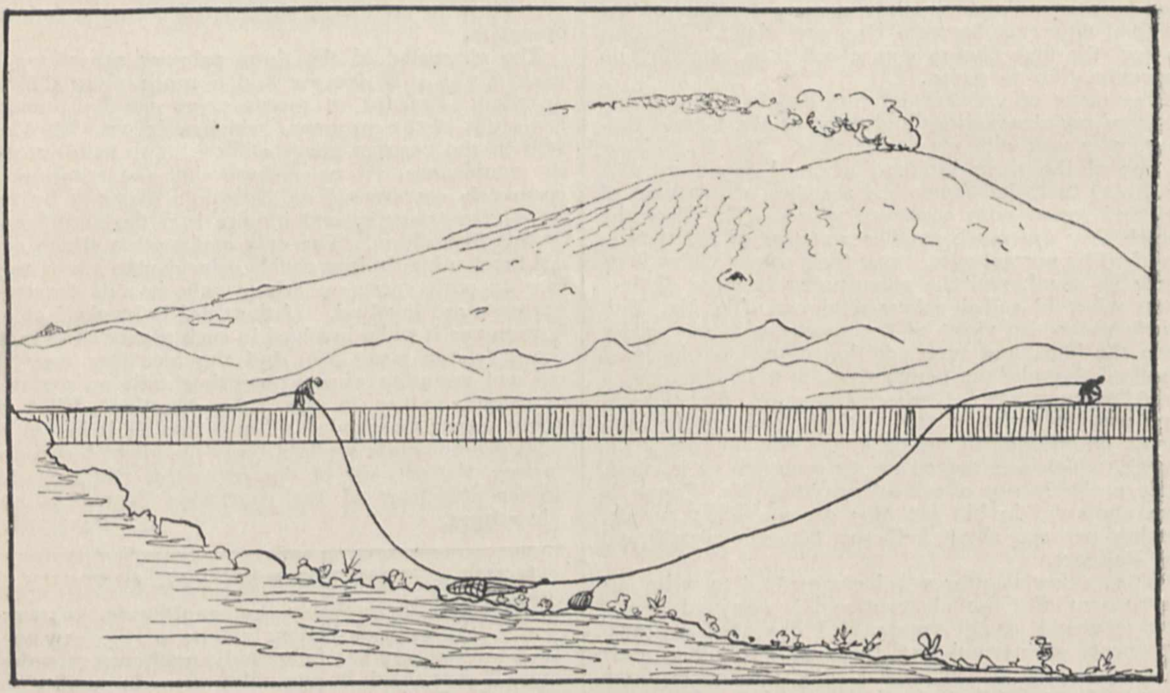


Diagram illustrating method of dredging. The ice (which is supposed to be five or six feet in thickness) and the bed of the sea are shown in section. One man is shown hauling the dredge and another is paying out the spare line to lessen the strain which tends to lift the dredge off the ground. A few feet in front of the dredge a weight is seen, which serves to keep the dredge down, and at the same time, by the length of its attaching cord, maintains it in the right position. From Vol. i., Biology, of the Reports of the British Antarctic Expedition, 1907–9.

(2) We turn from what is almost the last of one series to the first of another—the reports on the scientific investigations of the British Antarctic Expedition, 1907–9, under Sir E. H. Shackleton. The editor, Mr. James Murray, has lost no time in bringing out a part of the "Biology," and what he has to tell is of much interest. The collecting at Cape Royds (about lat. 77° 32′ S., long. 166° 12′ E.) was done under great difficulties. There was no vestige of life on the beach itself, where an ice-foot persists most of the year. The black lava inshore yielded only a few tufts of moss and some lichens. The small lakes had a sheet of vegetation at the bottom, but it was hard work reaching this through over fifteen feet of ice. Some laborious collecting was done in the sea by hauling a dredge between two holes cut in the ice. Traps were also baited, which brought up amphipods, molluscs, and the like.

The mean temperature of a summer day at Cape

Royds rarely rises above freezing-point, and there is no vegetation higher than mosses. It is therefore surprising to hear of an abundant microscopic fauna and flora. Mr. Murray's experience stood him in good stead, for he made much of a very unpromising centre of operations. "The kinds of animals which are usually to be found among mosses have at Cape Royds a shelter of another sort, which, judging from their numbers, appears to suit them better. This is furnished by the foliaceous vegetation which grows so abundantly in the lakes and ponds." Thus Mr. Murray reports:—"I have never anywhere seen bdelloid rotifers so plentiful as are the two dominant species at Cape Royds (*Philodina gregaria* and *Adineta grandis*). . . . The water-bears are of only a few kinds, but one of them (*Macrobiotus arcticus*) is extremely abundant. There are nematode worms of two or more kinds, mites of several kinds, and two crustacea belonging to the Entomostraca. The ciliate infusoria are very numerous, there are a good many flagellata, but only two rhizopods were observed." Numerous microphotographs were taken under disadvantageous conditions, and some of these are printed—showing not only rotifers, water-bears, and the like, but some other creatures which the editor has wisely refrained from naming.

Some sixteen species of rotifers were distinguished, representing all the orders, though mostly bdelloids. This is the first definite record of rotifers within the Antarctic Circle, and five of the bdelloids are new species. The most interesting facts are those regarding the toughness of the rotifer constitution. Thus *Philodina gregaria* n. sp. is normally frozen in the ice of the lakes for the greater part of the year, and revives at any time that the ice is thawed. It may be alternately thawed and re-frozen at weekly intervals for several months. In England it was subjected to a temperature of −78° C. for many hours, by Mr. J. H. Priestley, of Bristol, and survived. Of *Adineta grandis* n. sp., which survived the lowest temperatures experienced at Cape Royds (−40° F.), and repeated freezing and thawing, and immersion for a month in sea-water, it is further recorded that "a proportion of them lived after the bottle containing them (in the dry condition) was immersed in boiling water for a short time. It was one of the rotifers which was to be seen alive and active in London in September, 1909, after being dry for about a year, and spending some months in tropical and sub-tropical climates." This toughness of constitution is interesting in several ways; *e.g.*, in showing that these Antarctic rotifers can stand very adverse circumstances in the course of dispersal. Another point of interest concerning the rotifers is that the two dominant species, named above, are viviparous, which seems therefore the mode of reproduction best adapted to secure success in the struggle of existence under the severe conditions at Cape Royds. M. Jules Cardot reports on four mosses; the rest of the report is due to Mr. Murray, to whom we offer congratulations.

(3) From a third Antarctic expedition, the *Belgica* (1897–9), some additional reports have been recently received. Thus Dr. H. J. Hansen, who has done such good work among the crustacea, describes some new schizopods and cumacea. He indicates, as other authorities on crustaceans have done, that the familiar title schizopods will have to go, and that the orders of Euphausiacea and Mysidacea, which it includes, are far from closely related to each other. In regard to *Euphausia superba* he notes that it is the staple food supply of seals, such as *Lobodon carcinophaga*, and that it seems to live everywhere in the Antarctic Ocean. A. Pelikan gives a petrographical account of diorites, gabbros, porphyrites, and other types of rock collected by the expedition. Prof. A. Gilkinet reports on a few fossil plants from Magellan; Fagus, Nothofagus, Myrtiphyllum, Saxegothopsis, which seem to be of relatively recent age, and bear a close resemblance to members of the present-day flora of that region. H. van Heurck reports on the diatoms and adds to the value of his work by a survey of polar diatoms in general. Henryk Arctowski gives a beautifully illustrated account of his personal observations on the different kinds of ice and their transformations. These observations are all the more interesting since very little was known of southern ice before the voyage of the *Belgica*. As the author indicates, a good deal has been done since.

ATOMIC WEIGHTS.[1]

DR. CLARKE continues to put all chemists under an obligation to him by reason of the zeal and care with which he collects and disseminates information concerning the most important of all chemical constants—the atomic weights of the elements. In the volume before us—the third edition of a work with which his name is inseparably associated—he has brought to a focus all contemporary knowledge on the subject, discussing, digesting, and weighing the experimental evidence with the same lucidity, completeness, and impartiality which have characterised his previous publications.

It is interesting and instructive to compare the present issue with the original one of 1882. The number of the chemical elements has not greatly increased during the last thirty years. Even including the inert gases of the atmosphere and such of the radio-active elements of which the individuality may be said to be established, the increase is not more than about a dozen, and such values of their atomic weights as we possess are only of the order of first approximations. The most significant feature of the difference between the two issues is seen rather in the far higher standard of accuracy which is now required in such estimations. It is absolutely useless nowadays for anybody to engage in such determinations who is not prepared to impose upon himself the most rigorous checks, the most scrupulous attention to detail, and an inflexible determination to put forward no result that will not stand the severest scrutiny.

Atomic weights to-day are required for other purposes than chemical arithmetic, and comparatively rough approximations serve for the greater number of the operations of quantitative analysis. The errors due to manipulation, and to the use of methods faulty in principle, are, as a rule, far larger than those due to the employment of incorrect values for the atomic weights. Instances, indeed, might be quoted where it is apparently necessary to adopt a confessedly inaccurate value for an atomic weight in order to compensate for the error due to an imperfect method of quantitative estimation. Certain large trade operations could not be equitably arranged on any other basis. This, of course, does not concern the chemist as a man of science, and is certainly no argument for the retention of an inaccurate constant in our tables

[1] (1) The Constants of Nature. Part v., A Recalculation of the Atomic Weights. Third Edition. Revised and Enlarged. By Frank Wigglesworth Clarke. Pp. iv+548. (Washington: Smithsonian Institution, 1910.)

(2) Determinations of Atomic Weights. Further Investigation concerning the Atomic Weights of Silver, Lithium and Chlorine. By Theodore W. Richards and Hobart Hurd Willard.

The Harvard Determinations of Atomic Weights between 1870 and 1910. By Theodore W. Richards.

Methods used in Precise Chemical Investigation. By Theodore W. Richards. Pp. iv+113. (Washington: Carnegie Institution, 1910.)

of atomic weights. These require to be known with all the precision of which quantitative chemistry is capable.

It is only by such knowledge that we may hope to find solutions to some of the most interesting and important problems with which contemporary chemistry is confronted. There is, to begin with, the fundamental question of the validity of the law of the conservation of mass. Is there a dissipation of matter, as of energy, in a cycle of chemical changes? Is an atomic weight a fixed and unalterable quantity? Or is it, as first suggested by Marignac, a statistical quantity varying within limits, doubtless very small, but still possibly appreciable?

There is further the perennial question of Prout's law, which, like the poor, seems to be always with us. Modern views of the genetic relations of the elements and of the dependence of their properties upon their relative masses are intimately connected with the exact values and numerical relations of atomic weights. It is these and similar questions lying at the very basis of chemical philosophy that render it imperatively necessary that these constants should be known with the greatest possible precision. The greatest possible precision is, of course, relative; it depends upon the degree of perfection of contemporary quantitative chemistry, and as this is progressive, each decade seeing improvements, both in the application of old methods and in the discovery of new, it necessarily follows that there is no such thing as finality in measurements of this kind. A large number of atomic weights are now known with accuracy to the first decimal place; even in the case of those of high values a considerable proportion indeed are known even to the second decimal, and a few, especially those elements which are habitually employed as a basis of comparison in atomic-weight work, as, for examples, silver and the halogens, are being ascertained with a still greater exactitude. It is only when atomic weights in general are known to a like degree of precision that we can hope for definite answers to such questions as have been indicated above.

It is largely due to the attention which this subject has received in America that our present position has been reached, and it is especially to the Harvard School of Chemistry that we are indebted for the high standard of accuracy which is now incumbent on every worker in this field of determinative chemistry. No laboratory in the world can point to such a remarkable sequence of memoirs as those which are embodied in the short synoptical statement in which Prof. Richards has dealt with the Harvard determinations of atomic weights between 1870 and the present year. Initiated by the late Prof. Josiah Parsons Cooke, whose determination of the atomic weight of antimony is still regarded as the best ascertained value for that element, the work has been continued by his assistant and successor, Prof. Theodore Richards, partly alone, but mainly in collaboration with pupils whom he has trained and imbued with his own high sense of exactitude. What the outcome of this work, extending over many years, has been is abundantly illustrated by the significant table on p. 90 of Prof. Richards's memoir. Of the eighty-three elements at present known, and of which the atomic weights are given in the annual tables prepared by the International Committee on Atomic Weights, no fewer than twenty-eight of those estimations which are regarded by the committee as among the best ascertained values are to be credited to the Harvard laboratory.

It is remarkable that this work should have been done in America. It is commonly held that no nation is more keenly appreciative of the utilitarian value of science than America; but there is no money to be made out of the results of an atomic-weight determination. It is quite impossible to evolve a new colouring matter out of it, or to turn it into a synthetic drug. Not even the "smartest" and most enterprising of German chemists could bring it within the protective influence of the mystic letters D.R.P. On the contrary, atomic-weight work requires money, and that frequently in no small amount; platinum vessels, and apparatus of transparent quartz, electric ovens, high-class balances, and pure materials, render such work extremely costly. No doubt Harvard is well endowed, and Prof. Richards presumably has been liberally supported by his university. But the beneficence of the university has been largely supplemented by the action of the Carnegie Institution of Washington; without the pecuniary help afforded by the Trust, the work could not, says Prof. Richards, have been carried out on so large a scale, nor could it have reached the degree of precision which it has attained.

T. E. T.

TESTS FOR COLOUR VISION.

THE agitation concerning the official colour-vision tests for seamen has entered upon a new stage. The Board of Trade has announced its decision to hold an inquiry into the matter, and the *personnel* of the committee has been published (NATURE, June 30, p. 529).

After the reiteration of the confidence of the Board in the certitude of the official tests, this change of front comes somewhat as a surprise, but that can be forgiven in the welcome possibilities of a revision of tests that have forfeited the confidence of those most concerned.

It is not to be expected that the constitution of an official committee will please everyone, and already protest has been made by letter to the Board of Trade from the secretary of the Imperial Merchant Service Guild. The Guild protests that it was given to understand that the projected new committee would be of small size and of strictly impartial character, but that it proves to be large, and in the view of the Guild heavily weighted. The Guild states that of the members of the committee, at least two were prominent supporters of the official tests in recently disputed cases where the official position was admittedly wrong.

The choice of tests for colour vision is not so simple as it may seem at first sight. The difficulties presented in appreciating the mental picture of a colour-blind person are very great; and complexity is introduced by the several conflicting theories of colour vision which, consciously or unconsciously, bias the opinion of those who essay to determine these tests.

It is perhaps unfortunate that theories of colour vision should enter into the question of colour tests, at any rate, in the present state of our knowledge. It is, of course, conceivable, nay, even probable, that the true theory of colour vision when that is formulated and proven, supposing it for the moment to be none of those extant, will show an infallible means of testing the sense of colour in any and every person. Until then it would appear better that the test should be frankly empirical, and, so far as possible, unbiased by any theory. And for the reason that, unless rival theories be eliminated from the field, we can scarcely expect a reasonable uniformity in our tests.

There are two main lines of cleavage between rival schools of testing. One insists upon the matching of colours, the other on the necessity for naming colours. The first is official and based upon Holmgren's tests. A candidate is given a skein of coloured wool, and required to pick out from a heap of skeins other wools that, in his opinion, match the wool given him. The second method of testing is performed by exhibiting a colour in wool, card, or preferably by means of light from a distant lantern, and the candidate is required to name the colour shown in whatever language he knows. The colour is exhibited detached from any other colour that could give external help, the man must judge of the exposed colour alone and unaided, and name it in common terms. Now each of these modes of colour perception are common habits with us in our daily life. We constantly match colour, consciously or unconsciously, and we as often, perhaps more often, name colours we see, matching them mentally and naming them according to a standard we have learned by experience. On the respective merits of these methods, the rival schools clash, and, so far as can be judged, the disagreement rests upon theoretic conclusions rather than practical experience.

If we consider these two tests in relation to actual life, or, at any rate, the life of a seaman, it can scarcely be denied that the second non-official test, naming the colour, is the one that most nearly tallies with his experience. The seaman is required to pick up a light, most likely a solitary light, and judge of its colour without possible comparison; he must rely on his judgment of that light in relation to the mental impressions that are part and parcel of his cerebration, and the impression he receives is instantly and unconsciously correlated with a name, the name of a colour in the language in which his mind works. To name is second nature. What the name may be matters not, so long as it be current coin; the "B" line in the spectrum may be "red" to us or "blood-colour" to the savage, and "F" "blue" to us and "sea-colour" to the savage: the intention is the same.

But it is argued by the adherents of the Holmgren test that the matching of colour is more likely to be true, for it eliminates possible errors due to ignorance in precise nomenclature, *e.g.*, three people may see the same colour and variously describe it as purple or mauve or heliotrope, with a result that a fourth might not be sure what colour was meant, yet each of the three would find no difficulty in matching the colour correctly, particularly if they were women who took an interest in their dress.

