THURSDAY, OCTOBER 24, 1901.

LIFE BY THE SEA-SHORE.

Life by the Sea-shore: an Introduction to Natural History. By Marion Newbigin, D.Sc., &c. Pp. viii + 344. (London: Swan Sonnenschein and Co., Ltd., 1901.) Price 3*s.* 6*d.* net.

MANY of the people who now live on the coast, or of the constantly increasing numbers who periodically migrate for a few weeks to the sea-side, must have often felt the need of just such a book as the one before us. It is suited to the junior student or the amateur who as yet knows little or nothing of marine life; it is moderate in size and price, and contains a wonderful amount of information; it is almost as refreshing as a dip in the briny itself, and in the treatment of its subject-matter it reminds us of Charles Kingsley's "Glaucus" and of Philip Gosse's "Year at the Shore," and other charming works of a former generation. We in Britain are a maritime people, we owe much to the sea, and we boast on all appropriate occasions of our connection with it. Surely, then, we ought all of us to have some elementary knowledge of oceanography—of our seas and their ways and their inhabitants. British naturalists in the past have done much to enrich marine zoology by splendid monographs, such as those of the Ray Society and some of Van Voorst's series; but the public at the sea-side cannot be expected to read monographs—or to understand them if they did—and the volumes of Gosse are out of print, and moreover are somewhat antiquated both in nomenclature and science.

The present little book by Dr. Marion Newbigin is quite up to date, and although scientifically accurate and sound is so delightfully simple that it can be read and comprehended by anyone at the sea-side who can collect common shore animals and compare them with the printed pages. It is food for babes compared with the monographs, but is at the same time sufficiently nourishing and stimulating to lead to the healthy development of sturdy young marine zoologists. Judging from the results I have had with some average school-girls of fifteen to eighteen upon whom it has been tried during the last few weeks, I should expect that this book will give rise to many delightful collecting expeditions, and after-hours full of intellectual pleasure when observing and identifying the specimens and reading up and verifying their characteristics. It is satisfactory, by the way, to see that Miss Newbigin insists upon the educational value of a certain amount of collecting and of species work—"and the identifying of species, though now sadly out of fashion, is an occupation which may yield one of the subtlest of pleasures." "So much of the present-day academical teaching seems to have [a certain] result, that I cannot but urge anyone beginning open-air studies to find some time for species work, and for this habits of patient and minute observation are essential," &c. (p. 25).

Our author is already known to zoologists from her papers on the pigments of Crustacea and other animals and her little book on "Colour in Nature." The present book, she tells us, is based upon a course of lectures—given presumably to Edinburgh students, as most of the animals dealt with, or chosen as types, are common east coast forms, and as a result one occasionally comes upon a remark that does not apply to other parts of our sea.

After a couple of introductory chapters on the conditions of shore life and the general characteristics of shore animals, such as shells, burrowing, weapons, partnerships, masking, larval characters, classification, hints as to methods, and so on, Chapter iii. starts with sponges and goes on to zoophytes. Then sea-anemones, worms, echinoderms, crustacea, molluscs, fishes and ascidians occupy the next twelve chapters, after which is a final section on the distribution and relations of shore animals, a list of works of reference and a double index. On the whole, perhaps the section on the higher Crustacea is the most full and satisfactory. The crabs seem especially well done, and also the polychætes. More space than the passing reference on p. 27 should have been given to the Protozoa. It is useless to pretend that the subject-matter of this book can be worked through without the microscope, and if that instrument is required for the triradiate spicules of the calcareous sponge, why should it not be applied to show us *Noctiluca* and *Ceratium* and *Rotalia* and *Folliculina* or some other equally common and important shore Protozoa? A short section on a few of the more abundant diatoms also would be justified by their great importance in connection with the food of animals in the sea, and ultimately of man.

One would rather not make any critical remarks—but few are needed—and if certain points are now noted which may seem to detract to some extent from the value of the book, they are not put forward in any fault-finding spirit, but are to be regarded rather as suggestions which may be of use to the author when a second edition is called for. There is a certain want of proportion in the amount of space allotted to different groups. For example, we find more than twenty pages, and a dozen figures, on the hydroid zoophytes, and less than twenty lines (no figures) on the Polyzoa, which are so constantly associated with the hydroids in shore pools and on seaweeds such as *Fucus* and *Laminaria.* It is difficult to see any reason for this and a few other cases of arbitrary selection. The two groups occur together, the Polyzoa are usually the more abundant and striking, the same methods of collecting and examining apply—the pocket lens will show a certain amount of the structure of the colony in each case, but a microscope is really necessary for both. And as to the æsthetic pleasures derived from beauty and charm of movement, I find that the commonest of shore Polyzoa—such as *Flustrella hispida*, found all round our coasts, in profusion, on *Fucus*—alive in a watch-glass of sea-water under even a low power of the microscope, protruding and retracting its crown of ciliated tentacles, is one of the most fascinating objects that can be shown to, or found by, the young naturalist on the sea-shore, and one of the most easily obtainable from which to demonstrate ciliary action and to give as an example of an animal collecting food by causing currents in the water.

I have alluded to the inadequate treatment of Protozoa. A more serious omission even is that of the Copepoda, a group of great importance amongst marine animals on account both of its numerical strength and of the activity and utility of its members. It is true that very many of these are obtained from the surface of the sea and not strictly from the shore, but that same remark applies equally to the medusoids discussed and figured in Chapter iii., and it would be difficult to catch the medusoids without seeing Copepoda also. But there are also plenty of shore-haunting copepods to be obtained very easily with a muslin hand-net in pools, or from sand and mud at low tide, and under stones. A small boy of six has just brought me a cup full of bright red ones (*Harpacticus fulvus*) which he caught himself with a sixpenny hand-net along the edge of the sea and in pools, where they are quite visible to the eye. He wanted to know what they were and how they jumped, and his little sister of two-and-a-half added the important question, "Why are they so red?" If Miss Newbigin would answer these questions—and no one is more competent than she to deal with the last one—it would help not only the children, but their seniors. *Harpacticus* is sometimes very abundant in pools far up the shore, where their red bodies are quite conspicuous on the green *Enteromorpha*, and they are eaten with avidity by young blennies, sticklebacks and other little shore fishes. "*Why are they so red?*"[1]

The "keys for identification" and other similar tables of characters at the ends of chapters are of doubtful utility. They are, of course, incomplete; they only deal with a few selected genera and species in each section, and yet from their form they give the deceptive impression of a complete classification; they lead to a good deal of repetition and give little information beyond what is in the text—a considerable saving of space would be effected by their removal. What is the difference between "legs very slender and long" given as a character of *Phoxichilidium*, and "legs very long and slender" as a character of *Nymphon* in the table on p. 224?

Dissection of the types chosen and details of internal structure have, probably quite wisely, been avoided; but under those circumstances some statements in the book, such as that "the heart is in front of the gill" (p. 248) given as a character of the opisthobranchs, will probably be found meaningless to readers without further knowledge than the book gives. Even one simple anatomical diagram of the type form of each group would have been a useful addition.

There are, of course, other points of detail in connection with which alterations might be suggested. *Asterina gibbosa*, very common in shore pools amongst *Corallina* on some parts of the coast, might be added to the starfishes discussed. The presence of thread-cells in the cerata of *Eolis* is an interesting point worthy of mention. *Trochus zizyphinus* (p. 236) is not merely an inhabitant of deep water, but is common, alive, between tide-marks on some of our shores. On the whole the figures are good, but *Alcyonium* (p. 16), *Polycarpa* (p. 295) and *Pleurobrachia* (p. 330) are not satisfactory.

The style of the book is easy and pleasing—lively even in places, as on p. 277, where the author describes how she first made acquaintance with the grace and beauty of the living *Lima hians* when released from its woven nest of shells and weeds. In conclusion, it is a pleasure to cordially recommend "Life by the Sea-shore" as a charming and useful holiday companion which will not only give much information, but will also serve as a good introduction to one of the most fascinating branches of modern science.

W. A. HERDMAN.

[1] Obviously, there are two kinds of answer—the one in terms of lipochromes and the other in terms of natural selection.

SCIENTIFIC TOPOGRAPHY.

Recherches sur les instruments, les méthodes et le dessin Topographiques. By Colonel A. Laussedat. Tome ii. Part i. Pp. 198. (Paris: Gauthier-Villars et Fils, 1901.)

IN the first part of the second volume of his exhaustive treatise on topography, Colonel Laussedat treats of "iconométrie" and "métrophotographie"—two branches of the art which are but little studied in British military schools. He commences by tracing the evolution of the photo-theodolite from the primitive forms of the camera obscura and the camera lucida; and not the least instructive part of this volume is to be found in the careful analysis of those principles of perspective which are the governing principles of all methods of reducing a field of observation to its horizontal plan, whether for the purpose of topography or of plan drawing. He shows that the camera lucida is an instrument which (in France at any rate) has proved of immense value in the hands of the military engineer. Some excellent examples are given by Colonel Laussedat of the practical use that has been made of this instrument in the construction of accurate geometrical views of fortifications, with the object of obtaining precise plans of the same, on the principle which was first advocated by Beautemps-Beaupré, and which is fully explained by the author. It is curious that an English invention (it was invented in 1804 by Wollaston) should have been applied to so much greater practical purpose in France than it ever has been in England.