The good and bad of these tests can only be put to proof when they are tried on known colour-blind persons. Then it has been found that persons can successfully match colours who grossly misname them when the colours are shown singly. On the other hand, there are some who can name colours who fail to match well. The evidence of the cases, particularly those of the first and more important group, has been sifted and is established. Which, then, of these two persons is the colour blind, he who can match but not name or he who can name but not match? The solution of this perplexity is as follows: Matching depends rather on a keen sense of light and shade than on colour sense; colour-blind persons can be educated up to the matching test, but never to acquire a colour sense they do not possess. Those who name colour accurately yet fail to match are bunglers, folk just ignorant of what matching means; the maid-of-all-work will know, but a youth or a seaman may not.

On the mode of applications of tests, if a little pleasantry be permitted, it can scarcely be denied that in some aspects the official methods are as fine a joke as could well be devised. What would a stranger visitant think of these heaps of coloured wools? Surely he would commend a State whose paternal care extended to the examination of young ladies desiring employment in haberdashery shops, to the end that they may be good at matching their customers' patterns! That these wools were to test the seaman's ability to pick up lights in rain and shine, storm and fog, our visitant would surely find unthinkable. And yet it is so. So far has theory divorced from experiment carried us. If it be well to let the punishment fit the crime, how much more should the test of a quality fit the usage of that quality. It seems obvious that the ability to see lights and signal flags should be tested with lights and flags. That this is now recognised is shown by the number of testing lanterns that have been fathered since Edridge Green directed attention to the matter; but some of the lanterns are bad by reason of the poor range of their tints.

The next line of cleavage between rival schools is due to differences in opinion as to what are to be the crucial colours of the tests. Here theories of colour vision come in most emphatically, and until this problem is solved, we cannot expect agreement unless there be a truce to theory and a trial by ordeal.

There is one satisfactory mode of surmounting the difficulty in the choice of crucial colours, that is, by the use of the spectrum itself. Much of the experimental work on colour vision has been done with the spectroscope, and the appreciation of the value of it as an everyday appliance is shown in that, within the last two years, there has been devised three pieces of apparatus for colour testing by direct appeal to the spectrum. A very clever projection spectroscope has been devised by Dr. J. H. Tomlinson, and valuable instruments for direct view of the spectrum by Dr. Maitland Ramsey and by Dr. Edridge Green. Of these instruments, the first has the advantage that both examiner and candidate can view the spectrum together. But Edridge Green's instrument has the germ of the right principle in colour testing, for it is provided with scales which give the measurement of the aperture of the shutters in wave-lengths, so that by this means the range of distinction of colour throughout the spectrum can be measured and registered.

In conclusion, what we want is not only a trustworthy mode of qualitative test, but also a quantitative test—some mode whereby we can express a man's colour-sense in terms as stable as we can express his form-sense by Snellen's test types. At present, opinion and fact are hopelessly muddled by our inability to convey what our tests show. Say a man fails to distinguish a certain red: he must be written down "red blind," notwithstanding he can see another red. To say he is red blind is both true and false, but it is the only statement that can be made in the absence of finer modes of expression. We want to take the measure of his perception of the colours of the spectrum and register them in simple terms. Given such an absolute register of his colour sense, there will remain only the expression of opinion as to his capability for doing certain work. Requirements will vary with the work to be done. For seamen and railway men we should require the highest standard, even as is required of them for form vision.

We wish the new committee a happy issue out of all its troubles! N. B. H.

GREENWICH WATCH AND CHRONOMETER TRIALS.

"WHAT is the chief end of an astronomer?" is not so stereotyped a question as the corresponding conundrum respecting the chief end of man. This question is, however, suggested by the following statements in the last annual report of the Astronomer Royal to the Board of Visitors:—"In the year ending 1910, May 10, the average daily number of chronometers and watches being rated (at Greenwich) was 596." "The number of Government marine chronometers and watches now at the Observatory is 455." "For the annual trial of chronometers . . . 66 . . . were sent in . . . 8 were purchased for the Navy and 4 for the Indian Government." "For the annual trial of chronometer watches . . . 173 . . . were entered . . . and . . . 35 were purchased for the Navy." In addition there was a trial of pocket chronometers, seventeen being sent in and two purchased for the Navy. The average number of chronometers rated daily has, we learn, more than trebled since 1880, so that the burden of this work borne by the Observatory has enormously increased. The work is doubtless most valuable for the Navy, but is our great national Observatory exactly the place where it should be done?

The question is many-sided. Science for its own sake is regarded by the multitude as a most excellent occupation for wealthy amateurs, but a State-supported institution is expected to devote itself to immediately-practical ends. From this point of view it is only work such as supplying the national time and rating the national chronometers that justifies the existence of Greenwich. There is thus some reason to fear that if this and other obviously useful work ceased, the continuation of the financial support from Government that enables the Observatory to carry out work that is more directly astronomical might be jeopardised. On the other hand, whatever adds to the burden of routine and administrative labour borne by the Astronomer Royal, must reduce the time and energy which he can devote to what is purely scientific.

There are several points of interest in the details of the trials. The box chronometer trial lasted twenty-nine weeks, from June 19, 1909, to January 8, 1910, the temperatures to which the chronometers were exposed varying from 45·8° to 105·6° F. The chronometers are arranged in order of merit according to the value of $a+2b$, where a is the difference between the algebraically greatest and least of the weekly rates, and b the greatest difference in rate between two successive weeks. As in golf, the lowest score is the best. Pocket chronometers and chronometer watches are let off with an eighteen-week trial, notwithstanding the fact that, unlike the box chronometers, they are tried in a number of positions. Their place on the list is determined by a formula which takes account of the differences between the rates in the several positions. Even eighteen weeks is a long time compared to the duration of watch trials at the Swiss observatories, at Besançon or at Kew.

The chief obstacle to uniformity of rate, especially in box chronometers, is the effect of temperature, but a much shorter trial than twenty-nine or eighteen weeks would suffice to test the behaviour of the temperature compensation. The main object, presumably, in having so long a trial is to afford an opportunity for any weak point to declare itself. On this question one would like to know the views, both of the makers and of the Observatory authorities. A long trial means a lock-up of capital, which must presumably have an effect on the cost, especially as only a fraction—in the present case apparently only a small fraction—of the chronometers and watches were actually purchased for the Navy. In the present day, with the increase of speed, a ship is seldom isolated for any great length of time, and the breakdown of a single chronometer is unlikely to be a serious matter. Thus the case for a long trial does not seem so strong as it may have been a generation ago. Very probably ere long the development of wireless telegraphy may alter the whole situation.

NOTES.

A FINE specimen of a rare class among the scientifically eminent passed away when the Rev. Robert Harley, F.R.S., died on July 26, in his eighty-third year. Many friends will miss his hale face and hearty greeting at meetings of the Royal Society; and few of them can have had any idea that one so keen in his interest could be an octogenarian. Mathematics with him was a parergon, almost a hobby. He achieved distinction in it in early middle life, pursuing it in scanty intervals of leisure secured without neglect of engrossing non-scientific duties. The son of a Methodist minister, he had no early mathematical training. At the age of twenty-three he entered Airedale College as a student of theology, and shortly afterwards he was ordained as pastor of the Congregational Church at Brighouse, Co. Yorks. Here he found time to become a mathematician of mark. The application of mathematics to logic as developed by George Boole captivated his intelligence, and he became the most notable of Boole's admirers and followers, as also his biographer. His greatest mathematical achievements were, however, in another field. The unsolved problem of the solution of quintic equations fascinated him. Having once granted the impossibility of the solution by radicals, he proceeded to exhibit with remarkable power and patience the place of certain sextic resolvents in connection with such equations. Simultaneously, the late Sir James Cockle was engaged on like work; but Harley was the clearer writer on the difficult subject. Their work, and in particular Harley's, was welcomed enthusiastically by Cayley, who himself took it up and continued it. All three probably were not aware at the time that certain Continental writers had possessed some of their ideas beforehand; but everyone must recognise that Harley's development of the ideas was masterly. It secured for him the Fellowship of the Royal Society in 1863. Since then, as before, he carried on mathematical research only in such time as was allowed by devotion to pastoral, philanthropic, and temperance work. He laboured in Leicester, Oxford (where he was an original member of the Oxford Mathematical Society, and was given the honorary degree of Master of Arts by the University), Halifax, and elsewhere. From 1872 until 1881 he was vice-principal (and chaplain) of Mill Hill School. For the three years before his removal to Oxford in 1886 he was principal of Huddersfield College. In 1890 he took a period of rest (with pastoral work) in Sydney, Australia. Since 1895 his life was one of retirement, but far from one of inactivity, whether religious, benevolent, or scientific.

THE Berlin correspondent of the *Times* announces the death, in his seventy-sixth year, of Prof. A. Michaelis, who until three years ago was, since 1872, professor of classical archæology at Strassburg University. In addition to being the author of a large number of works on archæological subjects, Prof. Michaelis organised the admirable archæological museum of Strassburg University.

WE learn from *Science* that Dr. Frank H. Bigelow has resigned his positions in Washington, D.C., as professor of meteorology, U.S. Weather Bureau, and professor of astrophysics, George Washington University, in order to travel in Europe for a few months. He will then resume his studies in solar physics and terrestrial meteorology.

IN view of the removal of the work of the Meteorological Office to the new building in Exhibition Road, South Kensington, which is being arranged to take place in the autumn, Mr. R. G. K. Lempfert, superintendent of statistics, has been appointed by the Meteorological Committee to be superintendent of the forecast division; Mr. E. Gold, fellow of St. John's College, Cambridge, Schuster reader in dynamical meteorology, has been appointed superintendent of the statistics and library division; Mr. R. Corless has been reappointed special assistant to the director, with additional duties as secretary and clerk of publications. The appointments date from October 1.

APROPOS of Prof. W. J. Pope's discourse on "The Chemical Significance of Crystal Structure" at the Royal Institution, a full report of which appeared in last week's number of NATURE, it may be noted that the models which illustrated the lecture, together with explanatory labels, are exhibited by Prof. Pope in the Crystallography Section of the Science Hall at the Japan-British Exhibition. Next to this exhibit will be found also models of Bravais's fourteen space-lattices, and of certain of Sohncke's point-systems shown by Prof. H. L. Bowman. Among other interesting exhibits in the same section, in addition to those referred to in an article in NATURE of July 28, may be mentioned the series of goniometers, showing the great change that has taken place in the form of the instrument since it was first devised, the refractometers and protractors, and the pictures, obtained in natural colours by direct photography on autochrome plates, of the interference figures displayed by certain crystal-sections.

IN *L'Anthropologie* for May–June M. Louis Seret brings to a close his essay on the colonial empire of the Phœnicians. To this he attributes the spread of Neolithic culture in western Europe. In the sixteenth century B.C., the Phœnicians, after the first Egyptian incursions into Asia, started on their maritime career. The period of constant warfare which succeeded produced a demand for large supplies of arms of bronze, and the Cassiterides were the only source from which tin in the necessary quantity could be provided. But the accessible mines soon became exhausted, and in the twelfth century the increasing use of iron made the bronze trade much less important. He connects the menhirs of western France with the cult of a deity of reproduction, like the Greek Hermes. These brilliant generalisations will probably not meet with universal acceptance; but this important study throws new light upon the connection of the Phœnicians with the spread of Neolithic culture in western Europe.

IN a third instalment of a "symposium" on the palæontological record, published in the August number of the *Popular Science Monthly*, Prof. R. S. Lull discusses the relation of embryology and vertebrate palæontology. He mentions that the dinosaur Compsognathus was probably viviparous, and refers to the importance of ascertaining the origin of the peculiarity that the presumed ribs of chelonians are external to the limb-girdles. He also comments on the similarity between the head of a fœtal manati and that of a modern ungulate.

IN the course of a note on the first skull of the species obtained from the Pleistocene of Saxony, Dr. K. Wanderer, writing in *Sitzungsberichte und Abhandlungen der naturwis. Ges. Isis* for 1909 (1910), reviews recent literature relating to the local races of the musk-ox. In 1908 Dr. R. Kowarzik pointed out that the living representatives of the species are divisible into two main groups—an eastern and a western—distinguished by skull characters. The line of division between the two types is formed in North America by the Atlantic watershed and its continuation in the islands of the Arctic Ocean. The western type, *Ovibos moschatus mackenzianus* (of which Gidley's *O. yukonensis* appears to be a synonym), inhabits the Mackenzie Valley and the districts to the west, but appears to have been originally a native of Europe and northern Asia, whence it reached America by way of Bering Strait. The skull is characterised by the nearly quadrangular outline of the basioccipital, the flattened but large horn-bases, the close approximation of the stout sheaths of the horn-sheaths to the forehead, the presence of distinct lacrymal pits, the marked curvature of the tooth-line, and the long interval between the sphenomaxillary fossa and the last molar. The eastern American form is, it may be presumed, *O. m. typicus*, allied to which is the Greenland *O. m. wardi*. The skull described by Dr. Wanderer was obtained from Prohlis, near Dresden, in association with remains of *Rhinoceros antiquitatis*, and is referred to the western form.

Two volumes by Mr. J. Wright on the cultivation of allotments have lately been added to the series of "One and All" garden booklets. The first supplies information with regard to the preparation and improvement of the soil; the second deals with the production of vegetables, fruits, and popular flowers.

A NEW volume, the fifth, of the botanical section of the *Philippine Journal of Botany* begins with a number devoted to the first part of an enumeration of Philippine Leguminosæ, provided with keys to the genera and species, for which Mr. E. D. Merrill is responsible. The enumeration covers 90 genera and 285 species, of which 14 entire genera and 53 species are considered by the author to be introductions. The proportion of endemic species is low as compared with many other families. None of the genera are very large, Desmodium being predominant with twenty-nine species, while Monarthrocarpus and Luzaria are monotypic and endemic. Several species yield valuable timbers, notably *Pterocarpus indicus*, *P. echinatus*, *Albizzia acle*, *Intsia bijuga*, and *Pahudia rhomboidea*.

A NOTE by Mr. W. R. G. Atkins on the cryoscopic determination of the osmotic pressures in some plant organs, chiefly fruits, appears in the Scientific Proceedings of the Royal Dublin Society (vol. xii., No. 34). Following the methods adopted in earlier experiments, the osmotic pressures were calculated from the data obtained by measurement of the freezing point of the expressed cell sap. The values so obtained justify the deduction that similar organs of any plant species have approximately equal osmotic pressures, although a wide range of values is obtained for similar organs of different plants. Thus tomato fruits gave a value varying from six to nearly eight atmospheres, and greengages a pressure of twenty-nine atmospheres. The variation in pressure recorded for the tomato is connected with the ripening of the fruit, the lower pressure in this case referring to the ripe fruit, and is accounted for by the chemical changes in the cell sap.

BULLETIN No. 55 of the West of Scotland Agricultural College contains an account of experiments on soil inoculation for the lucerne crop. Lucerne is not at present cultivated in Scotland, and the necessary bacteria are presumably not present to any great extent in the soil. Addition of the organisms by inoculation has proved successful.

THE changes taking place during the storage of butter have been investigated at the Michigan Agricultural College Experiment Station by Messrs. Rahn, Brown and Smith. There was a distinct increase in the non-protein nitrogen, indicating a certain amount of proteolysis, but the exact agent was not determined. There were, however, micro-organisms found multiplying even at -6° C., whilst a torula proved extraordinarily resistant to salt, even growing in a 25 per cent. salt broth.

THE use of insecticides containing arsenic appears to be attended with considerable disadvantage in India, and experiments have for some time past been carried out at the Agricultural Research Station, Pusa, with the view of discovering some other compounds equally effective. Lead chromate was finally selected; being yellow, it is easily visible on the plant; it does not burn the foliage, and it adheres well. A suspension of 1 lb. in 64 gallons of water proved effective on plants that are being attacked, while 1 lb. in 100 gallons of water proved a sufficient preventive.

A RECENT circular of the Royal Botanic Gardens, Ceylon, contains an account, by Mr. Petch, of the root disease of the cocoa-nut palm caused by the fungus *Fomes lucidus* (Leys). No method of curing a diseased tree is known; once a tree is attacked there is little hope of saving it unless some only of the roots are affected and can be cut off. This only rarely happens, and it is usually best to fell the tree at once. Methods of treatment are badly needed for cases such as this; there seems to be no prospect of successful treatment by the internal application of a fungicide, since the tree is more easily killed than the fungus.

The renewed interest now being taken in the United States in all questions affecting natural resources, and particularly the soil, is reflected in the articles in the *Popular Science Monthly* (No. 6). Dr. McGee describes the scientific work of the Department of Agriculture, which includes more than half of the official bureaus in the States. Prof. Brigham gives a popular account of soil formation and of weathering, and shows how such apparently trifling details as the lowering of the level of water in the soil through the operations of man may in course of time lead to profound changes. There is also a well-illustrated paper by Prof. Herrick on instinct and intelligence in birds.

THE July number of the *Journal of the Board of Agriculture* contains a paper by Messrs. Robinson and Watt describing the Coombe plantation, Keswick, which was planted in 1848, and is now being cleared. It is remarkable in that careful accounts have been kept of all costs and of all returns, and further in that experimental groups of trees have been periodically measured. A discussion of the data is given, and there are a number of good photographs. Another paper, by Mr. A. B. Bruce, aims at giving the stock-breeder a general account of Mendelism which should go far to satisfy him that the scientific treatment of his problems is likely to lead to valuable results.

RECENT bulletins from the United States Department of Agriculture Bureau of Entomology deal with (1) the western grass-stem saw-fly (*Cephus occidentalis*, Riley and Marlatt), which causes trouble to the wheat-growers of North Dakota and elsewhere; (2) the woolly white-fly (*Aleyrodes howardi*, Quaintance), a new enemy of the Florida orange, which hitherto has only been known to infest orange trees in some of the West India islands, and especially Cuba; (3) the oyster-shell scale (*Lepidosaphes ulmi*, L.) and the scurfy scale (*Chionaspis furfura*, Fitch), now very generally distributed through the States, and sometimes confounded with the more serious San José scale; although they do not actually kill the trees, they cause serious financial loss; (4) the "brown rot" (*Sclerotinia fructigenia*, P. Schröt.) and plum curculio (*Conotrachelus nenuphar*, Herbst.) of fruit trees; the former is a fungus disease of the flowers, twigs, and fruit, especially harmful at the time of ripening; the latter is an insect that, in the course of its feeding and egg-laying, punctures the fruit, often so copiously that much loss is suffered; (5) the sorghum midge (*Contarinia* [*Diplosis*] *sorghicola*, Coq.), which is by far the most destructive agent affecting sorghum. A general description of the insects attacking crops in Michigan is issued by the Michigan State Agricultural College Experiment Station; the bulletin is well illustrated, and contains a considerable amount of useful information.

MESSRS. BURROUGHS, WELLCOME AND CO. have issued, in connection with their exhibit at the Japan-British Exhibition, an illustrated descriptive pamphlet (in English and in French) of the Wellcome Physiological Research Laboratories and of the work done there. This includes the preparation and standardisation of diphtheria antitoxins and other therapeutic sera, bacterial vaccines, the physiological standardisation of drugs such as ergot, &c.

THE fourth annual report of the Metropolitan Water Board, by Dr. Houston, on the results of the chemical and bacteriological examination of London waters for the year ending March 31 last, has recently been issued. It contains a mass of figures relating to the bacterial content and chemical composition of the raw, stored, and filtered water supplied to the metropolis, valuable on account of the systematic examination of the water and as showing how our water supply is, so far as possible, safeguarded. Dr. Houston again insists that the *raw* waters are undoubtedly unsatisfactory in quality, but that storage with sedimentation effects a considerable improvement, and he emphasises the supreme importance of storage as a means of preliminary purification of the raw water.

THE new catalogue of the Cambridge Scientific Instrument Co., describing Duddell oscillographs, gives particulars of the latest type of these instruments. The improvements incorporated in this instrument include greater accessibility and ease of repair of the vibrators and alteration of the design in such a manner as to prevent the leakage of oil from the damping chamber, which was such an unpleasant feature of the old type. Particulars are given of the accessory apparatus required and of the methods of using the instrument, and an appendix contains reproductions of a number of interesting records of wave shapes.

WE are in receipt of a copy of the "Catalogue of Mechanical Engineering and Electricity," containing information concerning the British exhibits in these sections at the Brussels Exhibition. The preface is written by Prof. W. C. Unwin and Mr. John Goodman, and gives a summary of the progression and tendencies of engineering science as exemplified by the exhibits referred to in the body of the catalogue. The nine sections include mechanical engineering, electricity, civil engineering, agriculture, horticulture and arboriculture, food products, mining and metallurgy, textile industries, and chemical industries. A plan at the end shows the positions of the stands of the various exhibitors.

THE *Physikalische Zeitschrift* for August 1 contains a review of the present state of our knowledge of the properties of the α particles sent out by radio-active substances, by Dr. H. Geiger, of Manchester. The velocity of the homogeneous rays sent out by radium C appears to be 2.06×10^9 centimetres per second, and the quotient of the electric charge by the mass 5.07×10^3 electromagnetic units. The mean number of α particles sent out by a gram of radium per second is 3.1×10^{10}, and each carries a charge 9.3 to 9.6×10^{-10} electrostatic units, and appears to be a helium atom. The progress of each is checked by the molecules of a gas, and in air the path described does not exceed a few centimetres in length. During the description of this path each is capable of producing 1.72×10^5 ions by collision. The results of the recent measurements of the diminution of the velocity of the particles as they pass through solids, their scattering, and their ultimate absorption are all discussed in a clear and thorough manner.

A LETTER from Sir William Ramsay, in the *Chemical News* of August 5, directs attention to a new fact in the history of the development of the Leblanc process for the manufacture of soda. It has generally been believed that Leblanc perfected a process devised by De La Métherie in 1789. A letter to Dr. Black, written by a Mr. Geo. Golder, of Edinburgh, and dated March 19, 1782, shows, however, that the black ash process had already been devised and patented by an English inventor named Collinson. A specimen of black ash prepared by Collinson's process was submitted to Dr. Black, who reported that it contained "more alkali than the best Alicant Barilla in the proportion of 68 to 44, and more than the best kelp in the ratio 68 to 10." "It is an excellent ash for the soap-boilers . . . and there is no need to use lime in drawing the leys from it, as it is already in a caustic state." "After this," the writer adds, "there appears little doubt who invented the black-ash furnace."

MANY examples of smoky chimneys are no doubt owing to carelessness and lack of knowledge in those concerned with the work, but we also find many architects and builders of repute being occasionally nonplussed by the problem. Some important points in chimney design are given in the *Builder* for August 13. The grate should be provided with a blower to induce a good draught at the start. The flue should be expanded laterally to a width of about 2 feet a short distance above the grate, and then brought in again, forming what is usually termed a "bottle." Above this, one or two bends of about 150 degrees should be made. The top should be slightly contracted, and the chimney-cap sloped up sharply all round the aperture or pot; outside chimneys should be avoided; stacks should come as near the highest part of the roof as practicable; a number of flues should not be packed too closely together in a large stack, but kept as distinct as possible; the outer walls of stacks should be 9 inches thick.

IN an article on the International Road Congress, which opened in Brussels on August 1, *Engineering* for August 12 gives the altered form of a rejected resolution, which in its original form condemned macadam. The resolution finally adopted is as follows:—"Macadam, carried out by the methods of Tresaguet and Macadam, causes dust and mud, is expensive to maintain, and is suitable in large cities only for streets where the traffic is not very great or heavy. The experimental work carried out in recent years with macadam, improved by using a bituminous or tarry coating or binder, ought to be continued to determine the best method of utilising this kind of construction under varying conditions, and the results considered at the next congress." Our contemporary directs attention to a point which requires scientific investigation, viz. the exact behaviour of a sand foundation under stone pavement. On the Continent, a bed of sand from 3 inches to 6 inches deep is almost invariably used, and the setts are bedded directly on and in the sand. The sand is spoken of as a "cushion," and is said to be elastic. Another view is that it absorbs the shock on the pavement, saves the stones from damage, and reduces the noise of traffic. It would be easy to settle the points in doubt by experiments in an engineering laboratory.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by the Rev. J. H. Metcalf at Taunton, Mass., on August 9. The position, at 9h. 15·2m. (Taunton M.T.), is given as R.A. = 16h. 10m., dec. = 15° 20′ N., and the comet was said to be moving in a south-westerly direction; at the time of discovery the brightness of the comet was about equal to that of an eleventh-magnitude star.

A later telegram gives the position of the comet as observed by Mr. Burton at Boston on August 10; at 12h. 28·8m. (Boston M.T.) R.A. = 16h. 10m. 29·3s., and dec. = 14° 56′ 41″. The comet is on the meridian at about 6h. 30m. p.m.

OBSERVATIONS OF COMETS.—Dr. Max Wolf records an observation of comet 1910*a*, on July 15, in No. 4429 of the *Astronomische Nachrichten* (p. 210). The comet was then a little to the south-east of υ Cygni, and its photographic magnitude was 16·5.

In No. 4430 of the same journal he states that on plates taken on April 11 he has found images of comet 1909*e* (Daniel); the comet was then fainter than Halley's at the time of discovery, and was not shown at all on a plate which had a longer exposure on May 12. In compliance with a request from Herr Jan Krassowski for unpublished observations of comet 1909*e*, Dr. Rambaut also publishes some positions of this comet, secured at the Radcliffe Observatory during December, 1909, and January, 1910.

OBSERVATIONS OF MERCURY.—During July and September, 1909, observations of Mercury were made at the Revard (Aix-les-Bains) and the Massegros (Lozère) observatories by MM. G. and V. Fournier, and the drawings are now reproduced and discussed by M. Jarry-Desloges in the August number of the *Bulletin de la Société astronomique de France*. Those made at Massegros, with a refractor of 29 cm. (11·5 inches) aperture at an altitude of 900 m., show that there are definite markings on the surface of the planet which can be seen and delineated by different observers at different times with striking agreement, although the observing difficulties are very great. A dark patch on the southern horn is shown on all the drawings, and in some even obliterates the actual cusp. Other markings agree on different drawings, and can also be identified with some observed by Schiaparelli and Lowell. The observations confirm the statements that the rotation period of Mercury is probably equal in length to the planet's revolution period.

DISPERSION OF LIGHT IN INTERSTELLAR SPACE.—Recognising the importance of the results obtained by MM. Nordmann and Tikhoff regarding the differential velocities of light of different wave-lengths through interstellar space, Herr Beljawsky made a number of observations of the Algol variable RZ Cassiopeiæ during the autumn of 1909. Using filters which transmitted either visual rays alone or photographic rays alone, he photographed the star with short exposures, taking a large number of photographs in quick succession, and from these he subsequently reduced the times of the photographic and visual minima respectively. The results first obtained showed a time-difference of six minutes, on the average, between the two divisions of radiations. But this difference was in the opposite direction to that found by the earlier observers: that is to say, the visual rays were "retarded" more than the optical.

A subsequent revision and refinement of the data confirmed this result qualitatively, but slightly reduced the time-difference (*Mitteilungen der Nikolai-Hauptsternwarte zu Pulkowo*, vol. iii., No. 31, 1910).

ANOMALOUS SCATTERING OF LIGHT.—No. 5, vol. xxxi., of the *Astrophysical Journal* contains an important paper in which Dr. Julius upholds his hypothesis as to the causes which produce the unequal distribution of light over the sun's disc, as shown on spectroheliograms. He states that the results so far obtained are no less favourable to the anomalous-dispersion theory than they are to that hypothesis which ascribes the variable illumination to absorption effects, and proceeds to support his statement by the discussion of the several phenomena.

Dr. Julius also defines his terms more rigorously than in former papers. "Anomalous dispersion" is reserved for the general property of matter, that its refracting power varies rapidly in the neighbourhood of an absorption line. Previously this term was used indiscriminately with "anomalous refraction"; but the latter is now to be used exclusively for the irregular phenomena with which Dr. Julius deals in all his papers; "anomalous scattering" is also introduced, and is shown to be an active agent in modifying various effects.

THE SPIRAL NEBULA M51 (CANUM VENATICORUM).—As an extract from the *Rivista di Astronomia* (Turin), we have received a paper in which Madame Dorothea Isaac-Roberts discusses in detail the numerous condensations, spires, &c., shown on Dr. Roberts's photograph of the spiral nebula M51 Canum Venaticorum. Each feature is described, and the position-angles, distances, &c., are given, so that any future worker may determine, with a minimum of labour, whether or not any variation has taken place since the epoch when Dr. Roberts's photograph was taken. Madame Roberts also shows that the present form indicates a process of evolution which has led, and will probably lead, to the partition of this remarkable object into secondary nebulæ and condensations.

SUPPLEMENT TO THE "ASTRONOMISCHE NACHRICHTEN."—We have received, as a supplement to the *Astronomische Nachrichten*, No. 17 of the *Astronomische Abhandlungen*, edited by Dr. Kobold. Among its six articles, it contains papers dealing with an experimental research on phase action in regard to heavenly bodies, a new explanation of the origin of comets, and a description by Prof. Lowell of the new canals discovered on Mars. The price of the supplement is 3 marks.

THE FIRST INTERNATIONAL CONGRESS OF ENTOMOLOGY.

THE first International Congress of Entomology was held at Brussels on August 1–6. The establishment of the congress was in great measure due to the initiative of Dr. Karl Jordan, of Tring, whose tact and energy have throughout contributed largely to the success of the undertaking. Having, in the first place, secured the support of leading entomologists in this country and abroad, Dr. Jordan organised, in the course of last year, a series of preliminary meetings in London, which were attended by Dr. Horn, of Berlin, M. Janet, of Paris, Prof. Poulton, F.R.S., of Oxford, and others, under the chairmanship of Dr. F. A. Dixey, F.R.S., president of the Entomological Society of London. At these meetings it was arranged that the first congress should be held at Brussels in 1910, and local secretaries were appointed to promote the interests of the movement in all countries of the civilised world. So well did these representatives perform their part, that no fewer than 292 entomologists assembled in Brussels for the opening of the congress.

Proceedings began on the evening of July 31 with an informal reception by Prof. Lameere (who, as president of the Entomological Society of Belgium, had been invited to preside over the congress) and the other members of the Belgian society. The gathering was highly enjoyable from the social point of view, and gave acceptable opportunities to entomologists from other parts of the world for making each other's personal acquaintance.

On August 1 the official proceedings were opened by Prof. Lameere in the Salle des Fêtes, a large building within the precincts of the exhibition, the use of which for the general and sectional meetings of the congress had been liberally granted by the authorities. His address of welcome to the delegates and other members of the congress included an eloquent vindication of the claims of entomology to serious attention, both as a science and also as a study having practical bearings of the highest importance. The address, which was well received, was followed by the reading of a report by the secretary of the congress, M. Severin, on whose shoulders the chief labour of organisation had fallen. After the conclusion of the more formal proceedings, the congress turned to the regular business of entomological communcations. Some of the most interesting items on the programme bore reference to subjects of economic importance. Prof. Theobald (Wye) had a paper on the artificial distribution of insect pests, and M. Andres (Alexandria) contributed notes on the lepidopterous enemies of the cotton-crop. Dr. R. Stewart MacDougall (Edinburgh) discoursed on the beetle *Galerucella lineola*, so destructive to the Midland osier-beds, and Sir Daniel Morris, formerly director of the Imperial Department of Agriculture in the West Indies, gave a graphic account of the progress of economic entomology in the West Indies and in India, to which progress, it may be noted, Sir Daniel's own efforts have very largely contributed. Among other items of interest were communications from Prof. Kolbe (Berlin) on the comparative anatomy of the Coleoptera, and from MM. Janet (Paris), Speiser (Sierakowitz), and Lyman (Montreal) on various points connected with classification.

The proceedings on August 2 opened with a luminous and admirably delivered discourse by M. Blanchard (Paris) on medical entomology. The eloquence of the lecturer, and the vast importance of the subjects with which he dealt—malaria, yellow fever, and the sleeping sickness, all of which are directly dependent for their spread on the agency of insects—made a great impression on his audience. The day's programme also included an excellent lecture by Father Wasmann on ants and their guests, illustrated by lantern-slides; communications by Prof. Theobald on the distribution of the yellow-fever mosquito, *Stegomyia fasciata*; by Prof. Carpenter (Dublin) on the warble-flies; and others of equal interest.

The business on August 3 was largely taken up with the subject of mimicry and its bearing on evolution. The proceedings began with the delivery of a discourse by Dr. F. A. Dixey, F.R.S. (Oxford), on the general subject of insect mimicry. The lecture, which was plentifully illustrated by lantern-slides, directed especial attention to the ascertained data of mimicry in relation to affinity and to sexual, seasonal, and geographical conditions. Various suggested explanations of the phenomena were discussed in the course of the lecture, and the opinion was advanced that natural selection afforded the only reasonable interpretation of the facts at present within the knowledge of entomologists. Special aspects of the subject were afterwards dealt with by Dr. Karl Jordan (Tring) and Prof. Poulton, F.R.S. (Oxford), the former exhibiting an interesting series of lantern illustrations, and the latter showing a wonderful series of models and mimics captured at the same time and place by Mr. Wiggins in Uganda. A note of scepticism was struck by Mr. Schaus, who, on the strength of many years' observation in the neotropical region, was disposed to deny that mimicry was of any service to the insects exhibiting it. A lucid exposition of Mendelism as applied to the Lepidoptera was given by Prof. Punnett (Cambridge), and an interesting account of his experiments on the influence of temperature on seasonally dimorphic moths was contributed by Mr. F. Merrifield (Brighton).

On August 4 much interest was excited by Mr. Donisthorpe's lecture on ants, with their bidden and unbidden guests, and also by Prof. Sjostedt's narrative of the Swedish expedition to Kilimanjaro. Able communications were also received from Dr. Horn (Berlin), M. Bouvier (Paris), M. Honrath (Budapest), and others.

On August 5 Mr. Howlett, of the Agricultural Research Institute at Pusa, India, gave an excellent account, illustrated by numerous photographs, of the work of that most useful institution; and M. Lahille (Buenos Aires) discoursed to an appreciative audience of the progress of economic entomology in the Argentine. The sectional programme also contained, amongst others, contributions from Dr. W. J. Holland (Pittsburg), Mr. H. Skinner (Philadelphia), and Dr. Horn (Berlin); but the chief business of the day consisted in the winding-up address of the president, Prof. Lameere, and the selection of Oxford as the scene of the next International Congress of Entomology, to be held in 1912, with Prof. Poulton, F.R.S., as president.