From camera lucida drawings of the elevation of a line of fortifications, or of buildings taken from two or more points of view, French engineers have found it possible to construct accurate plans of the same fortifications on precisely the same principles which now lead to the definition of topography from photographs. With this instrument, combined with a telescopic enlargement of the field of view, the defenders of Paris during the last memorable siege were able to construct a fairly accurate panorama of the German advanced positions around the city, to note the daily and hourly changes in those positions, and to keep the military authorities perpetually supplied with most important information which would otherwise have been impossible to attain. In his concluding chapter Colonel Laussedat renders a well-deserved tribute of recognition to those many assistants (astronomers, doctors, engineers, artists and architects) who all brought the necessary technical artistic skill to his assistance and maintained that remarkable record. In England the camera lucida is still recognised as an important aid to the illustration of geological phenomena. But its capabilities as a military instrument have been hardly recognised.

From the camera lucida to the photo-theodolite is a natural process of evolution, and the best half of the volume is devoted to its illustration. The application of photography to surveying has already been well tested in many European fields, as well as in America. Some tentative efforts are now being made to introduce the photo-theodolite to India, but the results are hardly mature enough to justify any opinion as to their success. In France photo-topography has been chiefly applied to the field of that which we should term in England "revenue" or "cadastral" survey; and in Canada (a fact which is not recognised by Colonel Laussedat) a still wider opening has been afforded by the Geological Survey, which is practically a small scale topographical survey leading to the first general map of the country. There are, at any rate, records sufficient to enable us to bring the test of actual experience in other countries than France to bear on Colonel Laussedat's estimate of the capabilities of the system. That estimate appears to be absolutely favourable, but it must be contended that the illustrations which support Colonel Laussedat's opinion are not in themselves comprehensive enough to justify the conclusions at which he arrives, which would apparently include all classes of reconnaissance, or survey, in all conditions of ground as suitable for its application.

An official examination into the results of a photo-theodolite survey was conducted in Paris as long ago as the year 1859, and the report of the commissioners nominated by the Academy of Sciences was so favourable that in 1863 a "photo-topographic brigade" was formed, under the direction of Laussedat, which executed surveys on comparatively large scales (from 1/1000 to 1/20000), and which lasted for a period of eight years. The brigade was broken up in 1871, and whilst Colonel Laussedat refrains from commenting on the reasons for its suppression, he clearly indicates that it was for no reason which implied technical failure.

Various modifications of the original system are discussed or recommended, and one or two excellent illustrations of the resulting surveys are given at the end of the book. But it must be noted that the field of survey to which this process has been applied in France is after all but local, and the scale of mapping is comparatively large. For instance, we find in Plate xiii. a reproduction of about 15 square miles of country, originally surveyed on a scale approximating to 12 inches per mile (reduced to one-fourth in reproduction), to which the following details are appended. The survey was completed in ten days in the field, supplemented by two and a half months of subsequent work in the drawing office (bureau). It involved the use of fifty-two photographs, which were taken at thirty-one stations. Of these stations eighteen were stations of triangulation, and the rest "supplementary." The map itself is fully contoured and apparently quite up to the standard, in detail, of maps on a similar scale executed by the English Ordnance Survey. The time (and consequently the expense) involved in its production will of course compare favourably with that of any other known system of surveying; but it would be rash to infer therefrom that photo-topography is under all conditions either a cheap or a rapid method of surveying. In Canada good work has been done by this process on the smaller scales of one inch or two inches per mile, and the system generally is well established. But Canadian surveyors are not prepared to advocate it in entire supersession of the more widely known system of plane table topography based on triangulation, maintaining that its advantages are confined to comparatively restricted conditions of surface conformation. Thirty-one stations of observation in fifteen square miles of country (giving an average of two "fixings" per square mile) may under certain conditions be sufficient to enable a surveyor to see into the topographical detail of ridge and furrow, plain and gully, that the country presents, and result in a creditable map. But in a vast proportion of the broken and rugged districts presented by the varied physiography of Asia, Africa, or America two stations per mile would certainly not be sufficient, and the accumulation of photographs would rapidly become an unwieldy burden. When we consider the requirements of geographical surveys on yet smaller scales (say 1/500000) it is impossible to concede that the recognised systems of rapid plane tabling in experienced hands, which result in daily outturns which may be reckoned in scores of square miles of finished mapping (no "bureau" work is required by a really well-trained topographer), can be surpassed in rapidity by any more complicated process which has yet been invented.

Possibly the discussion of the application of photography to this most important field of geographical survey may be reserved for a future volume, although it might certainly have been usefully included in the present one. The author is at any rate on perfectly sound ground when he recommends every explorer who makes use of photography for illustrative purposes to fix the position of his views and the direction (or azimuth) of them with careful exactness on his route map; with the assurance that in scientific hands they will prove of immense value in elucidating the topography of the country which they illustrate if they are thus registered.

There is no work in the English language equal to that of Colonel Laussedat as a comprehensive and up-to-date review of the history and development of topography; in the value of its scientific deductions and illustrations; or in the interest which is sustained by the literary skill exhibited. It should find a place in every library of civil or military engineering institutions which professes to maintain an efficient stock of standard works for reference.

T. H. H.

EUCLID REVISED.

Euclid's Elements of Geometry. Books i.–iv., vi. and xi. By Charles Smith, M.A., and Sophie Bryant, D.Sc. Pp. viii + 460. (London: Macmillan and Co., Ltd., 1901.) Price 4s. 6d.

IF Euclid is to continue as the foundation of geometrical teaching in our schools, this work must be very warmly welcomed. The exact order of Euclid is followed, but (as the editors inform us) with no special regard to the exact words of the translation of Simson (who for a moment becomes "Simpson" in the foot-note on p. 79). There is also a complete absence of the mechanical chopping up of each proposition into separate blocks under the heads of "general enunciation," "particular enunciation," "hypothesis," "construction," "to prove," "proof," "conclusion," which in some text-books, and in the minds of many boys, has reduced the whole subject to an artificial jargon.

Mrs. Bryant, both as an expert logician and as the daughter of a fellow of Trinity College, Dublin (Rev. W. A. Willock), who had no belief in the appropriateness of Euclid's book except to "grown-up, hard-headed, thinking men," was sure to remove from the path of the young pupil as much of the essential difficulty of Euclid as could be removed consistently with the retention of the book as the basis of school instruction.

To follow the subject in detail, we notice that the editors have deliberately left out alternative proofs of the "Asses' Bridge" on the ground that Euclid's proof is found by experience to be more readily understood than any of the alternative proofs—a statement which surely cannot be well founded. What can be more simple than the proof founded on the superposition of two identical triangles? And, again, if we imagine the bisector of the vertical angle to be drawn, we have the result as a direct consequence of prop. iv. It is not to the point to object that Euclid will not allow us to imagine this bisector unless we can show how to draw it; if the bisector were drawn, the result would follow—that is proof enough. At the end of Book i. there is a large collection of worked-out theorems and problems; and we may specially notice the excellent exposition of the method of analysis and synthesis in pp. 102–106, which will greatly help the pupil who is learning this method of attacking problems. Besides these worked questions, there is a collection of 100 unworked exercises in illustration of Book i.

In Book ii. the fundamental propositions 12 and 13 are proved as an extension of the proposition of Pythagoras (47, Bk. i.) by the famous old windmill figure so familiar to us all; and, as the editors inform us, this proof is found in Lardner's Euclid, but cannot be traced further back. It is strange that the editors of our school Euclids should have overlooked this most interesting and graphic proof. Lardner's Euclid, now seldom seen, is—even compared with the best modern editions—a work of great usefulness and high merit.

There is a note at the end of Book ii. (p. 148) the substance of which is that pure geometry must be kept severely apart from all arithmetical conceptions; and this is followed (p. 150) by a still more remarkable note stating that "in all examinations" the use of + and −, of the abbreviation AB^2 for *the square on* AB, and of the abbreviation AB . BC for the rectangle AB, BC, is permitted in writing out all theorems and problems of geometry, provided that these are not] given in Euclid's text.

Why such an extraordinary distinction and restriction should exist is incomprehensible to us, and remains so even after we have read the excuse put forward for it by the present editors; and after this excuse comes the statement

"the use of these symbols ought never to be allowed at any time until it is clear that AB^2 and AB . BC are used by the student simply as the shortest way of writing the square on AB and the rectangle contained by AB and BC, respectively."

Thus the divorce of all arithmetical conception—and, indeed, all quantitative conception—from geometry is advocated; and if the restriction were really carried out both by teachers and by examiners (which it is not), the teaching of the subject would be rendered much more slow and difficult than it is at present.

Book iii. ends with a very large collection of worked-out questions followed by 100 exercises, a very good feature being the association of each famous result with the name of its discoverer; and a similar remark may be made with regard to Book iv. Book v. is omitted, only the definitions required in Book vi. being given. Euclid's test of proportion—*i.e.* of the equality of the ratio A : B to the ratio C : D—is given and applied to six special cases (p. 293) under the heading "Theory of Proportion." This test is, of course, that C : D will be the same as A : B if when $mA \gtreqless nB$ we have $mC \gtreqless nD$; and we wonder whether any beginner in the world is introduced to the notion of the equality of ratios by this means. Probably without a single exception, every boy is first told that 4 : 2 is the same as 6 : 3, because 2 is contained in 4 just as often as 3 is contained in 6; and even if the one quantity were not contained an integer number of times in the other, he would be prepared to admit and understand the equality of ratios if this number was an endless decimal, provided it was the same for the two compared ratios. Euclid's test must infallibly be received by the beginner merely as the *ipse dixit* of Euclid; the beginner cannot understand its validity apart from arithmetical notions; and it seems rather grotesque to find it formally employed to prove such a trifle as "magnitudes which have the same ratio to the same magnitude must be equal." Lardner has, as usual, some excellent remarks on this criterion; but his exposition amounts to no justification that could possibly convince the mind of a beginner. Hear also the opinion of the Rev. W. A. Willock on the question ("Elementary Geometry of the Right Line and Circle," p. ix.):—

"The criterion of proportion used is that of Elrington, by *sub*multiples. This test is here adopted because it is more readily understood by young students, and also more conformable to the common notions of proportion. Moreover, it holds good, in all strictness, for commensurable magnitudes; and, as to the incommensurable, it holds equally good if the equisubmultiples taken of the first and third terms be infinitesimals. . . . The right conclusion as to the two tests is, probably, that both should be given in a treatise on elementary geometry, each having its own peculiar advantages."