The evening of August 5 was devoted to a banquet at the Taverne Royale, and on August 6 M. Max, Burgomaster of Brussels, entertained the members of the congress at a grand reception in the Hôtel de Ville. The exhibition buildings were open to members throughout the whole of the congress, and excursions were organised in the course of the week to the Congo Museum, the Ardennes, the Field of Waterloo, and other places of interest. The Brussels Museum of Natural History was also visited, and its treasures described by members of the staff.

The congress, as a whole, was an undoubted success. Any defect that may have been noticed in the arrangements was probably due to the fact that, this being the first occasion of the kind, there were no precedents to guide those responsible for the administration. Some inconvenience was suffered from the circumstance that the Salle des Fêtes was in request for other purposes, which interfered to an appreciable extent with the scientific business of the general and sectional meetings; for this, however, compensation was found in the varied attractions of the exhibition, free access to which, by the liberality of authorities, was allowed to all members of the congress.

It is satisfactory to be able to record that, of the 292 members, 67 were representatives of the United Kingdom, its colonies and dependencies. The contributions made by our countrymen to the scientific work of the congress may fairly be said to have surpassed in extent and value those of any other nation—a fact which is of good augury for the future of entomological research within the borders of the British Empire.

THE FIFTH INTERNATIONAL CONGRESS OF PHOTOGRAPHY.

THE International Congresses of Photography, the first of which was held in Paris in 1889, are arranged at irregular intervals as opportunities offer or necessity renders desirable, that representatives of all countries may meet and discuss questions of general importance. It is hoped by this means to avoid, or at least mitigate, the confusion that results from variations in standards, nomenclature, and methods, especially when such variations are due more to accident than intention.

The fifth congress, which has just been held in Brussels, was well supported, most of the European nations, as well as America, being represented. More than eighty communications were included in the programme, and these were classified into three main sections:—(1) Scientific questions; photochemistry; scientific applications of photography. (2) Technique of photography; artistic questions; industrial applications of photography. (3) Photographic documentation and archives; bibliography; legislation. The proceedings of the congress will be published in full in the report that will be issued in due time.

Several of the communications were of the nature of reports setting forth the present state of the section of photographic work dealt with. Captain Th. J. Saconney dealt with aërial photo-surveying. E. Deville gave details concerning photo-surveying in Canada, from which we learn that the extent of the region so surveyed is somewhat greater than the combined areas of Holland and Belgium, the most interesting application of the method being its application in defining the frontier between Alaska and Canada, a district of lofty mountains. A commission was given three years to report concerning a frontier of one thousand kilometres in length, and as only the short summer season of each year was available, on account of the climatic conditions, other than a photographic method would have been impossible. A satisfactory map was prepared from the three thousand photographs made. The photographic method of surveying employed in Canada is eminently practical, not excluding other methods, so that it should be understood merely that photography plays the most important part in it.

Prof. Wilder D. Bancroft contributed a long report on the photographic emulsion, and from the facts that he has set in due order concludes that the silver bromide grain is a complex of silver bromide, gelatine, and water, and that "the process of ripening consists in changing the composition of the silver bromide grain towards an unknown, optimum concentration." He concludes, too, that it seems theoretically possible to make an almost infinitely fast plate having a very fine grain. Dr. R. Luther set forth the various arguments concerning the nature of the developable image, and J. Desalme reported on present notions concerning the theory of development. The latter considers that the electrolytic hypothesis affords a much better explanation of development than that based on a reduction by a purely chemical process, that is, that a developing solution contains an electrolyte and a depolariser suitable to the positive ions produced. This explains the non-equivalence of the alkalies if substituted in the proportion of their combining weights.

The difficulties of measuring the true opacity or obstructive power of photographic plates were described by F. F. Renwick, who stated that the apparent opacity of a negative under any given conditions is the algebraic sum of several variable properties. These he classifies as the simple obstructing power, the diffracting power of small particles and of the slightly rough surface of the film, the increase in transmitted light when the incident light falls obliquely on the surface, and the increase when the plate being measured is placed close to a reflecting surface if the difference between the readings with the negative so placed, and when the negative is removed, is taken as the opacity. He also criticised adversely the use of acetylene flames as light standards unless many stringent precautions are taken. The principles involved in attempting to measure the diffuse reflecting power of photographic plates were enumerated by A. Callier and R. von Camvenberghe, but they gave no practical details. Drs. Mees and Sheppard described various improvements in acetylene burners when used as secondary light standards, to meet objections that have been urged against earlier forms, and referred shortly to other standards. Dr. E. Goldberg described an apparatus that he has devised (made by Schmidt and Haensch, of Berlin) by means of which the characteristic curve of a plate can be obtained without the more or less tedious plotting generally done. From the group of papers dealing with these branches of the subject, it is clear that the measurement of the densities of photographic plates is a process still set about with difficulties and confusions, and that much work remains to be done in this direction.

Coming to the more technical branches of the subject, we find that a great many widely different matters were treated of. Prof. R. W. Wood described how to take photographs with infra-red and ultra-violet lights. For the infra-red he uses, as a screen, a very dense cobalt glass with either a saturated solution of potassium bichromate or a suitable red aniline dye, and, of course, a suitably red-sensitised plate. Under such conditions grass and trees in full sunshine appear snowy white and the sky as black as midnight. All shadows are very black, as there is practically no light from the sky to illuminate them. For the ultra-violet photographs, quartz lens were used coated with metallic silver to such an extent that a brilliantly lighted window was barely visible through them, and appeared of a deep violet colour. The light transmitted was of wave-lengths from 3100 to 3250. When photographed under these conditions, certain white flowers (as phlox) and Chinese white (zinc oxide) appear as if absolutely black, but ordinary landscapes do not show points of much special interest. Prof. Wood suggests various possibly useful applications of such methods. Prof. R. Namias has examined prints toned with gold and platinum to ascertain the amount of precious metal entering into the finished print. C. W. Gamble described a method of determining the melting point of gelatine jellies. He uses capillary tubes, and notices when the concave meniscus changes to a flat surface.

A. and L. Lumière and A. Seyewetz classified and compared the various gelatine-hardening agents, and recommend the use of quinone and its sulphonic derivatives when the gelatine is on a rigid support, in preference to formalin, as the latter tends to contract the gelatine and detach it. They find that quinones in acid solution are serviceable for the reduction of photographic silver images, and that their action is comparable to that of ammonium persulphate in appearing to attack by preference the denser deposits. They suppose that the resulting hydroquinone tends to deposit silver, by reduction from the solution, on the surface, and so to prevent the loss of the thinner deposits.

A method for getting instantaneous exposures on autochrome plates was described by Ch. Simmen. The plate is sensitised to red by bathing, and with a suitable compensation filter is eight times more sensitive than the untreated plate. N. S. Amstutz reported on recent progress in process work in the United States of America. We notice that Paynetype has not yet come into general use; that collotype has not made much headway, in spite of the hopes of its adherents, presumably for lack of attention to climatic conditions; but illustrative telegraphy is taking its place as a practical method of transmitting pictures. W. F. Cooper and G. A. Freak have compared nickel (or nickel-surfaced plates) as a substitute for copper for half-tone work, and find that ferric chloride acts on it (for etching) at something less than half the rate that it acts on copper.

Telephotography is the subject of a report by Captain Owen Wheeler; other than this, photographic optics was hardly represented. It will, of course, be understood that in this summary it has not been possible to refer to more than a comparatively few of the communications made to the congress.

C. J.

THE ORIGIN AND CLASSIFICATION OF MAMMALS.[1]

A HEARTY welcome may be accorded to the work referred to below, which contains a well-elaborated and highly philosophical digest of the present state of our knowledge of the past history and relationships of the various groups of mammals, and the inferences which may be legitimately drawn from such knowledge. The work owes its inception to the need for a brief outline of the history of the ordinal classification of mammals for use in Columbia University; but it was soon found inadvisable to limit its scope to this portion of the subject, and it consequently covers a much wider range. It retains, however, traces of its original limitation in consisting of two distinct parts, namely, an account of the typical stages in the history of the classification of mammals, and, secondly, of the genetic relations of the orders and a discussion of the origin of the class as a whole, with special reference to the problem of the auditory ossicles.

The first part, although of great value to the student, may be passed over without further mention on this occasion, and attention concentrated on the second. Before proceeding to a brief survey of the latter, reference may be made to the author's endeavours to give a rational explanation of the meaning of each important feature with which he has to deal, and not to rest content with a mere catalogue of bare facts. Indeed, the adherence to mere facts on the part of so many of his predecessors has been, in the author's opinion, a fruitful source of our lack of progress in getting a real grasp of mammalian evolution, and he specially urges the need of an osteological treatise written from this newer point of view. It is added that the importance of osteology in the study of mammals cannot be overestimated, as the clue to the origin of the class and the relationships of its constituent orders can be obtained from palæontology alone, which in this case is restricted to the osteology and dentition.

As regards the origin of mammals, Mr. Gregory adopts the view that the class is descended in all probability from that section of the anomodont reptiles which Dr. Broom has proposed to designate cynodonts, but which are more commonly included in the theriodonts, although not from any known member of the same. The features in which cynodonts approximate to mammals on the one hand and to more ordinary reptiles on the other are carefully formulated. The difficult question of the fate of the reptilian quadrate and the homology of the mammalian malleus and incus is left to a great extent open, although the author seems inclined to favour the view that the incus represents the quadrate and the body of the malleus the articular.

The second chapter of this part is devoted to the monotremes, which are regarded as undoubted mammals, with evident relationships to the marsupials, as is indeed indicated by their geographical distribution. Nevertheless, monotremes are taken to represent a subclass by themselves, while marsupials and placentals are brigaded together in a second group of equivalent value, and it is added that the divergence of the monotreme from the marsupio-placental stock must have taken place at a relatively early date. Within the same section as the marsupials are grouped, as a second and equivalent order, the Mesozoic triconodonts, which cannot be regarded as true marsupials, and it is noteworthy that the theory of the conversion of the triconodont into the tritubercular type of molar by means of torsion is now definitely abandoned. On the other hand, in view of Gidley's study of Ptilodus, the Multituberculata are now re-admitted to the marsupial order, although the author will not allow that they are diprotodonts. The evidence of the Triassic Microlestes, supplemented by that of the structure of the teeth themselves, indicates that the multituberculate molar is a far older type than the tritubercular, which is first known—in an incompletely developed condition—in the Middle Jurassic Amphitherium.

The view that the carnivores of the Santa Cruz beds are not only marsupials, but likewise members of the same family as the Tasmanian wolf, is definitely accepted, and it follows from this that there is no definite genetic relationship between creodonts and carnivorous marsupials. Indeed, the author considers each group to have been independently derived from small insectivorous and completely or partially arboreal Mesozoic forms, this being, if true, sufficient to indicate that the resemblance between the larger Tertiary forms is due to convergence. In opposition to some of his contemporaries, Mr. Gregory regards creodonts as nearly related to the Insectivora (from which tupais and jumping-shrews are separated as a distinct order, Menotyphla), and likewise considers the latter to be more closely related to marsupials than is the case with any other placental group. On the other hand, he looks upon the palatal vacuities of Erinaceus as secondary rather than marsupial features. The date of separation between Carnivora and Insectivora is considered to be pre-Tertiary, and it is left an open question whether the ancestors of the latter had their incisors extending along the sides of the jaw (instead of being restricted to the front) as in their modern representatives.

Only very brief reference can be made to some of the other orders, among which it is important to notice that the extinct zeuglodonts are included in the Cetacea. Perhaps the greatest changes in classification are proposed in the case of the ungulates, from which the Artiodactyla are removed to form a separate ordinal, and supraordinal, group, as the author believes they have no near relationship with Perissodactyla. On the other hand, the Ungulata are taken to include, not only elephants, hyraxes, perissodactyles, and the South American groups, which are brigaded as Notoungulata, but likewise sirenians. Much is to be said both for and against these proposed changes, but space does not admit of discussing the matter, and it must suffice to add that we find the Primates, with man at the head, forming part of a "superorder" in the middle of the class instead of standing at the head. Whether we accept all his views or not, there can be no question that in this volume Mr. Gregory has accomplished a most valuable and important piece of work.

R. L.

[1] "The Orders of Mammals." By W. K. Gregory. Bull. Amer. Mus. Nat. Hist., vol. xxvii., 1910. Pp. 524.

THE MINERAL SURVEY OF PERU.

THE Cuerpo de Ingenieros de Minas del Peru continues to issue actively its valuable bulletins on mining areas. In No. 58 (1908) Mr. A. Jochamowitz reviews the mineral resources of the somewhat remote department of Apurimac, in the mountains south-east of Lima, where the rivers run northward along the ranges to join the great flow of the Amazon. The level lands are mainly devoted to the cultivation of sugar-cane for the production of alcohol; but alluvial gold-areas exist, and gold occurs in decomposed ferruginous zones among the prevalent stratified quartzites. Portuguese miners in old days appear to have secured most of the spoil that could be readily obtained.

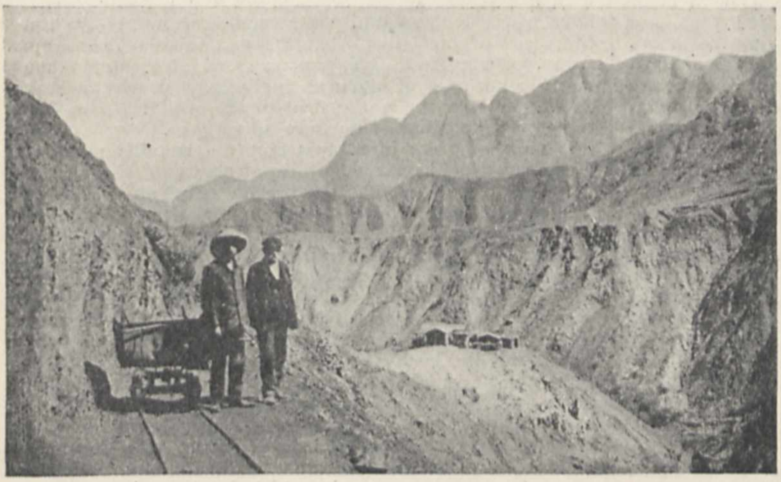


FIG. 1.—View from the Lower Cretaceous Coal-beds of Cupisnique, Peru.

Mr. E. T. Dueñas describes, in *Boletin* 62, the provinces of Tayacaja, Angaráes, and Huancavelica, famous for their mineral wealth, from silver-lead to mercury and gold. Here again alcohol is one of the main agricultural products, and the soil of the valleys, when watered, is highly productive. The sugar-cane crop, however, at present suffers greatly from locusts. The three provinces lie in a basin of the Andes, between Lima and Cuzco, and at the head-waters of the Mantaro. The rocks are much faulted, with crystalline masses thrust in among them. A series of slates is regarded as Silurian, and a red-rock series, containing salt, and traceable into that of Cuzco, is referred to the Trias. Mesozoic limestones and sandstones occur in places, and fossils prove some of these to be Liassic and others Upper Cretaceous (p. 154). The author (p. 24) explains the course of the Mantaro as of double origin. The western cañon above Anco is ascribed to the overflow of a lost lake in the upland south of Jauja—this town, by the by, might have been just squeezed into the margin of the map. The second cañon past Coris and Surcubamba was cut by the waters of another lake, the "Lago de Huanta," which has left its gravels below Anco and as far south as Acobamba. The Jauja lake drained into this near Anco. Both cañons are connected with faults running out from the Andes, and their excavation in Quaternary times was thus facilitated, until they grew large enough to drain off their respective lakes and unite in the sinuous course that now forms the Mantaro. We wish that the resources available in the United States Survey for the topographical representation of such problems had been at the disposal of Mr. Dueñas in Peru. Wolfram occurs at Lircay, in the province of Angaráes, and the author reviews the world's production of tungsten, now so important an element (p. 118). Mesozoic coal-seams are found in Huancavelica. It would have been convenient for reference if the name of this province had not appeared at the top of all the pages of the memoir.

The great rise in the price of antimony in 1907 leads Mr. E. Weckwarth (No. 68) to review the occurrences of antimony ores throughout Peru, including antimonial lead and silver ores. The bulletin also forms a compact monograph on the uses of antimony and its metallurgical extraction. No. 69 (1909), by Mr. E. du Bois Lukis, has geographical and geological interest, in addition to its description of a mining area. It describes the coal-bearing strata of the country near Cajamarca, in the midst of the Andes, and contains numerous photographs of the somewhat barren scenery of the highland. Even at Cupisnique, only 40 km. from the coast, we are up among rocky walls and desert features that remind one of the Wittebergen of South Africa (Fig. 1). Steinmann has referred the coal-bearing sandstones at this point to the Lower Cretaceous. In the extensive Piñipata field away to the north-east, above the long Maranon valley, the coal is probably of much the same age (p. 31). These Peruvian coals, which crop out on the hillsides, among strata that can be traced for miles across a rocky country, are mostly anthracitic, with a rather high percentage of ash; but a considerable future is predicted for them, and the Department of Mining Engineers, as in other bulletins, sounds a patriotic note, and urges the Peruvians themselves to do something towards the development of their resources.