At the end of Book vi. follows what may be regarded as a small encyclopædia of important results and methods—coaxal circles, harmonic ranges, poles and polars, centres of similitude, inversion, maxima and minima, &c.—an invaluable collection, excellently handled.

Book xi. calls for no detailed remarks: its accompanying illustrations are of the same high order of merit as that which characterises all the special work of the editors.

OUR BOOK SHELF.

The Life-History of British Serpents and their Local Distribution in the British Isles. By Gerald R. Leighton, M.D. Pp. xvi + 383. 8vo. Illustrated. (London: W. Blackwood and Sons, 1901.) Price 5*s.* net.

THE idea of supplying the "field-naturalists of the British Isles" with a handbook dealing with the life-history of the native snakes and their distribution is an excellent one. The existing treatises on British reptiles are either antiquated or compiled by writers insufficiently versed in the subject. It is only regrettable that Dr. Leighton, whilst engaged in the preparation of this little work, which contains much interesting matter, should not have made himself more thoroughly acquainted with what has been published on the subject, in England at least, as we notice the omission of important information which might have been obtained through reference to the volumes of the *Zoologist* and to the British Museum Catalogue of Snakes, of which he appears to be ignorant. The descriptions of the three species which make up the British ophidian fauna are inadequate, and this is all the more to be regretted since many points of structure and coloration which are subject to variation would have afforded an important topic in which to arouse the interest of the field-naturalist.

The reproduction of many of the photographs which are liberally scattered through the work leaves much to be desired, and the figures of the head-shields of the ring-snake or grass-snake and the smooth snake, as well as of the scales round the eye in the adder, are very inaccurate. True, the work is only intended for the non-scientific, who may perhaps not feel inclined to be too exacting on these points, if we bear in mind how few have the necessary training of the eye, in matters reptilian, to detect inaccuracies which would hardly be tolerated if they applied to birds or insects.

The book is made up to a great extent of letters from correspondents and of newspaper cuttings referring to distribution, size and habits, the adder's "swallowing of the young for protection" being, of course, the heading of an important chapter. All this is very useful and interesting information, and is well commented upon by the author.

It is not without surprise that we notice an attempt to restore the "small red viper," *Coluber chersea* of Linnæus, to the rank of a distinct species, under the new name of *Vipera rubra*, which is regarded by the author as "quite as distinct from the ordinary adder as a swallow is from a martin." On the other hand, Sowerby's *Coluber dunfrisiensis*, which still appears in the synonymy of the smooth snake (*Coronella austriaca*), is a distinct species, which inhabits North America and was erroneously ascribed to Scotland. In describing the common grass-snake it should have been stated that the yellow or orange collar is sometimes absent in adult specimens. It is held by most observers who have kept this snake that its food consists of nothing higher in the vertebrate scale than batrachians; but Dr. Leighton informs us that one of its most favourite meals consists of mice, and that it also feeds on water-voles and birds. The only instance known to the writer of this notice of a grass-snake containing a mouse is that of a sciagraph exhibited before a meeting of the Zoological Society of London a few years ago; but an inquiry elicited the fact that the mouse had been forcibly introduced. It is desirable that Dr. Leighton should adduce some more precise data in support of his statement.

In spite of the defects to which we have drawn attention, this little book will be of use and interest to field-naturalists, and will no doubt result in greater attention being bestowed on a somewhat neglected section of vertebrates.

G. A. B.

The Feeding of Animals. By W. H. Jordan. Pp. xvii + 450. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1901). Price 5*s.* net.

THE author takes a wide range. Beginning with a popular account of the chemical constituents of plants and animals, the processes of digestion and nutrition, and the functions of food in the body, he then proceeds to a description of cattle foods, and to the actual results obtained by the use of food as ascertained by scientific investigations and farm practice. The book is written in a somewhat diffuse and popular style, and the different parts are of unequal merit, but it is of undoubted value. The author is not pledged to any special theories, but readily accepts every well-proved fact. He is well acquainted with the most recent German and American investigations, and has brought together a large number of very important new results, for which teachers will heartily thank him. Had the author written with greater accuracy for science students, instead of writing for the half-educated general reader, he would probably have produced a better book on the feeding of animals than has hitherto appeared in the English language.

The book is thoroughly American, and the author illustrates every part of the subject as far as possible by the investigations and practice of his own country. He is naturally bound by American conventions, and to one of these we must strongly demur. The whole of the nitrogenous substances present in any vegetable food are collectively spoken of as "protein," although, in fact, a large part of them may be amides, and in some cases nitrates. This is distinctly worse than the German plan of calling the whole group "Rohprotein," as in this case some qualification is expressed. The American nomenclature results in a confusion of language which must be abhorent to every physiological chemist. Thus our author says (p. 179): "A much larger part of the protein of roots consists of amides than is the case with the grains, the protein of the latter being correspondingly richer in albuminoids." It is surely far better to give the collective nitrogenous matters the general title of "nitrogenous substance" instead of applying to them the name of a particular body, which in some cases forms only a small part of the group. The error is all the more important as the amount of true proteids present in a food has generally a great influence upon its nutritive value.

The chapter by Mr. W. P. Wheeler on the feeding of poultry is of considerable importance, as he brings before us the results of many recent American investigations.

R. W.

First Stage Building Construction. By Brysson Cunningham, B.E., Assoc.M.Inst.C.E. Pp. viii + 240. (London: W. B. Clive.) Price 2*s.*

THIS small volume on elementary building construction forms one of the "organised science series." It is intended for students preparing for the examinations in elementary building construction under the Board of Education. There are already several books published which cover the same course, but none, we believe, which profess to do so at the modest price of 2*s.*, as does the volume before us. Mr. Cunningham's book does not call for much comment. The information given is of the kind required, and is well and tersely put in a practical way, but the diagrams, which are so important in a book of this kind, are in many cases very carelessly drawn, and do no credit to the book. If these are improved in a future edition, it will render the book more valuable.

Théorie Nouvelle de la Dispersion. Par M. G. Quesneville. Pp. 72. (Paris: A. Hermann, 1901.)

WE opened this book in the hope of finding an intelligent criticism of modern theories of dispersion and an attempt to substitute something better; but the author appears to be very imperfectly acquainted with them; for instance, there is no reference to Sellmeier, or to Lord Kelvin's Baltimore lectures. His criticisms are mainly directed to the writings of Cauchy. The "new theory" does not appear to include any new suggestion as to physical mechanism, or anything to repay the labour of wading through sixty pages of algebraic developments.

J. D. E.

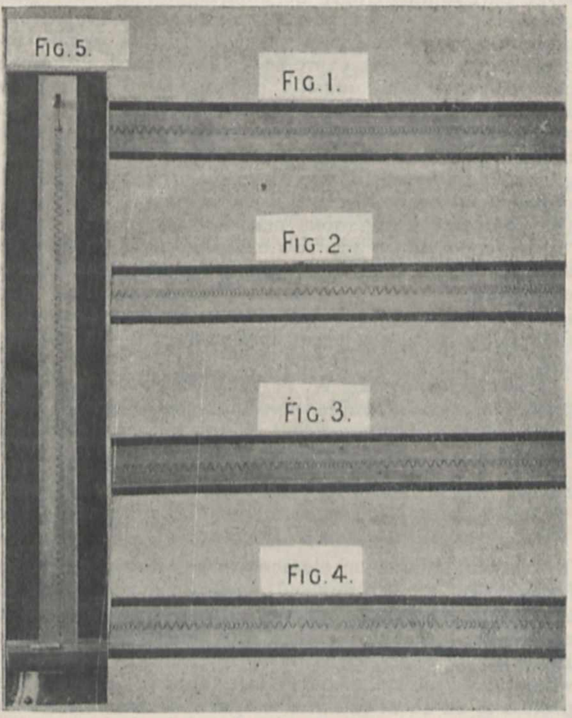
LETTERS TO THE EDITOR.

[*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.*]

A Simple Model for Demonstrating Beat.

THE phenomenon of beat produced by the interference of two series of waves having nearly the same wave-length can be objectively represented by a model of simple construction.

A spiral, whose diameter and pitch are respectively 2 cm. and 2·5 cm., is made of a steel wire about 1 mm. thick and hung vertically before a white screen. At a distance of a few metres we observe a very regular series of transverse waves. Another spring of exactly the same dimensions is suspended in front of the first spring so as to coincide with each other when they are seen at a distance. If one of the springs is then slightly stretched, there results a small difference in wave-length of the two sets of waves, thus causing them to strengthen in one place and destroy in the other. The distance between these



two places becomes less as the difference of wave-length increases. Figs. 1, 2, 3, 4 are the photographs of the springs suspended in the manner just mentioned, and show successive stages of interference produced by stretching the length of the second spring. The result of interference of two such waves evidently corresponds to the phenomenon of beat.

For practical purposes, two springs are suspended from a vertical board, one in front of the other, as shown in Fig. 5. Both ends of the first spring are fixed, while the upper end of the second is likewise fixed and the lower end pulled downwards by means of a string passing through a hook attached to the stand. Standing at a distance in front of the springs we can gradually stretch the second spring by pulling the string and easily observe the corresponding stages of interference in its different phases.

K. HONDA.

Physical Laboratory, Imp. Univ., Tokio, Japan, May 26.

Polar Exploration.

THE following sentence is extracted from an admirable notice of the Arctic explorer, the late Baron Nordenskiöld, by Prof. A. G. Nathorst, himself renowned as an investigator of the Polar regions:—

"It may perhaps be of interest at the present time to recall the fact that we in Sweden have always taken for granted that the leader of a scientific expedition must be a naturalist, to whom the commander of the vessel has to be subordinate."—*Geograph. Anzeiger*, ii. p. 129, September, 1901.

The marked success of the Swedish expeditions, not merely in pure science, but also in geographical discovery and the safe return of their members, gives this opinion weight as well as interest. Of course it is not what the president of the Geographical Section of the British Association calls "the good old British plan."

CIVILIAN.

ON THE CLUSTERING OF GRAVITATIONAL MATTER IN ANY PART OF THE UNIVERSE.

IN the Mathematical and Physical Science Section of the British Association, Lord Kelvin delivered a discourse on "The Absolute Amount of Gravitational Matter in any large Volume of Interstellar Space." Gravitational matter, according to our ideas of universal gravitation, would be all matter. Now was there any matter which was not subject to the law of gravitation? He thought he might say with absolute decision that there was. They were all convinced, with their President, that ether was matter, but they were forced to say that the properties of molar matter were not to be looked for in ether as generally known to them by action resulting from force between atoms and matter, ether and ether, and atoms of matter and ether. Here he was illogical when he said between matter and ether, as if ether were not matter. It was to avoid an illogical phraseology that he used the title "gravitational matter." Many years ago he had given strong reason to feel certain that ether was outside the law of gravitation. They need not absolutely exclude, as an idea, the possibility of there being a portion of space occupied by ether beyond which there was absolute vacuum—no ether and no matter. They admitted that that was something that one could think of; but he did not believe any living scientific man considered it in the slightest degree probable that there was space surrounding our universe beyond which there was no ether and no matter. Well, if ether went through all space, then it was certain that ether could not be subject to the law of mutual gravitation between its parts, because if it were subject to mutual attraction between its parts its equilibrium would be unstable, unless it were infinitely incompressible. But here again he was reminded of the critical character of the ground on which they stood in speaking of or giving very definite propositions beyond what they saw or felt by experiment. He was afraid he must here express a view different from that which Prof. Rücker announced in his address, when he said that continuity of matter implied absolute resistance to condensation. They had no right to bar condensation as a property of ether. While admitting ether not to have any atomic structure, it was postulated as a material which performed functions of which they knew something, and which might have properties allowing it to perform other functions of which they were not yet cognisant. If they considered ether to be matter, they postulated that it had rigidity enough for the vibration of light, but they had no right to say that it was absolutely incompressible. They must admit that sufficiently great pressure all round could condense the ether in a given space, allowing the ether in surrounding space to come in towards the ideal shrinking surface. When he said that ether might be outside the law of gravitation he assumed that it was not infinitely incompressible. He admitted that if it were infinitely incompressible, then it might be subject to the law of mutual gravitation between its parts; but to his mind it seemed infinitely improbable that ether was infinitely incompressible, and it appeared more consistent with the analogies of the known properties of molar matter, which should be their guides, to suppose that ether had not the quality of exerting an infinitely great force against compressing action of gravitation. Hence if they assume that it extended through all space, ether must be outside the law of gravitation, that is to say, truly imponderable. He remembered the contempt and self-complacent compassion with which sixty years ago he himself, he was afraid and most of the teachers of that time looked upon the ideas of the elderly people who went before them, who spoke of "the imponderables." He feared that in this, as in a great many other things in science, they had to hark back to the dark ages of fifty, sixty or a hundred years ago, and that they must admit there was something which they could not refuse to call matter, but which was not subject to the Newtonian law of gravitation. That the sun, stars, planets, and meteoric stones were all of them ponderable matter was true, but the title of his paper implied that there was something else. Ether was not any part of the subject of his paper; what he dealt with was gravitational matter, ponderable matter. Ether they relegated, not to a limbo of imponderables, but to distinct species of matter which had inertia, rigidity, elasticity, compressibility, but not heaviness. In a paper he had already published he had given strong reasons for limiting to a definite amount the quantity of matter in space known to astronomers. He could scarcely avoid using the word "universe," but he meant our universe, which might be a very small affair after all, occupying a very small portion of all the space in which there is ponderable matter.

Supposing a sphere of radius $3{\cdot}09.10^{16}$ kilometres (being the distance at which a star must be to have parallax $0''{\cdot}001$) to have within it, uniformly distributed through it, a quantity of matter equal to one thousand million times the sun's mass, the velocity acquired by a body placed originally at rest at the surface would, in five million years, be about 20 kilometres per second, and in twenty-five million years would be 108 kilometres per second (if the acceleration remained sensibly constant for so long a time). Hence if the thousand million suns had been given at rest twenty-five million years ago, uniformly distributed throughout the supposed sphere, many of them would now have velocities of twenty or thirty kilometres per second, while some would have less and some probably greater velocities than 108 kilometres per second; or, if they had been given thousands of million years ago at rest so distributed that now they were equably spaced throughout the supposed sphere, their mean velocity would now be about 50 kilometres per second (*Phil. Mag.*, August 1901, pp. 169, 170). This is not unlike the measured velocities of stars, and hence it seems probable that there might be as much matter as one thousand million suns within the distance $3{\cdot}09.10^{16}$ kilometres. The same reasoning shows that ten thousand million suns in the same sphere would produce velocities far greater than the known star velocities, and hence there is probably much less than ten thousand million times the sun's mass in the sphere considered. A general theorem discovered by Green seventy-three years ago regarding force at a surface of any shape, due to matter (gravitational, or ideal electric, or ideal magnetic) acting according to the Newtonian law of the inverse square of the distance, shows that a non-uniform distribution of the same total quantity of matter would give greater velocities than would the uniform distribution. Hence we cannot, by any non-uniform distribution of matter within the supposed sphere of $3{\cdot}09.10^{16}$ kilometres radius, escape from the conclusion limiting the total amount of the matter within it to something like one thousand million times the sun's mass.

Lord Kelvin then went on to compare the sunlight with the light from the thousand million stars, each being supposed to be of the same size and brightness as our sun; and stated that the ratio of the apparent brightness of the star-lit sky to the brightness of our sun's disc would be $3{\cdot}87.10^{-13}$. This ratio (*Phil. Mag.*, August 1901, p. 175) varies directly with the radius of the containing sphere, the number of equal globes per equal volume being supposed constant; and hence to make the sum of the apparent area of discs 3·87 per cent. of the whole sky, the radius must be $3{\cdot}09.10^{27}$ kilometres. With this radius light would take $3\frac{1}{4}.10^{14}$ years to travel from the outlying stars to the centre. Irrefragable dynamics proves that the life of our sun as a luminary is probably between 50 and 100 million years; but to be liberal, suppose each of our stars to have a life of 100 million years as a luminary, and it is found that the time taken by light to travel from the outlying stars to the centre of the sphere is three and a quarter million times the life of a star. Hence it follows that to make the whole sky aglow with the light of all the stars at the same time the commencements of the stars must be timed earlier and earlier for the more and more distant ones, so that the time of the arrival of the light of every one of them at the earth may fall within the durations of the lights of all the others at the earth. His supposition as to uniform density is quite arbitrary; but nevertheless he thought it highly improbable that there could be enough stars (bright or dark) to make a total of star-disc-area more than 10^{-12} or 10^{-11} of the whole sky.

To help to understand the density of the supposed distribution of 1000 million suns in a sphere of $3{\cdot}09.10^{16}$ kilometres radius, imagine them arranged exactly in cubic order, and the volume per sun is found to be $123{\cdot}5.10^{39}$ cubic kilometres, and the distance from one star to any one of its six nearest neighbours would be $4{\cdot}98.10^{13}$ kilometres. The sun seen at this distance would probably be seen as a star of between the first and second magnitude; but supposing our 1000 million suns to be all of such brightness as to be stars of the first magnitude at distance corresponding to parallax $1''{\cdot}0$, the brightness at distance $3{\cdot}09.10^{16}$ kilometres would be one one-millionth of this; and the most distant of our stars would be seen through powerful telescopes as stars of the sixteenth magnitude. Newcomb estimated from 30 to 50 million as the number of stars visible in modern telescopes. Young estimated at 100 million the number visible through the Lick telescope. This larger estimate is only one-tenth of our assumed thousand million masses equal to the sun, of which, however, nine hundred million might be either non-luminous, or, though luminous, too distant to be seen by us at their actual distances from the earth. Remark also that it is only for facility of counting that we have reckoned our universe as a thousand million suns; and that the meaning of our reckoning is that the total amount of matter within a sphere of $3{\cdot}09.10^{16}$ kilometres radius is a thousand million times the sun's mass. The sun's mass is $1{\cdot}99.10^{27}$ metric tons, or $1{\cdot}99.10^{33}$ grammes. Hence our reckoning of our supposed spherical universe is that the ponderable part of it amounts to $1{\cdot}99.10^{42}$ grammes, or that its average density is $1{\cdot}61.10^{-23}$ of the density of water.