The coast of southern Peru, and the Pampas west of the Andes, are studied by Mr. V. F. Marsters in *Boletin* 70 (1909). Here again the numerous illustrations appeal to the geographer, and include several features due to recent volcanic outbreaks. The huge cone of Misti (Fig. 2), more than 22,000 feet in height, appears in several views. A small picture even shows the snow-flecked rim of the crater, with its broad central cone. The pampas are swelling plains of detrital material, which is often of volcanic origin, and volcanic cones sometimes break their surface. They rarely show features due to erosion, and in places contain traces of saline pools. The discovery of a limited deposit of caliche, or nitrate-bearing earth (p. 61),

FIG. 2.—Cultivated alluvial valley-floor near Arequipa, with the volcano of Misti beyond.

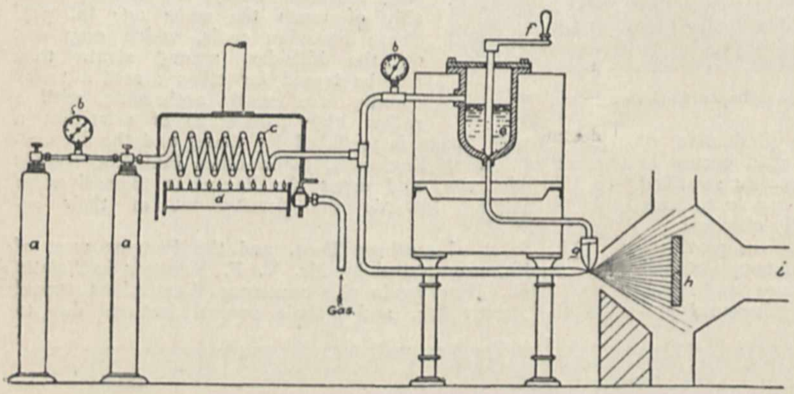
in the hollow of Indio Viejo, leads Mr. Marsters to urge a thorough examination of the pampas between the valleys of the Caraveli and the Chaparra.

Bulletins 71 and 73, on water-supply for agricultural districts, show the wide view taken of their responsibilities by this energetic body of engineers. G. A. J. C.

NEW PROCESS FOR PRODUCING PROTECTIVE METALLIC COATINGS.

THERE are various means of coating metals with other metals, generally of a protective nature; thus, for example, electroplating, galvanising, and drawing the metal. A new process of considerable interest, invented by M. U. Schoop, of Zürich, was described in a paper read before the Engineers and Architects Society of Zürich on April 13, and reproduced in *Metallurgical and Chemical Engineering* (vol. viii., p. 404).

The chief point in the new process is that the metal in the liquid condition is sprayed upon the surface to be coated. The atomising of the metal may be brought about in a variety of ways. The metal is melted in a closed crucible, and is forced out of a nozzle by the pressure of gases or vapours; or the subdivision of the metal may be brought about by causing two jets of metal to pass out of separate nozzles, so that they meet at a suitable angle. These, being under pressure, break up into a fine spray, which is carried forward and coats any object placed near to the spray.



Schoop Process for Production of Metallic Coatings.

The most satisfactory method, however, appears to be to cause the subdivision of the metal by the use of compressed gases. The metal which is to be employed for coating purposes is melted in a closed crucible which has a pipe at the bottom, ending in a nozzle with a capillary opening. Another pipe enters the upper part of the crucible, which is connected with a source of compressed gas, the gas being pre-heated by passing through a coil, *d*. Another tube is connected externally with the gas-pressure tube and ends in a nozzle, which is situated below the metal outlet. The compressed gas impinges with great pressure on the fine stream of metal, which is also being forced out under great pressure. The metal is thus very finely atomised, and is blown against the article to be coated, *h*. Various gases may be used to press the metal out of the nozzle, for example, an inert gas such as nitrogen, and this may also be used for atomising; but, on the other hand, for atomising agent an oxidising gas may be used. It has, for instance, been found possible to produce coatings of lead peroxide of a firmly adhering character.

Different metals naturally behave differently, depending upon their fluidity, melting point, oxidisability, and so on. The material of the crucible also depends upon the metal which is to be melted in it. Thus for melting aluminium and its alloys iron or steel crucibles cannot be used. It appears, indeed, that under high pressures metals alloy much more readily and quickly than under ordinary atmospheric pressure. Obviously alloys may be melted and sprayed, but the metals require to be mixed in their eutectic proportions.

What probably happens in the spray process is that when the metal forced out under pressure leaves the nozzle, it is met by the gas stream, also under pressure. The stream of metal is thus torn up and converted into a mist. The individual particles of the metal when sprayed on to the surface to be coated lose their surface tension and their globular form, and are pressed out on the surface in the form of a circular film. These circular films overlapping become automatically welded into a continuous homogeneous coating. Calculation shows that with a pressure of 25 atmospheres the metallic particles have a speed of 20 km. per second—*i.e.* twenty-five times the speed of the bullet from the gun used in the German Army. Owing to this enormous speed of the metal mist, metallic surfaces of a surprisingly high density are produced. For example, the density of rolled tin was found to be 7·47, and that of the sprayed tin 7·42.

A point of great interest is that the metallic mist is at a comparatively low temperature, at about 40° C. to 60° C., in spite of the fact that the molten metal as it is ejected has a temperature of several hundred degrees, and also the atomising gas. This rather surprising fact is probably due to the sudden reduction of tension of the gas, whereby the metal mist, which presents a relatively very great surface, is also cooled. This is, however, a very great advantage, because it is possible to give a metal coating to substances of low melting point or of high inflammability, such as paper, wood, celluloid, wax, &c.

The hardness of the metal film is greater than the hardness of metallic films produced by other methods, *e.g.* casting or rolling. This great hardness should be of advantage in the manufacture of electrotypes and cuts, in which hardness is an important feature. Microscopic examination also shows that the surface is absolutely homogeneous.

In carrying out the operation, the metallic surface to be coated is first freed from oxide or adhering dirt. In many cases, especially when metals are to be coated, it is found advantageous to pre-heat the surface before spraying on the metal. It is not, however, absolutely necessary to pre-heat; consequently, with a portable apparatus, metallic structures such as bridges, machinery, and so on, could easily be coated, and it is claimed that it would be no more expensive than painting. At to the applications, they are almost numberless. It may be used for all cases in which plaiting is at present employed. Paper may be coated with metal so that it can be used for packing such things as chocolate, tea, and so on, in place of tin foil. The cases of balloons can be coated—an aluminium coating 1/30th mm. thick is sufficient to render it quite gas-tight.

The wooden propellers of aëroplanes coated in this manner are protected against the action of the weather, and the air friction is considerably reduced. Wall-paper, stage scenery, and textiles can all be coated with metals.

Certainly the process is one of great interest; and one point of particular note is, it is now possible to coat metals with aluminium, which will be perhaps one of the most useful applications of this new process. In this case it will be necessary to employ a crucible the material of which will not alloy with the aluminium.

THE GALITZIN SEISMOGRAPH.

DR. SCHUSTER has recently presented to Eskdalemuir Observatory a pair of Galitzin seismographs, and the instruments have been set up under the personal direction of Prince Galitzin, member of the Imperial Academy, St. Petersburg. Similar instruments have been in use in Russia for some time, with very remarkable results, and they are rapidly being adopted by the principal Continental observatories.

The object secured by these instruments is that they record, not merely the occurrence of an earthquake on a large scale of magnification, but also give an exact reproduction of the horizontal motion of the earth at the observing station.

Primarily, the seismograph is a horizontal pendulum on the principle of Dr. Milne's apparatus, but instead of reducing friction to a small amount, Prince Galitzin increases it until the pendulum reaches the limit of "aperiodicity" or "dead-beatness." Electromagnetic damping is so strictly proportional to the velocity that it is immensely superior to other forms of frictional damping. A copper plate attached to the pendulum moves across the field produced by two strong horse-shoe magnets, and the pole distance is adjusted until the required degree of damping is attained. There is no other friction, as the pendulum is carried by steel wire.

A heavily damped and truly dead-beat pendulum reproduces with great precision the motion of the earth, which sets the pendulum in motion.

The actual movement of a heavily damped pendulum is very small, but Prince Galitzin has shown how to magnify the movement to any required degree without loss of accuracy. A coil of fine wire attached to the pendulum moves in the field of a second pair of horse-shoe magnets, and the currents so generated in the coil when the pendulum moves are measured by a D'Arsonval galvanometer which has the same natural period as the pendulum, but the circuit resistance is chosen so that the galvanometer is also "dead beat." It can be shown that, except for a few special cases, the motion of the galvanometer mirror is a precise reproduction of the pendulum motion, and hence of the earth motion. By means of an experimental table on which the instruments are tested, Prince Galitzin has shown that impressed motions of great complexity are faithfully reproduced on the galvanometer. It is true that the final scale of magnification differs for different periods of incident waves, but in actual seismological practice it is comparatively easy to allow for this.

The registration is made photographically by reflecting light from a fixed source and producing a dot of light on a strip of photographic paper carried on a rotating circular drum. The paper moves at a rate of 3 cm. per minute, and the drum is carried sideways, so that it can be used for a twelve-hour record. The trace is interrupted every minute by an electrical time break, and so the times can be estimated with ease to half a second.

The pendulum and galvanometer are duplicated, so that two records are obtained on the paper. One of these gives the motion of the earth from north to south and the other the motion east to west. They are arranged so that a movement of the earth to north or to east is represented by a motion of the corresponding dot up the sheet.

Prince Galitzin has shown that the ratio of the amplitudes of the very first impulse on the two pendulums gives the tangent of the azimuth of the epicentre. He has proved practically that this determination of the direction is accurate to $\frac{1}{2}^{\circ}$ of arc.

The usual method (Wiechert Zöllpritz) of calculating the distance from the times of occurrence of the first and second phases is followed.

Thus a pair of Galitzin seismographs enable an observer at a given station to determine the epicentre of an earthquake with great precision. Further, one can follow the complete movement with confidence, although a certain amount of computation is strictly necessary when waves of widely different periods actually occur. Intelligent examination of the record shows when this is necessary.

Identity of natural period of pendulum and galvanometer and strict "aperiodicity" is the ideal. In practice it is sufficient to get approximate equality, and determine the differences by a simple process of standardisation. For information on this point the reader is referred to Prince Galitzin's original memoirs in the publication of the Imperial Academy, St. Petersburg. G. W. W.

RECENT AGRICULTURAL PUBLICATIONS IN GREAT BRITAIN.[1]

THE Board of Agriculture issues each month a Journal intended for farmers, small holders, and others interested in agriculture, and, in order that it shall be accessible to all, the price is fixed at the very low sum of fourpence. It represents a very laudable, and on the whole successful, attempt to bring to the farmer the best scientific work on the problems confronting him; it also deals with matters of agricultural importance in foreign countries.

A large proportion of the papers is devoted to plant diseases. In a recent issue, Mr. Salmon describes the Sclerotinia disease of the gooseberry. The mycelium of the fungus penetrates into the tissue of the stem, permeating the cortex and the bast; in time the stem is completely "ringed" and the bush dies. Sometimes the attack is not in the main stem, but in the young wood, the leaf, or the berry. Burning all infected old and dead wood has been found the best method of control. Mr. Salmon points out that this fungus is capable of developing vigorously on dead parts of the bush, while the American gooseberry mildew, with which growers have sometimes confused it, is not. Where burning is not practicable, recourse may be had to spraying with copper sulphate solution.

Other papers deal with possible improvements in agricultural practice. Of these, one is by Mr. Priestley on the effect of overhead electrical discharges on plant growth. It has been known for some time that an electrical discharge in some way increases plant growth, but the practical difficulties have only recently been overcome by the use of Sir Oliver Lodge's high-tension valves, in conjunction with a Ruhmkorf coil of a type similar to that used in X-ray work. The physiological problems are not yet solved, and the practical application of the method is, of course, very limited so far as can be seen at present. But the fastidiousness of the present generation demands fruit and vegetables in unnatural seasons, and the market gardener, in furnishing the supply, is prepared to adopt any methods likely to increase the rate of growth, provided the cost is not too high. Mr. Priestley's data show that a good case can be made out for the use of electrical discharges.

Supplements to the Journal are periodically issued, each dealing with a special subject. One deals with the work of the International Agricultural Institute, but it is not very clearly arranged. Another gives *in extenso* the papers read at the discussion on wheat at a joint meeting of Sections B and K with Subsection K of the British Association last year. As this discussion has already been dealt with in these columns, it is unnecessary to say any more here; the plan of printing and distributing widely these British Association discussions is admirable, and will, we trust, be acted upon again.

Under the able guidance of Mr. Mackenzie, the Journal of the Royal Agricultural Society is steadily making up lost ground. This Journal has had a remarkable history. The early volumes, from 1840 (when it began) to about 1860, contain some of the finest papers that have been written on agriculture and agricultural science. Then it had a long series of lean years, due, no doubt, in part to the decadence of agricultural science in England during that period. It is now taking its place in the remarkable revival that the last few years have witnessed. Mr. Hall gives a connected account of the various investigations he and other workers at Rothamsted have made on the secondary effects of manures on the soil. Sulphate of ammonia tends to make the soil acid, and therefore infertile, unless sufficient lime is present; the acidity is caused by certain fungi in the soil which decompose the salt to obtain the ammonia and thereby set free sulphuric acid. On the other hand, nitrate of soda tends to make the soil alkaline and to get it into a sticky, unworkable condition. The decomposition is in this case brought about at the roots of the plant in some way not yet understood, and results in the acid radicle entering the plant while the base remains outside as sodium carbonate. The latter substance is known to deflocculate clay, and is the cause of the unfavourable soil condition thus induced. Suitable methods of treatment are suggested.

Mr. F. H. A. Marshall discusses some of the physiological problems of the stock-breeder. This subject has been curiously neglected, and it is of interest that Cambridge, which has taken the lead in plant-breeding work on Mendelian lines, should now be turning its attention to stock-breeding. The practical man has acquired by long experience a vast fund of information, which, however, needs sorting out and systematising. Apart from the problems involved in raising pedigree stock—a highly

[1] Journal of the Board of Agriculture, and Supplements; Journal of the Royal Agricultural Society; Agricultural Students' Gazette.

specialised and valuable, though restricted, branch of agriculture—there are many other questions of interest to the physiologist. Thus it is a very common practice to castrate male animals in order to increase their docility and their capacity for laying on flesh. Ovariotomy of the females is also practised, though much less commonly, but with the same object. Abortion is another matter to which attention is directed. Enormous amounts of money are involved in these stock-breeding problems, and in addition many of them are of considerable physiological importance.

The *Agricultural Students' Gazette*, the organ of the Royal Agricultural College, Cirencester, contains articles by old students or members of the staff dealing with questions of general agricultural interest. Mr. B. Bathurst writes on tariff reform and the tenant farmer, and Mr. Boulger on the biology of the soil. The scientific work of the college is published in a separate bulletin, which has already been reviewed in these columns.

THE EDUCATIONAL VALUE OF THE SCHOOL GARDEN.[1]

IT is becoming increasingly common for rural elementary schools to start a garden in which the scholars may take a certain number of lessons during the season. The idea of a school garden appeals to the village community; the village critic is nothing if not practical, and he insists, and with a good show of reason, that if book-learning is any good at all it ought to teach a man how to raise onions and potatoes well. So successful has the movement been that it has spread widely, and has reached a stage when the whole question of the relation of gardening to rural education may usefully be considered.

The circular before us contains a highly suggestive discussion of the place of the garden in the school curriculum. The garden, it is pointed out, makes two very powerful appeals to those who wish education in our public elementary schools to be more practical; it leads to the formation of habits of thoroughness, and it is eminently useful. But it may also be dealt with on a much higher plane. The purpose of the garden should be to educate boys and girls, and not merely to show them the usual ways of cultivating the common vegetables and flowers, or to practise them in the manual operations of gardening. The scholar must be led to understand the reasons of the common processes in their relation to the soil and climate, the causes and conditions of health or disease in plants, and something of the principles on which the selection and improvement of seeds and plants depend. It is, indeed, a branch of nature-study rather than a training for a profession, and it has two great advantages over many other branches: it produces visible and tangible results—thereby appealing forcibly to the utilitarian instincts of the child—and it does not, or should not, degenerate into the series of disconnected object-lessons of little educational value that sometimes passes under the name of nature-study.

Gardening has another great advantage over other subjects in that it is essentially experimental. Set experiments cannot easily be made because the areas are far too small for inequalities of the ground to be smoothed out; indeed, they may be wholly misleading. But throughout the scholar is trying and trying again, observing his results, attempting to account for his failures and to devise better methods for the future. The teacher has to strike the happy mean between doing too much for the scholars, thus relieving them of the responsibility of thinking, and of doing too little, and leaving them overwhelmed with a sense of failure.

Of course, the garden is not necessarily a success. If the teacher has no taste for gardening or nature-study he had much better let them alone; he will save himself a good deal of discredit and the children a good deal of trouble. There is no particular virtue in a wide curriculum. If the subjects are treated in a dry and illiberal fashion, no appeal is made to the child's natural interests and his imagination is left untouched, in spite of the range of the syllabus. On the other hand, a restricted choice of subjects liberally treated may have great educational value. It all turns on the teacher himself; his choice of material must be largely determined by what interests him most.

In order to get the fullest value out of the gardening lesson, it should be correlated as much as possible with the other school work—with drawing, arithmetic, composition, nature-study, and so on. A number of hints are given showing how this may be done.

The publication is very interesting, and shows a lively appreciation by the Board of the possibilities of the case. A teacher who works in accordance with the spirit of these suggestions will do some distinctly useful work.

[1] Suggestions for the Consideration of Teachers and others concerned in the Work of Public Elementary Schools. (Circular 746 of the Board of Education.)

THE TELEGRAPHY OF PHOTOGRAPHS, WIRELESS AND BY WIRE.[1]

IT frequently happens that when two alternate processes are available for certain work, and one of them is considerably less practical than the other, the less practical one is possessed of much higher scientific interest. This may certainly be said of the telegraphy of pictures and photographs. The whole of the methods of transmission can be classed as either purely mechanical or dependent on the physical properties of some substance which, like selenium, is sensitive to light.

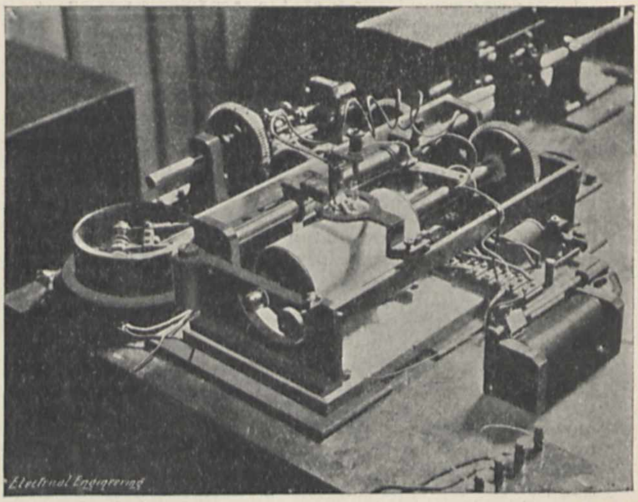


FIG. 1.—Photograph showing a Portion of the Photo-telegraphic Apparatus.

The latter methods are of no little scientific interest, and, although very delicate and for the moment obsolete, there is every likelihood of their coming into more extended use later on.

The telegraphy of pictures differs only from the transmission of ordinary messages in that the telegraphed signals, recorded by a marker on paper, must essentially occupy a fixed position. In the case of an ordinary telegram, it matters little whether the received message occupy two, three, or more lines when written out on paper, but when a picture is telegraphed every component part of it must be recorded in a definite position on the paper.

Suppose you greatly enlarge a portrait, and divide it up by ruled lines into a thousand square parts. Suppose, also, that the photograph is printed on celluloid, so that it is transparent. If, now, the portrait be held in front of some even source of illumination, it will be seen that each square —each thousandth part—is of different density. The light parts of the photograph will consist of squares of little density, the dark parts of squares of greater density, and so on. In this way the photograph is analysed into composite sections, each section corresponding precisely to a letter in a message; letters and spaces recombined form

[1] Discourse delivered at the Royal Institution on Friday, April 22, by Mr. T. Thorne Baker.

words and messages; squares of different densities recombined, in correct position, form a photograph.

I propose to deal with the more practical system first, which, as already pointed out, is perhaps the less interesting from the theoretical point of view. The telectrograph system has been employed by the *Daily Mirror* for the transmission of photographs since July, 1909, and has been worked very regularly between Paris and London and Manchester and London.

Instances of its use may be recognised in the publication of photographs taken in court in the recent Steinheil case at Paris, when photographs of witnesses or prisoners were sometimes received in London actually before the court rose at which they were taken, a clear day being gained in the time of publication.

The method of telegraphing photographs that has been employed on a large scale by the *Daily Mirror* may be called a practical modification of several early attempts.

FIG. 2.—Fashion Plate Transmitted by Prof. Korn's Telautograph.

The effect of an electric current to discolour certain suitable electrolytes or to set free an element or ion that can be used to form with a second substance a coloured product was employed in many early forms of instruments for telegraphing writing, &c. If we break up a photographic image in the way already described into lines which interrupt the current for periods depending on their width, these interrupted currents can be used at the receiving station to form coloured marks, which join up *en masse* to form a new image. My telectrographic process is thus briefly as follows:—

At the sending station we have a metal drum revolving under an iridium stylus, to the drum being attached a half-tone photograph printed on lead foil. Current flows through the photographic image to the line, and thence to the receiver. The receiver consists of a similar revolving metal drum, over which a platinum stylus traces. Every time the transmitter style comes in contact with a clear part of the metal foil, current flows to the receiver, and a black or coloured dot or mark appears on the chemical paper. But you will readily understand that if our reproduction—built up of these little marks, which have to be made at the rate of some two hundred per second—is to be accurate, each mark must be only exactly as long, in proportion, as the clear metal space traversed by the stylus.

It will be easier to explain the system by means of the rough diagram shown in the figure (Fig. 4). The transmitting instrument is shown on the left, the receiver on the right. A metal drum is revolved by a motor, one revolution every two seconds; over this a metal stylus or needle traces a spiral path in the same way as a phonograph. On the drum is fixed a half-tone photograph broken up into lines, and printed in fish-glue upon a sheet of lead foil. I will show one of these line photographs on the screen, and you will see that the light and shade of the picture are made up of masses of thinner or thicker lines, with clear spaces in between.

As the stylus traces over such a photograph, its contact with the metal base is interrupted every time one of these fish-glue lines comes beneath it, and for such a time as depends, of course, on the *width* of the line. The transmitting instrument thus sends into the telegraph lines a series of electric currents the periods of duration of which are determined by the width of the lines composing the photograph.

A similar stylus, S_2, traces an exactly similar path over a revolving drum in the receiving instrument, but round this drum is wrapped a piece of absorbent paper impregnated with a colourless solution, which turns black or brown when decomposed by an electric current.

FIG. 3.—Photograph Wired from Paris to London by the Author's Telectrograph.

What happens, then, is that every brief current which passes through the paper causes a mark to appear on it. The width of the mark depends on the duration of the current—or should do—so that you will see that these marks gradually combine to recompose the photographic image.

This method is all very well in the laboratory, but when we come to try it over a long distance the capacity of the line at once causes serious interference. It is well known that if a current be sent to some apparatus, such as a telegraph, from a distance, the current having to pass through long wires the capacity of which is appreciable, a certain time is taken for the current to charge the line, and the line discharges itself into the apparatus with comparative slowness. If the circuit be closed by means of a Morse key, the time of contact at the key being a sixth of a second—a common time of duration of a short tap—the discharge of current from the cable would be considerably longer than one-sixth of a second. When, therefore, we are sending signals through the line at the rate of 175 per second, it is not difficult to see that every signal will run into the next dozen or so at the receiving apparatus, and the result will be a hopelessly confused mass of overlapping marks. This is well illustrated in Fig. 5, where A shows a series of taps passed through a cable of high capacity into the telectrograph receiver; instead of getting a series of sharp dots or short lines, we get elongated lines ending off in tails. Without the capacity, we get the short lines as shown in the B series. These short, definite lines are again obtained, even when the capacity is present, in series C; but in this case I had shunted on to the receiver what I have termed the line balancer, a modified form of shunt apparatus embodying the principles of *wiping out* residuary currents from the cable in the way frequently made use of in duplex telegraphy.

The use of this apparatus has rendered commercial the old ideas of telegraphing by the electrolytic method, and as many as three hundred sharply defined chemical marks can be recorded in one second by its means. The method of application will be seen if we have the last slide shown again (Fig. 4); here, shunted on to the line (which is closed by the stylus S_2 and the metal drum), is a circuit containing two batteries, B_1 and B_2, and the two sections of a divided 1000-ohms resistance, W_1 and W_2. Shunted across the variable contacts of the resistances is a variable condenser K. By varying the resistances, W_1 and W_2, we can vary the power of the current used to sweep out the residuary charges in the line; the current can, of course, flow through the chemical paper on the drum, but the pole of the battery B_1, connected to the style, is of opposite sign to that of the line unit connected to it.

When the leakance on the line is great and evenly distributed, less reverse current from the balancer is necessary, this being quite in accordance with Heaviside's formulæ for telephony over lines with capacity and inductance. It is interesting to note, also, that by increasing the voltage of the reverse batteries B_1 and B_2, considerable greater contrast can be obtained in the pictures; the finer the half-tone screen employed in splitting up the photographs into lines, the higher, again, must the voltage of B_1 and B_2 be made.

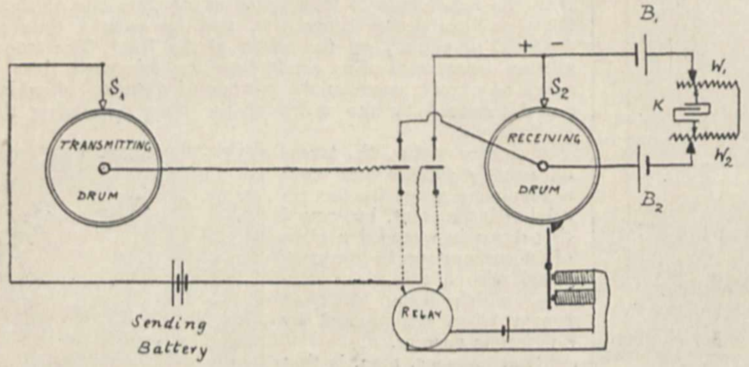


FIG. 4.

I should like to take up a few moments in referring to the actual utility of photo-telegraphy. The demand by the public for illustrations in their daily papers must be admitted. News is telegraphed in order to expedite its publication, and photographs illustrating this news can therefore be telegraphed advantageously. But where a large installation and establishment, with accumulators, a large instrument and an operator to work it are required, the cost of telegraphing every individual picture becomes quite out of proportion to its value. It is therefore desirable to direct especial attention to the portable instruments, the first one of which is shown for the first time to-night. A photographer going to obtain pictures of some important function or interesting event can take the machine with him, prepare his pictures, and telegraph them to his head office, and when the event is over he simply returns with the apparatus. For criminal investigations the portable instrument will, I feel sure, become of considerable value also. Through the continued courtesy shown by the Postmaster-General and Major O'Meara, the engineer-in-chief, we have been given every facility for developing the work, and I believe that the uses of the portable instrument will before long have been amply demonstrated.

If a picture revolving beneath a tracer has to re-draw itself, as it were, on a piece of paper perhaps hundreds of miles away, it is obvious that each mark re-drawn must occupy a precisely similar spot on the new paper as it does in the original picture. As cylinders or drums are used in picture telegraphy, this means that they must revolve in perfect unison. If one drum were to gain on the other we should have, in the case of a portrait, a nose being recorded where the eye ought to be, or something equally disastrous; in fact, if the two machines get the least bit out of step, the received picture is completely ruined. The method of synchronising used by Prof. Korn has proved very satisfactory, and has been adopted in practically all systems of photo-telegraphy. The motors which drive each drum are run at about 3000 revolutions per minute, and geared down very considerably, so that the drums themselves revolve, perhaps, at 30 revolutions per minute; the motors are run from secondary batteries of ample capacity to ensure smooth working, and should be run for a sufficient time before beginning a transmission, to allow of their warming up.

The speed of each motor is controlled by a regulating resistance in series with the field magnets, and the speed is ascertained by means of a frequency meter, which indicates the number of revolutions per second. The dial of this meter is shown on the screen. A set of tuned steel tongues are fixed in front of a magnet, which is supplied with alternating current obtained from slip rings on the motor, and each tongue has a different period of vibration. When the alternations in magnetism correspond with the period of vibration of any one spring, that spring vibrates, and thus serves as an indication of the speed of the motor.

The receiving drum is revolved a little quicker than the transmitting drum. It consequently completes its revolution before the transmitter. It is then stopped by a steel check, and is obliged to wait until the other drum has caught it up. When the transmitting drum has completed *its* turn, a fleeting contact comes into play, a reverse current is sent to the receiving instrument; this is led into a polarised relay, which actuates an electromagnet, and this magnet removes the check.

Thus, however much one drum gets out of step with the other, the fault is limited to each revolution, and both drums must always start off in unison for each new revolution. I have found that where each operator endeavours to keep his motor running uniformly by regulating the resistance according to the fluctuations recorded by the frequency meter, the personal element makes itself visible in the results; straight lines appear wavy, and the synchronism is not at all good. I therefore tried very carefully calibrating the motors by timing first, and then arranged that, once started, the motors should not be touched; the gain in speed of each is approximately the same if both motors are run from secondary batteries of the same ampere-hour capacity, and in this way we have obtained the most perfect results as regards synchronisation.

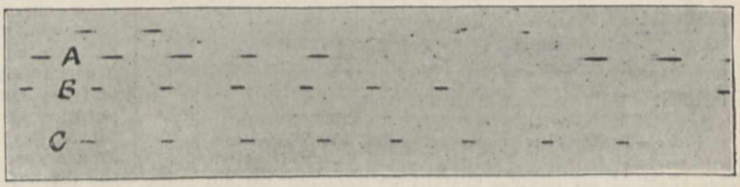


FIG. 5.

The great advantage of this process is that the whole operation is in full view, whereas with systems in which the received picture is obtained on a photographic film one has to develop such film before it is possible to discover whether anything is wrong. With the receiver described, the operator keeps his hand on the sliding contact of the resistances, and merely adjusts their position during the first two or three seconds, according to the condition of the electrolytic marks, *i.e.* whether crisp and concise or not. The transmitting cylinder can be used as the receiving cylinder, and the apparatus is thus reduced to the limits of simplicity.

Towards the end of last year I designed a portable machine, two of which Mr. Sanger-Shepherd has just completed, embodying in them a number of improvements of his own, and these machines, which have worked successfully on their trials, are shown on the lecture table to-night. They are suitable for line or wireless work, and will, I believe, prove of great value in naval and military operations.

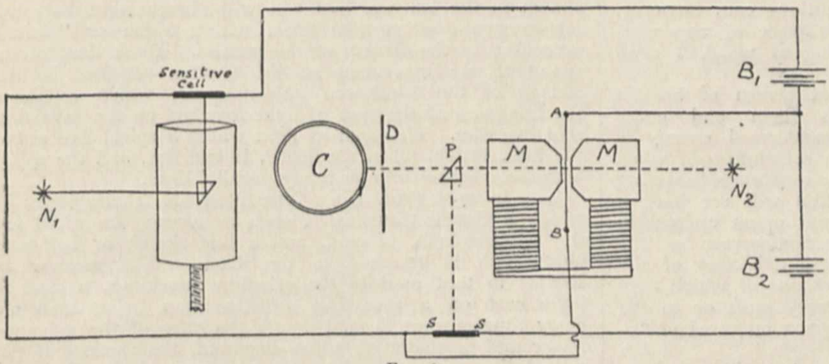


FIG. 6.

The *Daily Mirror* inaugurated the Paris-London photographic service in November, 1907, with Prof. Korn's selenium instruments, which I shall briefly describe, as Korn is now making two new selenium apparatus with the view of transmitting photographs from New York to London. In this system use is made of the fact that the electrical resistance of the metal selenium varies according to the strength of illumination to which it is subjected, a beam of light passed through the light and dark parts of a photograph in succession being used to vary the strength of an electric current sent to the receiving apparatus.

In Korn's selenium transmitter light is concentrated from a Nernst lamp to pass through a revolving glass cylinder, round which a transparent photograph (printed on celluloid) is fixed, the beam traversing the film at its brightest part, where the rays come to a focus (Fig. 6). The light which passes through the picture is reflected by a prism inside the cylinder on to the selenium cell, through which the current passes. Across the circuit is shunted a galvanometer of the Einthoven pattern, containing two fine silver strings free to move laterally in a strong magnetic field. These are represented by AB, the magnet poles being MM. When a bright part of the photograph admits of light falling on the sensitive cell, current passes through AB, and it shifts aside, allowing light from a Nernst lamp N_2 to enter the prism P, whence it is reflected on to the second cell SS. The telephone lines connecting the two instruments go direct to the wires of a similar galvanometer, which is in series with the galvanometer of the transmitting instrument. If we imagine MM to be the receiving galvanometer, then we remove the prism P, and the light acts on a sensitive photographic film attached to the drum C, which revolves synchronously with the glass cylinder of the sending instrument.