Lord Kelvin returned to the question of sum of apparent areas, the ratio of which to 4π, the total apparent area of the sky viewed in all directions, is given by the formula (*Phil. Mag.*, August 1901, p. 175) $\alpha = \frac{3N}{4}\left(\frac{a}{r}\right)^2$; provided its amount is so small a fraction of unity that its diminution by eclipses, total or partial, may be neglected. In this formula, N is a number of globes of radius a uniformly distributed within a spherical surface of radius r. For the same quantity of matter in N′ globes of the same density, uniformly distributed through the same sphere of radius r, we have $\frac{N'}{N} = \left(\frac{a}{a'}\right)^3$, and therefore $\frac{\alpha'}{\alpha} = \frac{a}{a'}$. With $N = 10^9$, $r = 3{\cdot}09\ 10^{16}$ kms.;

and a (the sun's radius) $=7.10^5$ kms.; we had $a=3{\cdot}87.10^{-13}$. Hence $a'=7$ kms. gives $a'=3{\cdot}87.10^{-8}$; and $a''=1$cm. gives $a''=1/36{\cdot}9$. Hence if the whole mass of our supposed universe were reduced to globules of density 1·4 (being the sun's mean density), and of 2 cms. diameter, distributed uniformly through a sphere of $3{\cdot}09.10^{16}$ kms. radius, an eye at the centre of this sphere would lose only 1/36·9 of the light of a luminary outside it! The smallness of this loss is easily understood when we consider that there is only one globule of 2 cms. diameter per 360,000,000 cubic kilometres of space, in our supposed universe reduced to globules of 2 cms. diameter. Contrast with the total eclipse of the sun by a natural cloud of water spherules, or by the cloud of smoke from the funnel of a steamer.

Let now all the matter in our supposed universe be reduced to atoms (literally brought back to its probable earliest condition). Through a sphere of radius r let atoms be distributed uniformly in respect to gravitational quality. It is to be understood that the condition "uniformly" is fulfilled if equivoluminal globular or cubic portions, small in comparison with the whole sphere, but large enough to contain large numbers of the atoms, contain equal total masses, reckoned gravitationally, whether the atoms themselves are of equal or unequal masses, or of similar or dissimilar chemical qualities. As long as this condition is fulfilled, each atom experiences very approximately the same force as if the whole matter were infinitely fine-grained, that is to say, utterly homogeneous.

Let us therefore begin with a uniform sphere of matter of density ρ, gravitational reckoning, with no mutual forces except gravitation between its parts, given with every part at rest at the initial instant; and let it be required to find the subsequent motion. Imagining the whole divided into infinitely thin concentric spherical shells, we see that every one of them falls inwards, as if attracted by the whole mass within it collected at the centre. Hence our problem is reduced to the well-known students' exercise of finding the rectilinear motion of a particle attracted according the inverse square of the distance from a fixed point. Let x_0 be the initial distance, $\frac{4\pi\rho}{3}x_0^3$ the attracting mass, v and x the velocity and distance from the centre at time t. The solution of the problem, for the time during which the particle is falling towards the centre is

$$\tfrac{1}{2}v^2=\frac{4\pi\rho}{3}x_0^3\left(\frac{1}{x}-\frac{1}{x_0}\right),$$

and

$$t=\sqrt{\frac{3}{8\pi\rho}}\left(\frac{\pi}{2}-\theta+\tfrac{1}{2}\sin 2\theta\right)=\frac{\pi}{2}\sqrt{\frac{3}{8\pi\rho}}\left[1-\frac{2\theta}{\pi}\left(1-\frac{\sin 2\theta}{2\theta}\right)\right],$$

where θ denotes the acute angle whose sine is $\sqrt{\frac{x}{x_0}}$. This shows that the time of falling through any proportion of the initial distance is the same whatever be the initial distance; and that the time (which we shall denote by T) of falling to the centre is $\frac{1}{2}\pi\sqrt{\frac{3}{8\pi\rho}}$. Hence in our problem of homogeneous gravitational matter given at rest within a spherical surface and left to fall inwards, the augmenting density remains homogeneous; and the time of shrinkage to any stated proportion of the initial radius is inversely as the square root of the density.

To apply this result to the supposed spherical universe of radius $3{\cdot}09.10^{16}$ kilometres, and mass equal to a thousand million times the mass of our sun, we find the gravitational attraction on a body at its surface gives acceleration of $1{\cdot}37.10^{-13}$ kms. per second per second This therefore is the value of $\frac{4\pi\rho}{3}x_0$, with one second as the unit of time and one kilometre as the unit of distance; and we find $T=52{\cdot}8.10^{13}$ seconds $=16{\cdot}8$ million years. Thus our formulas become

$$\tfrac{1}{2}v^2=1{\cdot}37.10^{-13}x_0\left(\frac{x_0}{x}-1\right),$$

giving

$$v=5{\cdot}23.10^{-7}\sqrt{x_0\left(\frac{x_0}{x}-1\right)};$$

and

$$t=52{\cdot}8.10^{13}\left[1-\frac{2\theta}{\pi}\left(1-\frac{\sin 2\theta}{2\theta}\right)\right];$$

whence, when $\sin\theta$ is very small,

$$t=52{\cdot}8.10^{13}\left(1-\frac{4\theta^3}{3\pi}\right).$$

Let now for example $x_0=3{\cdot}09.10^{16}$ kms., and $\frac{x_0}{x}=10^7$; and therefore $\sin\theta=\theta=3{\cdot}16.10^{-4}$; whence $v=291{,}000$ kms. per second, and $t=\mathrm{T}-7080$ seconds $=\mathrm{T}-2$ hours approximately.

By these results it is most interesting to know that our supposed sphere of perfectly compressible fluid, beginning at rest with density $1{\cdot}61.10^{-23}$ of that of water, and of any magnitude large or small, and left unclogged by ether to shrink under the influence of mutual gravitation of its parts, would take nearly seventeen million years to reach ·0161 of the density of water, and about two hours longer to shrink to infinite density at its centre. It is interesting also to know that if the initial radius is $3{\cdot}09.10^{16}$ kilometres the inward velocity of the surface is 291,000 kilometres per second at the instant when its radius is $3{\cdot}09.10^9$ and its density ·0161 of that of water. If now, instead of an ideal compressible fluid, we go back to atoms of ordinary matter of all kinds as the primitive occupants of our sphere of $3{\cdot}09.10^{16}$ kms. radius, all these conclusions, provided all the velocities are less than the velocity of light, would still hold; notwithstanding the ether occupying the space through which the atoms move. This would, I believe,[1] exercise no resistance whatever to uniform motion of an atom through it; but it would certainly add quasi inertia to the intrinsic Newtonian inertia of the atom itself moving through ideal space void of ether; which, according to the Newtonian law, would be exactly in proportion to the amount of its gravitational quality. The additional quasi inertia must be exceedingly small in comparison with the Newtonian inertia, as is demonstrated by the Newtonian proofs, including that founded on Kepler's laws for the groups of atoms constituting the planets, and movable bodies experimented on at the earth's surface.

In one thousand seconds of time after the density ·0161 of the density of water is reached, the inward surface velocity would be 305,000 kilometres per second, or greater than the velocity of light; and the whole surface of our condensing globe of gas or vapour or crowd of atoms would begin to glow, shedding light inwards and outwards. All this is absolutely realistic except the assumption of uniform distribution through a sphere of the enormous radius of $3{\cdot}09.10^{16}$ kilometres, which we adopted temporarily for purposes of illustration. The enormously great velocity (291,000 kms. per second) and rate of acceleration (13·7 kms. per second per second) of the boundary inwards, which we found at the instant of density ·0161 of that of water, are due to greatness of the primitive radius and the uniformity of density in the primitive distribution.

To come to reality according to the most probable judgment present knowledge allows us to form, suppose at many millions, or thousands of millions, or millions of millions of years ago, all the matter in the universe to

1 "On the Motion produced in an Infinite Elastic Solid by the Motion through the Space occupied by it of a Body acting on it only by Attraction or Repulsion." Cong. International de Physique, Paris, Vol. of Report. (*Phil. Mag.* August, 1900).

have been atoms very nearly at rest[1] or quite at rest; more densely distributed in some places than in others, of infinitely small average density through the whole of infinite space. In regions where the density was then greater than in neighbouring regions, the density would become greater still; in places of less density, the density will become less; and large regions will quickly become void or nearly void of atoms. These large void regions would extend so as to completely surround regions of greater density. In some part or parts of each cluster of atoms thus isolated, condensation would go on by motions in all directions not generally convergent to points, and with no perceptible mutual influence between the atoms until the density becomes something like 10^{-6} of our ordinary atmospheric density, when mutual influence by collisions would begin to become practically effective. Each collision would give rise to a train of waves in ether. These waves would carry away energy, spreading it out through the void ether of infinite space. The loss of energy thus taken away from the atoms would reduce large condensing clusters to the condition of gas in equilibrium[2] under the influence of its own gravity only, or rotating like our sun or moving at moderate speeds as in spiral nebulas, &c. Gravitational condensation would at first produce rise of temperature, followed later by cooling and ultimately freezing, giving solid bodies, collisions between which will produce meteoric stones such as we see them. We cannot regard as probable that these lumps of broken-looking solid matter (something like the broken stones used on our macadamised roads) are primitive forms in which matter was created. Hence we are forced in this twentieth century to views regarding the atomic origin of all things closely resembling those presented by Democritus, Epicurus, and their majestic Roman poetic expositor, Lucretius.

THE CHEMISTRY OF THE CYGNIAN STARS AND BASIC ROCKS.

I HAVE recently received from Prof. Suess the following important letter, with a request that it should be sent for publication in NATURE. It is obvious that Prof. Suess' striking generalisation will lead to many interesting inquiries; for my part I shall lose no time in making the additional researches for which he asks. The results on the chromosphere spectrum obtained during the eclipse of 1898 now being published by the Royal Society will also, I think, throw some light on the question. NORMAN LOCKYER.

Vienna, October 7.

MY DEAR SIR,—In reading your highly suggestive and instructive book on Inorganic Evolution and your last papers in *Proc.* Roy. Soc. and NATURE, I was struck by what you say on the spectrum of *α* Cygni, and beg leave to submit a question.