The inertia of selenium, once overcome, the metal immediately becomes of great use for many purposes. Prof. Korn's method of *compensation* is to let the light fall at the same time on two cells of opposite characteristics; one has great inertia and small sensitiveness, the other low inertia and great sensitiveness. By using the two cells on opposite sides of a Wheatstone bridge, dividing the battery into two parts for the other sides, the deflection in the galvanometer is very rapid. You will see the effect from the two curves now shown on the screen; that above the axis along which exposure is measured is the sensitive cell, that below this axis the cell of low sensitiveness. Clearly the current passed through the galvanometer is that obtained by joining the sums of the ordinates. This gives the small curve shown as the shaded portion. When the illumination is thrown on the cell the current rises very rapidly instead of gradually, whilst when it is suddenly shut off (at P in the upper curve) it drops to zero almost instantly instead of falling gradually.

I shall now show, by means of a meter, an image of the pointer of which will be projected on to the screen, how the inertia of selenium is overcome. You will first see that if I take away the screen so as to allow light to fall on the selenium cell, current passes into the galvanometer, and the needle slowly deflects several degrees. Now, I quickly shut off the light by intercepting it with the screen, and the needle comes slowly backwards. Such sluggish movement would be impossible for the purposes of photo-telegraphy, where at least half a dozen changes per second are required to be recorded abruptly even in transmitting the simple portraits to which the selenium process is limited.

Now, using two cells of different characteristics and a Wheatstone bridge arrangement, I will once more allow light to fall suddenly on the two cells simultaneously, and you will see that the galvanometer needle records the change in resistance of the combination quite quickly; the combination is even more noticeable when the light is suddenly shut off again, the needle returning to zero with great rapidity. This compensated arrangement of selenium cells at once renders their use of practical value for various physical and optical measurements. Prof. Korn has found that for an increase in the illumination δI, the current obtained is given by the equation $y = \alpha.\delta I.e^{-\beta t^{-\frac{1}{m}}}$, where y is the current, α the sensitiveness of the cell, β and m its inertia constants, and e the base of Naperian logarithms. For two cells to be combined to the greatest advantage, we must have them such that if their equations are respectively

$$y_1 = \alpha_1 \delta I.e^{-\beta_1 m^{-\frac{1}{t}}}$$

and

$$y_2 = \alpha_2 \delta I.e^{-\beta_2 m^{-\frac{1}{t}}}$$

then

$$\frac{d(y_1 - y_2)}{at} = 0.$$

This makes the condition for good compensation that

$$\alpha_1 \beta_1 = \alpha_2 \beta_2.$$

m is usually almost constant, and with suitable Giltay cells is about two-thirds.

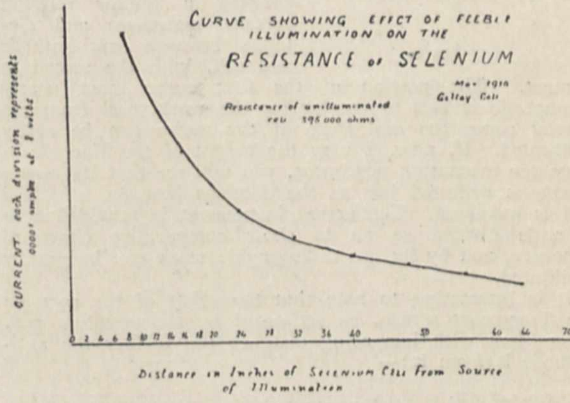


FIG. 7.

In practical language, the condition for compensation is that the principal cell should have great sensitiveness and a small inertia constant, the compensation cell low sensitiveness and a high inertia constant, the product of sensitiveness and inertia constant being the same in the case of both cells.

The physical properties of selenium are of such importance that I feel I may be allowed to digress for a few moments to show one way in which they may be utilised to solve a problem that has long occupied many investigators, viz. the satisfactory measurement of the beam of heterogeneous rays from an X-ray tube. Whenever a new tube is used in radiographic work, a different voltage, or different interrupter or coil, the time of exposure for the photographic plate has to be determined anew. The strength of the tube under any conditions can, however, be determined by means of a simple piece of apparatus which I have constructed, the working of which I shall now be able to show you.

If the X-rays fall on a fluorescent screen of barium platino-cyanide, the screen absorbs them and emits yellowish-green visible rays; this transformed energy is capable of affecting a very sensitive selenium cell when placed in contact with the screen, the resistance becoming less the greater the fluorescence. You will see here a selenium cell of approximately 395,000 ohms resistance, over which is placed a small fluorescent screen of the same size; the cell is put in series with a battery of 100 volts and a milliampere meter, the divisions of which may be made to correspond to some arbitrary scale or to the time necessary for the exposure of a given make of photographic plate.

The dividing of the dial depends on two things: first, the characteristic curve of the selenium cell connecting its resistance with the strength of illumination, the linear distance of the source from the cell being, in this case, the most convenient to employ.

Second, this characteristic curve must be modified to meet the case of illumination by the rays from the anti-kathode, which do not necessarily diminish in their power to make the screen fluoresce as the square of the distance from it. You will see on the screen the characteristic curve of a selected selenium cell for feeble illumination, the maximum being of about the same wave-length as that of the fluorescence, showing the relation between resistance and distance separating the source of illumination and the cell, and also the modified curve showing a similar relation between resistance and distance between anti-kathode and cell, with the screen in contact. The portion of the first curve most nearly asymptotic is best to employ for the work, and from the second curve the dial scale of the metre can be easily calibrated. If, now, I vary the height of the X-ray tube from the measuring apparatus, you will see that the metre needle is deflected less as the distance between tube and cell is increased. The actual instrument is provided with a scale divided so as to show comparative times of exposure, and by its use radiographic work can be greatly facilitated.

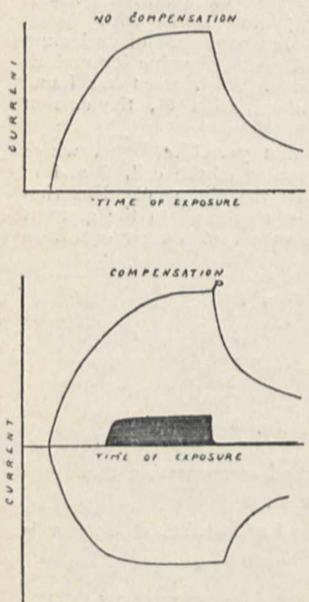


FIG. 8.

It is interesting to note that the effect of the rays on the fluorescent screen, as estimated by the selenium cell, differs less with increasing distance the further the anti-kathode is from it:—

Distance of anti-kathode from apparatus Inches	Current recorded in milliamperes	Difference
6	0·33	—
8	0·27	0·06
10	0·22	0·05
12	0·20	0·02
14	0·18	0·02
16	0·16	0·02

A good deal of time has, I am afraid, been taken up in giving details of apparatus; but I will now show some of the results that have been obtained in practice. The selenium machines already referred to were operated between Paris, Manchester, and London until the end of the year 1908. The first photograph received (slide) was of King Edward, and was received at the *Daily Mirror* installation in November, 1907. Several results will now be shown in the lantern, and you will observe that they are all composed of parallel lines, which widen or "thin" according to the density of the picture. These lines correspond to the movement of the shutter attached to the strings of the Einthoven galvanometer, which regulates the thickness of the spot of light focussed on the revolving sensitive film. This spot of light traces a spiral line round the film, which, when developed, is laid flat, and the spiral becomes resolved into so many parallel lines.

Late in 1908 Prof. Korn introduced his telautograph, in which a Caselli transmitter, such as already described for the telectrograph, is used, and a line sketch or half-tone photograph is attached to the drum. The receiver is similar to that used in the selenium machines, a spot of light cast on a revolving sensitive film being shut off every time current flows through the wire of the galvanometer and displaces it; when displaced, the shadow of the wire falls over a fine slit placed in front of the film, and so prevents the light from passing through to it. A line sketch transmitted from Paris to London in this way is now shown (Fig. 2). The methods of synchronising the sending and receiving cylinders is the same as that used in

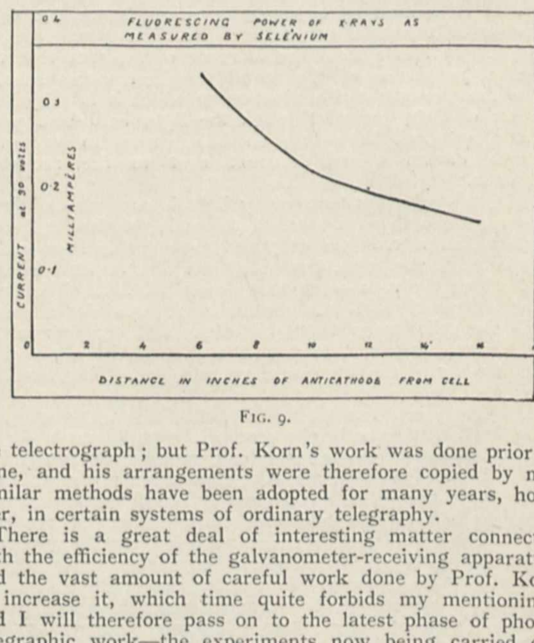


FIG. 9.

the telectrograph; but Prof. Korn's work was done prior to mine, and his arrangements were therefore copied by me. Similar methods have been adopted for many years, however, in certain systems of ordinary telegraphy.

There is a great deal of interesting matter connected with the efficiency of the galvanometer-receiving apparatus, and the vast amount of careful work done by Prof. Korn to increase it, which time quite forbids my mentioning; and I will therefore pass on to the latest phase of phototelegraphic work—the experiments now being carried out to effect wireless transmissions.

The wireless apparatus for transmitting sketches, writing, or simple photographic images over distances up to about fifty miles may perhaps be looked upon as rather rudimentary, but I shall be able to show, from actual results, that it is at any rate practicable, and it is certainly more simple than any method based on later wireless researches.

I will first show you an experiment, for the simplicity of which I must ask your pardon; but it illustrates so clearly how easy it really is to transmit a photograph by wireless under ideal conditions. I have here a small electric lamp, coupled up with the local side of a relay and battery, the relay being actuated by means of a coherer detector. At the other side of the platform there is a Morse key, which, when depressed, closes the primary circuit of an induction coil, the secondary being coupled up in the usual way to give oscillations. When I press the key, and thereby send a signal, you see that the lamp at once lights up. If the coherer be tapped, the lamp is extinguished, and another tap of the Morse key causes it to light again.

Now suppose that the taps of the Morse key were controlled by the lines in a photograph or sketch, and that the light from the lamp were concentrated on a revolving photographic film, and you will see at once how a photograph could be transmitted by wireless telegraphy.

Such a process would be utterly impracticable commercially, but my telectrographic system can be used with success in its place. A line picture prepared in the way already described is attached to the drum of the transmitter, and the intermittent current, which is ordinarily

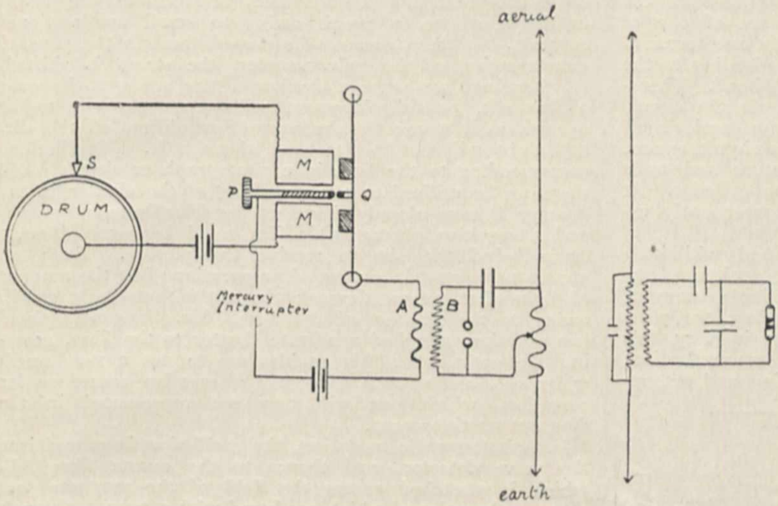


FIG. 10.

passed into the telephone line, goes into an electromagnet, M in Fig. 10, which then attracts a soft iron diaphragm attached to brass springs, which are fixed to two rigid supports. Every time current flows through the magnet coils this diaphragm is attracted to it, and the platinum contacts PQ are brought together; when the current flows, and PQ are in contact, the primary circuit of a transformer is closed, and the secondary having a spark gap and being inductively coupled to the aërial and earth, a signal is transmitted into space. Thus in the wireless transmitter the only difference from ordinary telegraphy lies in the fact that the length of the signals and their distance apart are regulated by the lines composing the sketch or photograph.

When working with high voltages in the primary, such as 110, arcing is liable to take place, and hence the distance between *p* and *q* when not attracted must be considerable. This means that the distance between the diaphragm clamps, *ss* in the figure, must be short, and the German-silver spring of which the diaphragm is made must be thick, these two conditions making the natural period of vibration very short. I have, however, found that by interposing a mercury motor-interrupter in the primary circuit, arcing is almost entirely avoided, as if an arc be formed the current is interrupted an instant later, and the arcing ceases in consequence.

The receiving apparatus is very simple, and depends, for short-distance work, upon a coherer cymoscope, the decohering apparatus being of a particular character. Every time an oscillation passes to the antenna, the coherer becomes conductive in the ordinary way, and a relay is actuated; this relay is usually made to start a hammer vibrating, the hammer hitting the coherer, and thus causing it to lose its conductive power. But a vibrating hammer is useless for the photo-telegraphic receiver, and it is essential to have one strike only on the coherer for each signal detected.

The form of apparatus I have employed for this purpose is seen diagrammatically in the next lantern-slide (Fig. 11). EE is the magnet which is actuated by the relay R. It then attracts an armature MN, which moves towards the magnet poles and brings a resilient hammer H, fitted with a platinum contact *p*, against the coherer. The coherer AB is also fitted with a collar F and contact pin, so that in the act of striking the coherer the hammer closes a local circuit, and so causes a black mark to appear on the chemical paper. Successive distinct marks can be obtained in 0·017 second in this way, which is considerably more rapid, I believe, than a decoherer was given credit for.

There is not sufficient time to show an actual transmission by wireless, and I should like to make it clear that only sketches of the simplest character are at present being transmitted; but, as you will see from the result thrown on the screen—a simple portrait of His Majesty the King—the images are recognisable, and merely require slightly more detail to make them quite comparable with the early results in line obtained by Prof. Korn's telautograph.

Another result shows a plan transmitted by wireless; here an island is seen represented, and a lighthouse—or it might be a fort—and by means of letters the positions of sections of an army on the island are supposed to be designated, while the shaded portion might mean that the "enemy" is in that part of the island. Such plans as these could be drawn direct in shellac ink on a slip of metallic foil, placed upon a portable machine coupled to a portable military wireless set, and communicated from one section of an army to another. The small portable machines I have already shown are used for the wireless transmissions, and they possess the advantage that "tapping" of the communications would be quite impossible. It is for this reason that I think the method would be of such value for military and naval purposes; even supposing that anyone wishing to intercept a plan or written message were to have an exactly similar instrument, with the same dimensions, screw-threads, and so on, by merely altering the rate of running by 5 or 10 per cent., according to prearranged signals, the picture as received by the intercepting party would be quite unintelligible and confused.

We have already seen that in the telegraphy of a picture by any system, accurate synchronising of the sending and receiving apparatus is essential. Where a metallic circuit links the transmitting and receiving instruments together, the matter is an easy one, and we have seen in what way it is effected. But when dealing with wireless work, the question of synchronism becomes more

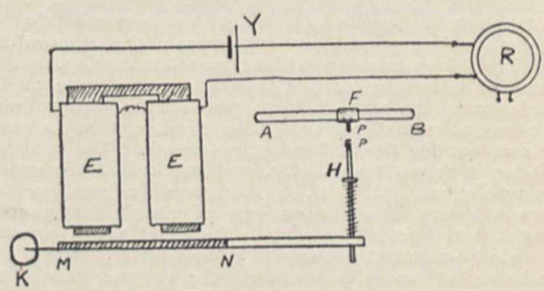


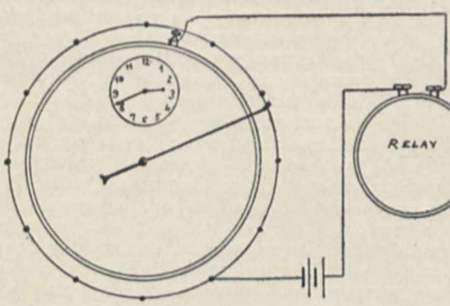
FIG. 11.

serious. I have employed two methods, each of which appears to answer satisfactorily, and as they are very important I will devote a few moments to their description.

The first method secures accurate synchronism independently of any wireless communication. You have already seen how, in the ordinary telegraphic work, the receiving cylinder is driven rather faster than the sending one, and when it finishes up a complete turn too soon it is arrested until the sending cylinder has caught it up, when the latter sends a reverse current, which is responsible for its release. But in the wireless apparatus both sending and receiving cylinders are driven too fast, so to speak—that is, they are made to revolve in 4⅘ seconds instead of a nominal 5. A check comes into play at the end of the revolution, and the cylinder is stopped until the 5 seconds are completed, the motor working against a friction clutch in the ordinary way during the stop. At the end of the fifth second each cylinder is automatically released by chronometric means, in the manner shown in the next diagram (Fig. 12).