I believe I am in accord with the best masters of geology of our time in regarding our earth as a ball of NiFe, surrounded by a silicious slag. This slag has parted (or has differentiated) into two zones, one richer in SiAl and felspathic minerals (trachyte, granite, &c.), and the other richer in SiMg (peridotite and serpentine, olivine-rock, lherzolite, dunite, kyschtymite, &c.), and both extremes are united by a host of intermediate rocks. The SiAl group is lighter, exterior and partly used up in forming sediments, the SiMg group is lower or interior and related by the universal occurrence of traces of Ni, and by other features, to NiFe. They are, in fact, the acid and the basic group of Bunsen, Durocher and all their followers.

[1] "On Mechanical Antecedents of Motion, Heat and Light"; Brit. Assoc. Rep., part ii. 1854; *Edin. New Phil. Jour.* i. 1855; *Comptes rendus*, xl. 1855; Kelvin's "Collected Math. and Phys Papers," vol. ii. art. lxix.
[2] Homer Lane, *American Journal of Science*, 1870, p. 57; Sir W. Thomson, *Phil. Mag.*, March 1887, p. 287.

Now Prof. Vogt, of Christiania, has in a series of remarkable papers shown that the metallic ores accompanying the SiAl rocks are different from the ores of the SiMg group, and that certain metals are very characteristic for each group, and more especially for certain ultra-basic rocks. The same author has, in *Zeitschrift für prakt. Geolog.*, 1898, p. 326, given a list of the elements characteristic for the ores of each group. This list does not regard the rocks themselves, but only the ores, and I have thought to give a better approach to the sum of occurring elements by introducing a few trifling changes, viz. in noting Si, Al and also Cu on both sides, and adding C, according to South African experience, to the basic list.

(1) Acid rocks: *Si*, *K*, *Li*, Be, *Al*, *W*, *U*, *Ce*, *Y*, Cu, *Sn*, *Zr*, *Th*, B, F.

(2) Basic rocks: Si, *Ca*, Al, Ba, Sr, *Mg*, *Fe*, Mn, *Ni*, *Co*, *Cr*, *Cu*, V, *Ti*, *Pt* and allied metals, *C*, P, *S*, Cl.

(The most characteristic members are italicised.)

The ultra-basic rocks have their exact equivalent in the meteoric stone of Chassigny.

The great number of analyses of meteor irons by Cohen recently published by the Berlin Academy gives Fe, Ni, Co, Cr, Cu, C, P, S, Cl, joined in single cases by SiO_2, MgO and CaO. You know that Davison also found Pt and probably Ir. It is Vogt's list of metals from basic rocks.

Ångström's older list of Fraunhofer lines gives H and Na, and besides these Ca, Ba, Mg, Fe, Mn, Ni, Co, Cr and Ti.

These are all elements accompanying the basic rocks, and although your own later observations show the existence of lines of some of the characteristic metals of the acid series, such as K, Li, U and Ce, I must conclude that Vogt's basic list is more distinctly represented in the sun's absorbing layer.

Now your comparison of the sun's chromosphere with the enhanced lines of *α* Cygni gives a quite similar list for *α* Cygni: Mg, Ca, Fe, Ti, Mn, Ni, Cr, V, Cu, Sr, and the impression is that the metallic vapours, which accompanied the intrusion of ultra-basic rocks and sometimes, as in Norway, gathered as ores at the circumference of these ultra-basic intrusive rocks, must have been of a remarkable likeness to those of the sun's chromosphere and of *α* Cygni.

One might even be induced to go a step further. Among the ores of the ultra-basic rocks Vogt distinguishes two varieties, which he calls the oxydic, characterised by the prevalent occurrence of Ti, and the sulfidic ores (nickeliferous pyrrhotite). And I find that you remark *γ* Cygni to be distinguished by the prevalence of Ti, *α* Cygni by Fe, Cr and Ni, and *β* Orionis by Si and Mg—corresponding to these two varieties of ores and to the intrusive rock SiMg (*β* Orionis being the country rock of the ores). But I am very far from proposing any conclusions whatever in this imperfect state of knowledge, and only venture to point out the interest which is attached to the examination of a number of elements named by you on p. 58, "Inorganic Evolution"—which have only been investigated by you with lower dispersion, and which embrace several typical representatives of the acid series—and to the special research of metals like W, U, Ce, Sn and others of this series.

The question, which I take leave to submit, is: Have we indeed to suppose that metallic vapours answering to metals from acid rocks are less represented in the sun and stars than those from basic rocks, or is it some secondary cause, the nature of their spectrum or other, which gives the present seeming prevalence to the metals from basic rocks?

I beg you, dear sir, to accept the expression of my highest esteem.

Yours most respectfully,
EDW. SUESS.

RUDOLPH KOENIG.

THERE has passed away in the person of Dr. Rudolph Koenig one whose name will be remembered in the science of physics, and who filled a unique place. To the outer world he was known simply as a maker of tuning-forks. To the inner circle of science he was known as the author of original researches in a line peculiarly his own. To the few who had the privilege of an intimate acquaintance he was known as a simple-hearted, whole-souled devotee of his chosen science of acoustics: one who lived for and loved his work.

Born at Königsberg in 1833 of a family connected with the University, he was himself trained in the Philosophical Faculty of that famous centre. He graduated as Doctor of Philosophy, and well might have looked forward to a successful career as professor of physics in one of the Universities of his native land. What cross-currents of destiny drove him far afield are not clearly known to the present writer. But the year 1860 saw him established in Paris as a constructor of acoustical instruments, carrying out the traditions of fine workmanship established by Cavaillé-Coll. He had an *atélier* in the Place du Lycée Louis le Grand, and here he worked out a number of new acoustical instruments. The phonograph, or phonautograph as it was later called, of M. Scott de Martinville for recording the vibrations of tones and words was brought to Koenig to be put into shape. Accounts of this instrument will be found in *Cosmos*, vol. xiv., in the *Athenaeum* of 1859, and in the Report of the British Association for the same year. It was Koenig's part to devise a better mouthpiece and a more sensitive membrane. He also devised the recording drum, driven on an axis cut with a screw thread. I once asked him whether, when he was working with M. Scott on this instrument, it had not occurred to either of them that the record of the vibrations might not be used over again to reproduce the sound, as discovered nearly twenty years afterwards by Edison. His reply was: "No, the idea never occurred to either of us; we never thought of anything except recording." He constructed series of standard tuning-forks furnished with recording styluses; he improved the mechanical construction of the Seebeck siren; he studied the vibrations of plates and of columns of air. In 1862 he brought over to London to the second of the series of International Exhibitions a fine set of his new apparatus, including an acoustical album or collection of graphic tracings recording the composition of vibrations; and for the exhibit he was awarded a gold medal. About the same time began the publication of his experimental researches in acoustics which lasted nearly forty years. The earliest of these to be noted was the invention of the manometric flame. Organ pipes fitted with manometric capsules for investigating the vibrations of the air column by means of gas-flames were shown in the London Exhibition of 1862, and they were described by him in vol. cxxii. of Poggendorff's *Annalen*, pp. 242 and 246, of the same year. He constructed resonators for Helmholtz (see Appendix I. of the first edition of the "Tonempfindungen," 1863); he repeated the experiments of Philipp Reis with the primitive telephone of that neglected inventor; he devised a new stethoscope furnished with one or more flexible rubber tubes to admit of simultaneous auscultation by several observers. In the *Comptes rendùs* of March 1864 he had a memoir upon the vibration of plates, in which he discussed the sound-figures in sand discovered by Chladni and the explanation of their formation then recently suggested by Wheatstone. In 1870 he had another article in the *Comptes rendus*, on the fixed notes which are characteristic of the different vowels. In 1872 came a second memoir on manometric flames in the *Annalen*.

During these ten years Koenig had been attempting to build up the business of manufacturer of acoustical instruments. His standard tuning-forks were sought after by physical investigators. The impulse given to acoustical subjects by the publication of the famous book of Helmholtz was undoubtedly great; and the researches of Chladni, Wertheim, Melde, Terquem, Wheatstone and Mach were claiming great attention. Koenig adopted the suggestion, urged by Chladni in 1830, of fixing as the normal scientific pitch for his standards that in which middle C of the keyboard is assigned to 256 complete vibrations per second. In the "Catalogue of Acoustical Apparatus" which Koenig published in 1865—itself an evidence of his scientific and industrial activities—he notified his adherence to this standard for the *diapason normal*. He had now moved into the Rue Hautefeuille on the south side of the Seine, where he lived and worked until about 1878, when the house was demolished in the construction of the Boulevard St. Germain through the Quartier Latin. Unhappily the outbreak of the Franco-Prussian War rendered it difficult for a German to live in Paris. Of a retiring and sensitive disposition, he found himself somewhat isolated in his work. The scientific world was rather cold toward the man who made a living out of selling tuning-forks. Other instrument makers began to copy his instruments, and were able, not having the same scientific ideals, to undersell his manufactures by producing less carefully-made articles. Koenig never swerved one hair's breadth to meet this competition. He knew the quality of the work that left his little factory. Not one tuning-fork, during these more than thirty years, left the place without having been personally adjusted and verified by him. No single instrument of second quality ever bore his mark. The monogram "R. K." stamped upon his work became an absolute guarantee of first-rate workmanship. Others might cheapen their manufacture by neglect of quality: he would maintain the quality of his *coute que coute*. If by some stroke of luck he sold instruments that brought in a few hundred francs above the regular income of his business he would hail it as the means of constructing some new piece of experimental apparatus that might never find a sale, but would help his investigations. And so with a slender business and a few faithful workmen at his back he maintained a proud independence, sufficient to enable him to continue research.