Here you will see that a special form of clock is used, with a centre seconds' hand which projects beyond the face by about an inch, and to the end of it is attached a brush of exceedingly fine silver wires. At every twelfth part of the circumference of the clock dial is fixed a platinum pin, and consequently every five seconds the little brush wipes against the convex surface of one of them. Each of these pins is connected with one terminal of a battery B, the other side of the battery leading to the relay R, as does also the centre seconds' hand. Therefore each time the brush wipes against a pin the circuit is closed, and the relay throws into action the local circuit connected up with the terminals TT. This circuit excites an electromagnet, which attracts an armature and pulls away the check which is holding back the cylinder. At the end of each 5 seconds the cylinders consequently recommence turning.

Well calibrated clocks of the pattern used will keep good time for the period taken to transmit a picture, one gaining on the other quite an inappreciable amount, depending on the friction of the brush against the pins. By this means the two cylinders are kept in very fair synchronism independently of any wireless communication, and the less the interval between the stopping and restarting of the cylinders be made, the more accurate and satisfactory will be the effect.



CHRONOMETRIC SYNCHRONISER FOR WIRELESS APPARATUS

FIG. 12

The other method of synchronising is controlled by electromagnetic oscillations. Let us suppose that a coherer is being used as cymoscope; the transmitting cylinder is kept running without any interruption, but by means of a fleeting contact it sends out a wave at the conclusion of its turn, a bare space in the picture being necessary about half a second beforehand, so that no waves are sent out for the half-second previously. The receiving cylinder is driven too quickly, and checked at the end of the revolution. It then, by means of a cam pressing down a spring lever, throws out of circuit the marking current, and brings into circuit the relay which actuates the electromagnetic release. Consequently, when the synchronising wave is received, the coherer causes the relay to work, the release is effected, and the receiving cylinder starts a new revolution in unison with the transmitter.

This means of synchronising is only possible in cases where a cymoscope is employed that is capable of actuating a relay, and you will therefore see that it is out of the question, except for short distances. I am therefore using the chronometric system already described in the apparatus, and it is being embodied in the quartz fibre apparatus I am now about to describe. I must first remark that the wireless work has been greatly facilitated by the courteous assistance so readily given by the Marconi Company.

The general form of the Einthoven galvanometer is well known, and the modified type of it used by Prof. Korn for photo-telegraphic purposes has been already shown. If, now, we make the magnetic field very much more intense by building the field magnets heavier, and using a large number of ampere turns in the winding, and also employ a "string," which is very much more elastic than the silver ribbon, the displacement of the string will be correspondingly greater. The silvered quartz fibre used by Duddell for this purpose gives an extremely sensitive instrument, and very appreciable displacement is obtained with the current from one dry cell passing through 35 to 90 megohms resistance.

It is not long since Prof. Fleming explained at this institution the valve receiver for detecting wireless oscillations; in ordinary wireless telegraphy, the minute alternating currents are rectified, and sounds are heard in the telephone in circuit owing to small unidirectional currents. If these currents be passed through the silvered quartz string of the galvanometer, the string is shifted. If, therefore, we cause a shadow of the string to lie over a fine slit, any displacement will cause the slit to be opened, as it were; the shadow will be shifted off the slit, and light will be free to pass through it. Oscillations corresponding to the lines in a photograph or sketch could therefore be utilised to cause shifting of the shutter in the manner I have already described for Korn's telautograph, and a sensitive photographic film could be revolved on a drum beind the slit to receive the picture. Such an apparatus is now in course of preparation; but the amount of light that passes through the slit is extremely small, owing to the fineness of the fibre. Mr. Sanger-Shepherd has therefore attached a minute shutter to the fibre, crossing the optic axis; this enables me to use a very much wider slit, and also to adopt the alternative procedure for reception, which you will now see represented in the diagram on the screen.

For photographic reception, the oscillation is passed into the valve detector, and thence to the quartz fibre AB, which is stretched across the field of the magnets (not shown), the poles of which are bored with a tunnel, through which the beam of light is directed. When the fibre is displaced, light is enabled to pass through a fine slit W, and so act on the photographic film. Where, however, the shutter is attached to the fibre, a much wider slit can be used, and then a pair of narrow compensated selenium cells SS are placed behind the slit W, a positive lens being interposed. When a signal corresponding to a dot in the photograph (*i.e.* the traversal of a line by the stylus) is received, the fibre shifts, light falls on the cells SS, and their resistance is decreased sufficiently to enable the battery E to actuate the relay R. This closes a local circuit, in which the telectrograph receiver is included, and a mark appears on the paper. In this way a visible record is obtained, which greatly facilitates the process.

Wireless photo-telegraphy may eventually prove of more utility than the closed-circuit methods, because it would bring America within reach of this country, and would enable communication to be made where telephone or telegraph lines did not exist. It is not limited to photographs—banking signatures, sketches, maps, plans, and writing could be transmitted. But I would point out most particularly that the work is as yet in the very earliest stages, and that in giving you some account of it to-night I may be bringing before your notice methods and systems on which a few years hence you will look back with a smile—as curious merely from a historical point of view.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE inaugural address on the occasion of the opening of the winter session of the London School of Tropical Medicine will be delivered by Prof. H. A. Miers, F.R.S., principal of the University of London, on Friday, October 14.

THE calendar of the faculty of medical sciences of University College, London, is now available. The college is a university centre for preliminary and intermediate medical studies, and its faculty of medical sciences comprises the departments of physics, chemistry, botany, and zoology (the preliminary medical sciences); also the departments of anatomy, physiology, and pharmacology (the intermediate medical sciences), and the departments of hygiene and public health and of pathological chemistry (post-graduate study). Prof. G. D. Thane is the dean of the faculty, and Prof. J. P. Hill the vice-dean. The calendar contains full particulars of the general arrangements for the coming session and of the scholarships and exhibitions open to competition.

THE following courses in illustration of recent progress in various departments of physical investigation will be delivered at the Royal College of Science (Imperial College of Science and Technology), South Kensington, during the autumn:—About ten lectures on "Colour Vision," by Sir William De W. Abney, K.C.B., F.R.S., beginning on Tuesday, November 8; about ten lectures on "Spectroscopy," by Assistant-Professor A. Fowler, F.R.S., beginning on October 10; about ten lectures on "The Internal-combustion Engine, illustrated by a Study of the Indicator Diagram," by Dr. W. Watson, F.R.S., beginning on October 13; about nine lectures on "Radio-activity and Electric Discharge," by Prof. the Hon. R. J. Strutt, F.R.S. The following courses, of about ten lectures each, will be given after January 11, 1911 (details to be announced later):—"Measurement of High Temperatures, and Optical Pyrometry," by Prof. H. L. Callendar, F.R.S.; "Magnetic Properties of Metals and Alloys," by Dr. S. W. J. Smith.

ON December 21, 1909, the London County Council decided to make a maintenance grant of 8000*l.* to the Imperial College of Science and Technology, South Kensington. In return for this grant it secures the privilege of nominating twenty-five students for one year's free instruction at the Imperial College. These are now to be filled for the first time. The instruction will be of an advanced nature, and therefore only advanced students who are qualified to enter on the fourth year of the course should apply. There is no restriction as to income, but intending candidates must be ordinarily resident in the administrative county of London, and must be students at an institution aided, maintained, or approved by the Council. The free studentships do not entitle the holders to any maintenance grants, but cover all ordinary tuition fees. No examination will be adopted for the final selection of the students from the applications received. The free studentships will be awarded on consideration of the past records of the candidates, the recommendations of their teachers, the course of study they intend to follow, and generally upon their fitness for advanced study in science applied to industry. It is quite possible that, in special cases, the free places may be extended to two or more years. Owing to the summer recess, it has been decided to accept entries for the free places until Saturday, October 1. Application forms (T. 2/268) can be obtained from the Education Officer, London County Council, Victoria Embankment, London, W.C.

THE new University of Queensland is now inviting applications in England and Australia for four professorships, in classics, in mathematics and physics, in chemistry, and in engineering. The selection committees will enter on their duties at the end of this month, and it is expected that the men who are to be the nucleus of the first staff of the University will be ready to begin work in the new year. The inauguration of the University was held on the fifteenth of last December, the fiftieth anniversary of the day when Queensland first became a self-governing colony. The event was the occasion of a very large gathering at Government House in Brisbane, when the Premier, Mr. Kidston, announced that his Government had set aside 50,000*l.* to meet initial costs; that 10,000*l.* a year was to be provided for working charges; that the historic building where the meeting was held, together with its beautiful grounds and gardens, was to be dedicated to university purposes; and, finally, that a large number of scholarships, including research scholarships, were to be offered to students. The unveiling of the commemorative tablet was one of the first acts performed by Sir William MacGregor in his capacity as Governor of Queensland. With one exception, all the Australasian States have now placed universities at the head of their educational systems, and it is expected that Western Australia will soon follow the example of her sister colonies. Considering the youth of these States—Queensland herself is only celebrating her jubilee—this is surely a very notable thing. Moreover, some of these universities are magnificently endowed and equipped, and all of them exercise considerable and fast-growing influence over the thoughts and the material progress of the countries which they serve.

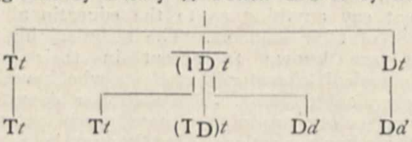
THE address on schools of dyeing, delivered by Mr. S. H. Higgins to the Manchester section of the Society of Chemical Industry last March, has been reprinted from the journal of the society, and a copy has reached us. Mr. Higgins thinks that British schools compare very favourably with those in other countries. England does not, he maintains, occupy a second place to Continental schools so far as equipment is concerned. Moreover, to quote from the paper, he says,—"In Germany the schools are not very particular as to the quality of the student they admit; they make an effort to get as many as possible. It has been said that students from the high schools pass through the schools of the Crefeld type before entering industry; but such cases are exceptional, as these men have other outlets for their training. A student from a technical high school does sometimes find his way into a trade school, and then the authorities show their delight; they do not say anything as to the educational standard of the bulk of their students. The technical high schools themselves are known to accept in their specialised technical chemical laboratories students who have had little previous chemical training. The volunteer departments of the German colour works are now much patronised in place of the schools mentioned, but it must be remembered that the training obtained in these departments, although good, cannot be a substitute for attendance at technical schools." The tone of the address is optimistic throughout, and by way of summary the address states:—"The dyeing schools of other countries do not compare with those at, *e.g.*, Leeds, Manchester, Bradford, and Glasgow, and even with many others of lesser importance in these islands. Just as we lead in the production, preparation, dyeing, bleaching, printing, and finishing of textiles, so also is this lead maintained as far as the technical instruction applied to these industries is concerned. Also it must be said that there is little difference between the positions of England, Germany, and America as regards the appreciation which manufacturers show of the training received at these institutions." In the discussion which followed, the principal of the Manchester School of Technology said he had more respect for the school at Crefeld than Mr. Higgins, and went on to emphasise the fact that in nine German technical high schools there were 13,500 students, none of whom were under eighteen years of age, while in ninety-nine English institutions, including the science sides of the universities, and students from fifteen years of age and upwards, they did not reach more than 5000 a few years ago. The greater number of students in technical schools in Germany were undoubtedly men who had passed the gymnasia or the Ober-Real Schule, where they remained until they were at least eighteen years of age. The technical schools in this country had comparatively few students in the daytime. The preparation of the student made all the difference.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, July 18.—Dr. R. H. Traquair, F.R.S., vice-president, in the chair.—Francis J. **Lewis**: Plant remains in the Scottish peat mosses, part iv. Four areas are considered: (1) the Shetland Islands; (2) Poolewe district in Ross-shire; (3) Rhilochan district of east Sutherlandshire; (4) raised beaches at Ardgour and Banavie, with an appendix on some peat areas in south-west Iceland. In the Shetland deposits there are two peat growths at two distinct periods, the earlier being stratified, the newer not. Special attention was paid to the position and the flora of the forest bed, the wide distribution of well-grown trees of birch, alder, and mountain ash in districts now quite devoid of trees, indicating a decided change in meteorological conditions. Evidence was brought forward that the first and second Arctic beds and the lower and upper forest are true datum lines traceable through extensive areas in Scotland. The view is taken that the first Arctic bed, the lower forest, and the second Arctic bed represent distinct climatic phases during early post-Glacial times.—Dr. D. Berry **Hart**: The validity of the Mendelian theory. In Mendel's well-known experiment of the crossing of the tall and dwarf varieties of pea, the first generation of plants gave all talls, and these when self-fertilised gave *somatic* talls to dwarfs in the ratio of 3/1. The dwarfs then bred pure, while the somatic talls gave pure talls and impure talls in the ratio of 1/2, and so on. The tall character being called dominant and the dwarf recessive, the question has to be answered, "How is the recessive quality represented in the plant of the first generation?" By regarding the plant as having a propagative and somatic part, and the oospore or zygote as having a part set aside for the propagative and one for the somatic part, Dr. Hart proposed to amend the Mendelian scheme as follows. Using TD to represent the tall and dwarf propagative parts, and *td* their somatic parts, then T*t*, D*d* will represent pure talls and dwarfs respectively. In the first generation of plants only *t* is present, although T, D both exist pure or mingled. Hence the following scheme:—

Egg-cells of Dwarf × *Pollen Grains of Tall.*



All the Mendelian ratios are satisfied. The answer to the question, "Where is the recessive quality in the first generation?" is that it is present pure in the propagative part of a quarter of the zygotes, present along with the tall determinants in a half, and not at all in the somatic part of the zygotes. The unit characters segregate out in the Mendelian ratio in plants because the determinants of these combine in the propagative part by the law of frequency. This explains why biometric results, measurements of organs, &c., follow the law of frequency or some modification of it.—Dr. John **Aitken**: Did the tail of Halley's comet affect the earth's atmosphere? The measurement of the number of dust particles during the passing of Halley's comet was made in the West Highlands at a place where in previous years Dr. Aitken had made a series of similar measurements. Some curious results regarding the prevalence of haze during May of this year were obtained, but none of these could be connected with the comet.—Sir David **Gill** exhibited some photographs of the comet which had been taken in the Transvaal just before the comet passed in front of the sun.

PARIS.

Academy of Sciences, August 8.—M. Boussinesq in the chair.—H. **Deslandres**: The properties of the polar filaments of the sun. As the sun-spots diminish, the filaments at the centre are also reduced, but the filaments round the poles remain. The causes of this are discussed.—Ch. **Lallemand**: The changes of level caused by the Messina earthquake. The changes of level produced by the earthquake are shown on a map of the Messina and Reggio districts. In the neighbourhood of these two towns the displacement is about 60 centimetres.—A. **Laveran** and A. **Pettit**: An epidemic disease in trout. This disease has been proved to be identical with the *Taumelkrankheit* of B. Höfer, and is caused by a parasitic Protozoa, resembling *Rhinosporidium kinealyi*, described by Minchin and Fantham.—Alfred **Picard**: The floods in the basin of the Seine during January and February, 1910. Remarks on the report of the committee on the Paris floods. A comparison of this flood with earlier inundations, and a discussion of the various proposals for preventing a recurrence.—A. **Perot**: The rotation of hydrogen in the solar atmosphere. The results obtained by the application of the interferential method accords with observations recently published by Hale.—G. **Darmois**: Correspondences with concurrent normals.—R. **de Saussure**: Concerning a reclamation of priority by E. Study.—H. **Larose**: The problem of a cable with transmitter.—Gabriel **Sizes** and G. **Massol**: The vibration of a tuning-fork. Rotating vibrations. The fork has two sets of vibrations, one in the plane parallel to that of the prongs and the other perpendicular to this plane. From these two as fundamentals, sixteen notes are produced.—G. **Austerweil** and G. **Cochin**: Certain causes of geranium smells. A study of the connection between smell and composition. The results are applied to the question of the formula of nerol.—G. **Friedel** and F. **Grandjean**. Lehmann's anisotropic liquids. The authors regard the conception of these fluids as liquid crystals as erroneous; they should be considered as representing a new state of matter as different from the crystalline state as an ordinary isotropic liquid.—H. **Hérissey**: The preparation of pure arbutine. The arbutine of commerce is a mixture of arbutine with its methyl homologue. A method of separating these two substances is described, based on the conversion of the arbutine into a potassium salt, insoluble in alcohol.—C. **Tanret**: The relations between callose and fungose. In opposition to the views recently expressed by M. Mangin, the author regards callose and fungose as distinct substances.—Raoul **Bayeux**: Experiments made on Mt. Blanc in 1909 on the variations of glycemia and hematic glycolysis at very high altitudes.—C. **Jouan** and A. **Staub**: The presence of hæmolytic and bacteriocidal alexine in the plasma of birds.—Charles **Nicolle** and E. **Conseil**: Some new experimental data on exanthematic typhoid.—Ed. **Retterer** and Aug. **Lelièvre**: The epithelial origin and development of Peyer's patches in birds.—Armand **Dehorne**: New interpretation of reduction in *Zoogonus mirus*.

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