In 1876 he went over to America and took with him to the Centennial Exposition at Philadelphia a splendid series of his beautiful instruments in the hope of doing advantageous business. The Jury's report of the awards in Group xxv. speaks in glowing terms of this effort. "In the present Exhibition," it runs, "Dr. Koenig has presented a collection of instruments of demonstration and investigation constructed on a scale of magnitude heretofore unattempted, and exhibiting with surprising power the effects of interfering undulations. He also presents a tonometric apparatus, consisting of about 670 diapasons or tuning forks, giving as many different shades of pitch, extending over four complete octaves, and making equal intervals of eight simple vibrations each for the first octave, and of twelve each for the succeeding octaves; the whole forming an absolutely perfect means of testing, by count of beats, the number of vibrations producing any given musical sound, and of accurately tuning any musical instrument. In addition to these more conspicuous portions of his display, Dr. Koenig exhibits the various forms of apparatus of demonstration for which he is so well known, all of which are marked by the accuracy of indications and excellence of workmanship which have given him his deserved reputation as a constructor." . . . "Of the exhibit of Dr. Koenig, as a whole, it may be said that there is no other in the present International Exhibition which surpasses it in scientific interest." The interest excited by this exhibit was so great that an appeal was circulated, signed by Joseph Henry and others, suggesting the purchase of the instruments. Koenig was induced to leave them at the University of Pennsylvania under promise of their being insured for 10,500 dollars and of a weekly account of the subscription being sent to him. But after a long and vain expectation of the weekly accounts, and the writing of many unanswered letters, it became evident to Koenig that things were going wrong. In June 1878 Mr. Munzinger, who had undertaken to collect the funds, announced to Koenig that he had remitted the whole subscription to Prof. Barker, but on December 15, 1879, Prof. Barker wrote: "Mr. M. has not yet turned over to me the subscription for the acoustical collection." On June 30, 1882, he again wrote: "With regard to your collection, I have been entirely unable to complete the subscription for its purchase." There remained nothing for Dr. Koenig to do but to go over and remove the collection. A portion of it was sold at some sacrifice to the University of Toronto, the physical collection of which it adorns; while the rest was brought back to Paris. The incident had the most unfortunate effect on Dr. Koenig. It crippled his slender resources for more than ten years, and it tended to sour his sensitive temperament. He had in 1876 communicated to Poggendorff's *Annalen* two papers, one on a tuning-fork of variable pitch, the other upon the phenomena produced by the interference of two tones. This latter paper is one of the undoubted classics of science. Using the most splendid and perfect of all tone-producers, the substantial steel tuning-forks of his own design, he had for years been investigating the phenomena of beats and the production of interference-tones. Applying the phenomena of beats every day in his workshop for the purpose of adjusting forks to their exact pitch, he acquired a familiarity with the phenomena such as no other experimenter could possibly attain. His published research is a model of careful and accurate observation. Helmholtz had given the well-known theory that when two tones are sounded together there are produced two other tones, known as the difference-tone and the summation-tone, having frequencies respectively corresponding to the difference and the sum of the frequencies of the two fundamental tones. Koenig, finding himself unable to confirm the existence of these alleged tones, set to work to find out what the actual facts were. He investigated both the beats and the resultant tones. He found that primary beats were not all of one kind; that they could be ranged in two sets, an inferior and a superior set. Of these the inferior alone correspond to the difference of the frequencies, and so correspond only in the first octave. Outside the first octave neither set of beats corresponds either to difference or to sum. He found that when with higher forks resultant tones are produced they likewise may be ranged in two sets, an inferior and a superior set, the pitch of these resultant tones being always precisely that calculated as for beats. These resultant tones are never either summation-tones or difference tones except for tones within the range of the lower half of the first octave of relative pitch, within which limits alone they correspond to the difference of the frequencies. Outside that limit there are no difference-tones. Under no circumstance, when pure notes are used as the two fundamentals is the alleged summation-tone heard. It is true that Prof. Rücker has by the most refined optical appliances demonstrated the objective existence of the summation-tone. But the source was a powerful siren which notoriously generates an impure tone. Koenig's statement of 1882, "Je ne connais jusqu'à present aucune expérience par laquelle on pourrait prouver avec quelque certitude l'existence de sons différentiels et de sons d'addition," remains absolutely true to-day. During the years that followed the unhappy incident of 1876 Koenig continued his investigations. Amongst the apparatus at Philadelphia was the first of his wave-sirens, a novel instrument which for the first time enabled the experimenter to build up synthetically a complex tone out of harmonic constituents in such a way as to vary at pleasure the phases of the component tones. He had discovered that, contrary to the theory of Helmholtz, phase-difference does exercise a modifying effect upon the timbre, and is physiologically observable. This theme he developed in a memoir entitled "Bemerkungen über die Klangfarbe," which was published in *Wiedemann's Annalen*, vol. xiv., in 1881. For this research he constructed a large new wave-siren on a different plan. The same instrument enabled him to investigate the properties of tones produced by a succession of irregular waves. In 1882 he published, under the title of "Quelques Expériences d'Acoustique," a volume of 243 pages resuming his experimental researches down to that date. This volume is now very scarce: it is a veritable treasury of careful and refined experimental investigation. Of these acoustical researches a summary was given by the present writer in NATURE some years ago. In 1890 Dr. Koenig brought over to London his large wave-siren and a number of the larger tuning-forks, and himself demonstrated the principal points of his researches before a meeting of the Physical Society. These instruments were also shown at the Royal Institution in June of the same year at a Friday evening discourse on the physical basis of music. A few of the forks were acquired for the National Collection at South Kensington.

On recovering in the autumn of 1882 the unsold portion of his acoustical collection, he proceeded to reconstruct, on a larger scale than before, the great tonometer, the series of standard tuning-forks which originally extended in unbroken series only from the frequency of 128 to that of 4096 vibrations. He added massive steel forks, some of them weighing nearly 200 pounds, taking the frequency down to 16, while at the higher end of the scale he added several octaves, so that eventually he reached a pitch above the superior limits of ordinary audition. One of his latest researches was, indeed, upon the verification by the method of Kundt of the wave-length of these inaudible forks, going up to 45,000 vibrations per second. This splendid set of standard instruments has remained until now in Dr. Koenig's *atélier*. An attempt was made about three years ago—unfortunately without success—to secure it for the National Collection of Scientific Apparatus at Kensington. It can never be duplicated, and its dispersal would be a misfortune for science.

Dr. Koenig suffered during his last years from much broken health. He never married, but lived alone, surrounded by the instruments of his creation, in his workshop on the Quai d'Anjou. Here he received from time to time the visits of his friends. The late Mr. Spottiswoode used frequently when passing through Paris to visit him. A brief word of announcement that one would give oneself the pleasure of calling next Sunday morning always found Koenig ready and pleased to spend an hour in showing his latest experiments. The last time that I had this opportunity was during the Electrical Congress in September 1900. He had during the preceding week had a similar visit from Lord Kelvin. Koenig was even then very ill. He suffered terribly in body and was obviously feeble. For some months he had lived on nothing but milk. But he was as animated and keen as ever. He had some new observations and a new instrument—no account of which has been published—demonstrating the influence of phase upon the quality of compound tones. They were simple and convincing. But the occasion was mournful; his bodily sufferings were only too evident. He wrote me in the spring of the present year that his health was still more precarious. He died on October 2, 1901, aged sixty-eight years.

Dr. Koenig was an honorary fellow of the Physical Society of London. He had received few tokens of recognition from academies or learned societies; and this one, conferred only last February, gave him evident pleasure. But his work, so courageously maintained in the true spirit of scientific devotion, will remain as his monument to all time. S. P. T.

THE McCLEAN TELESCOPE AT THE CAPE OBSERVATORY.

WE have on many occasions recorded munificent gifts towards scientific research and education from wealthy Americans and others, and now and again it has been our pleasurable duty to call attention to instances of similar generosity on the part of our own countrymen. Naturally it is more gratifying for us to record the latter than the former, especially, perhaps, as the occasions are less frequent. The weekly edition of the *Cape Argus* for October 2 instances a notable example of such a gift in its account of the ceremony which took place recently of the unveiling, by his Excellency the Governor (Sir W. Hely-Hutchinson), of the inscription stone of the magnificent telescope which Dr. Frank McClean, F.R.S., has presented to the Royal Observatory at the Cape. This telescope was offered and accepted some years ago, but many delays have occurred.

Says our contemporary: "The pleasant little ceremony . . . deserves more than passing mention. It gives an opportunity for the cultivation of a virtue which is not too common at the Cape—the virtue of gratitude which Shakespeare knew as a 'noble thankfulness.' And if for the nonce the public should be led to depart from its usual Philistine attitude towards pure science and the higher walks of research, the change may not be ungraceful, and may do it good. The value of Mr. McClean's gift it would be hard to overestimate. In mere money's worth it was princely—more than the Imperial Government could well spare, and more than the Colonial Government could venture to dream of as an encouragement to unapplied science. It was given, too, at the right time and to the right place, there being immediate need for a wide development of spectroscopic work, and the southern hemisphere being poorly supplied with astronomical equipment compared with the affluent north. Further, it did not come from a mere millionaire, willing to be moderately fleeced in return for a little notoriety; Mr. McClean was a skilled and assiduous worker in this branch of science, and what he gave was the outcome of a pure heart and a noble enthusiasm. Nor did he stop at the purely material gift, but gave time and thought and trouble to make sure that the telescope and its accompaniments should be fit for the performance of the very best type of work. He came to the Cape and resided for months here, and those who were privileged to meet him will always remember his unassuming ways and his unflagging interest in his work. He had a double purpose in coming, and by far the greater portion of his time was spent in obtaining the spectra of certain southern stars, in order to supplement his similar work in the north. When this was done, the kindly English gentleman left as quietly as he came. The scientific equipment of the Colony had been handsomely enriched by him, but so far as the general public was concerned he left 'unhonoured and unsung.' . . . The need of scientific and literary endowments at the Cape is well known, and the forgetfulness of those whom the land has made wealthy is occasionally bewailed: it would ill become us, therefore, to be equally forgetful of the far-seeing liberality of a stranger who owed us nothing."

The proceedings were opened, in the presence of a distinguished company, by Sir David Gill, K.C.B., F.R.S., His Majesty's Astronomer at the Cape, who delivered an address, space for which we regret to be unable to spare, after which Sir W. Hely-Hutchinson, in the course of a brief speech, said that in regard to the magnificent gift which Mr. McClean had made to the Observatory, he ought to say that it was the desire of H.R.H. the Duke of Cornwall and York to have performed the ceremony which he (the Governor) was now inadequately to undertake. The fact that the telescope had been named the "Victoria Telescope" was, doubtless, one reason which had actuated His Royal Highness in this regard, but the fact that so handsome—he might say, so princely—a gift had been made to science deserved the full recognition of the highest in the land. His Royal Highness not having been able, however, to unveil the inscription stone, owing to the great number of engagements which were pressed upon him during his recent visit, it had fallen to his (the Governor's) part to do so.

The whole company then proceeded to the outside of the building, where his Excellency removed the Union Jack which covered the inscription stone. The inscription was simply as follows:

1897: The Victoria Telescope.
The Gift of Frank McClean,
of Rusthall, Kent.
David Gill, H.M. Astronomer.

While assembled round the stone cheers were given, first for the donor of the telescope and then for the Governor, and the proceedings terminated.

THE NERNST LAMP IN AMERICA.

THE paper read last August by Mr. A. J. Wurts at the annual convention of the American Institute of Electrical Engineers on the development of the Nernst lamp in America is especially interesting as being practically the first to contain any full description of the physical characteristics of the Nernst filament, or "glower" as it is generally called to distinguish it from the carbon filaments of incandescent lamps. It is interesting, too, in that it affords evidence that the lamp is eventually emerging from the laboratory stage and becoming a really trustworthy commercial article. It will be remembered that shortly after Nernst's invention was made public the commercial development of the lamp was taken up by four companies—by the Allgemeine Elektricitäts Gesellschaft in Germany, by the Westinghouse Company in America, by the Nernst Electric Light in England and by Ganz and Co. in Austria. The German company, who possess the patent rights for most of Europe, including England, have for some time had the lamp on the market in Germany, and, as their exhibit at the Glasgow Exhibition shows, are now introducing it into this country. The Westinghouse Company have also, to judge by the paper by Mr. Wurts, developed the lamp to a degree justifying its introduction into commercial use in America. Three or four years may seem to some a long time to have spent on the improvement of Nernst's invention before it could be considered practically available, but when the great complexity of the lamp as compared with an ordinary incandescent lamp is taken into account it cannot be regarded as excessive.

We propose to consider briefly some of the electrical properties of the glower as described by Mr. Wurts rather than to give a detailed account of the mechanical construction of the lamp. Those who take an interest in this side of the subject may be referred to the *Electrical Review* of New York for August 31 and September 7, in which will be found a full reprint of the paper and a short summary of the discussion which it raised. The glower, as is well known, is made of a mixture of oxides similar to those used in the manufacture of Welsbach mantles, which are mixed to a paste and then pressed through a die into threads of the desired thickness. These threads are cut into convenient lengths and baked, after which leading-in wires are affixed to the ends. This connection, as originally made by Dr. Nernst, consisted of a few turns of platinum wire twisted round the ends of the glower and cemented to it by a suitable paste; the terminal connection worked out by the Westinghouse Company has the platinum lead wire terminating in a small bead which is actually embedded in the end of the glower, the object being to prevent any shrinking of the glower spoiling the contact between it and the platinum. It has often been stated that if the current through a glower be altered, the potential difference between its ends falls as the current is increased. The curves published by Mr. Wurts show that for a glower burning in air this statement is not quite correct; the curves only give the characteristic of the glower between 0·3 and 0·65 ampere, but they show that as the current is increased from 0·3 to 0·5 ampere the potential difference rises also, from 180 to 197 volts; the potential difference remains constant as the current is further increased up to 0·55 ampere, after which it begins to fall slightly. It is, however, quite evident that if the glower is run anywhere near the crest of this curve, as is the case in practice, a steadying series resistance is essential, especially on a circuit in which the voltage fluctuates, as it does on all the supply circuits with which we are acquainted.

In the above respect the glower behaves in a manner comparable with the arc rather than with the carbon filament. The behaviour is generally accounted for by saying that the glower being an electrolytic conductor becomes less resisting as its temperature is increased. That the phenomenon is, however, more complex than this is shown by the characteristics of the glower in other gases than air, or in a vacuum. For a glower burning in oxygen the characteristic appears to be almost identical with the air curve; when nitrogen is used the curve is similar in shape, but the maximum voltage occurs at a lower current and is about 4 per cent. less in magnitude. The characteristics for hydrogen and a vacuum show only a falling curve; there is no portion within the same current limits in which the potential difference rises with the current. These results seem to indicate that some chemical changes are going on between the glower and its surrounding envelope of gas which have an important influence on its behaviour and very possibly on its efficiency and life. There can be little doubt that when the Nernst lamp is easily available it will open up a field of research as interesting and possibly as fruitful as that afforded by the electric arc.

The work of M. Blondel and Mrs. Ayrton has made us familiar with the physical necessity of a resistance in series with the arc on account of its falling characteristic. Such a resistance is still more necessary with the Nernst glower—since a smaller overload of current is more dangerous. With an arc a comparatively small "dead" resistance in series is sufficient, that is to say a resistance which remains of practically constant value throughout the working range of current and does not heat sufficiently with a small overload to alter appreciably. But with the glower it is easy to see, from the curves published by Mr. Wurts, that if a dead resistance were used it would have to be so large for safety as to greatly diminish the efficiency of the complete lamp. A resistance has therefore had to be sought which will increase very rapidly with increase of current, and the solution of the difficulty has been found in using fine iron wire nearly at a red heat, the wire being enclosed in a small sealed bulb filled with hydrogen to prevent its oxidation. This "ballast," as it is named by the Westinghouse Company, has a remarkably high corrective power; with a rise in current of 15 per cent. the resistance increases about 180 per cent., the potential difference between its terminals increasing 200 per cent. As a consequence with such a ballast in series with the glower, a rise in the supply pressure does not produce a serious increase in the current. It follows also that the Nernst lamp (consisting of glower and ballast) cannot be overrun in the same way as an incandescent lamp in order to get it to give more than its rated candle-power or to work at a higher efficiency. With an increase of the supply pressure of 5 per cent. the candle-power of an incandescent lamp increases 40 per cent., whereas that of the Nernst lamp only rises about 7 per cent., the corresponding increase in efficiency being 26 per cent. and 2 per cent. respectively. It is obvious that as this result is attained by running the iron wire nearly at a red heat, the resistance of the ballast when cold is considerably lower than its correct working resistance, and there is therefore a tendency for the glower to take too much current when it first lights up. The ballast has for this reason to be constructed in such a way that the iron wire shall very quickly assume its full resistance, a requisite satisfied by the free suspension of the wire in the hydrogen bulb.

Mr. Wurts does not give any curves showing the candle-power and efficiency during the life of the glower, a thing to be regretted, as it is by the performance of the lamp in this respect that it must ultimately stand or fall. It is, however, stated that the average life of 220-volt glowers on a by no means over steady alternating circuit was found to be from 800 to 900 hours, and that neither the efficiency nor the candle-power fell off much during this life. The life of the 110-volt glowers is said not to be so good, and the average life of the glowers on direct current is given as only about 250 to 300 hours. It should not be assumed that this is an inherent defect, as the Westinghouse Company have devoted their attention mainly to alternating current, and since the German company make lamps for either type of supply it seems evident that the difficulty can be overcome.

We have done no more than indicate a few of the many interesting considerations raised by Mr. Wurts' paper; it contains in addition descriptions of the heater, of the cut-out used for breaking the heater circuit when the glower lights, and of the complete lamp as now constructed in America. Suffice it to say that the lamps are made in candle-powers from 50 to 2000, the higher candle-powers being obtained, not by the use of a larger glower, but by mounting a number of glowers in parallel in the same lamp. Smaller candle-powers than 50 have not been made, as it has been deemed advisable to design the lamp to compete with the arc rather than with the incandescent lamp. In conclusion, we must agree with Mr. Steinmetz, the president of the American Institute, that the lamp should not be compared too severely with existing standardised lamps since, as it is just fresh from the laboratory, it is to its promise rather than to its performance that one should look. And there can be little question but that its promise is exceptionally good.

FLORAS OF THE PAST.[1]

THIS "extract" from the twentieth annual report of the U.S. Geological Survey forms a bulky volume of more than 200 pages and 150 plates. Prof. Lester Ward tells us in the introductory remarks that the aim of the memoir is "to give a succinct account of the progress thus far made in the direction of developing the Mesozoic floras of the United States." The present instalment deals with the vegetation of the Triassic and Jurassic

[1] "Status of the Mesozoic Floras of the United States." First Paper: The Older Mesozoic. By Lester F. Ward, with the collaboration of W. M. Fontaine, A. Warner and F. H. Knowlton. Pp. 211–430 + Plates xxi–clxxix. (Washington: Government Printing Office, 1900.)

periods, the Cretaceous floras being reserved for a second part. The numerous scattered references to the Mesozoic botany of the United States, and the conflicting opinions that have been expressed as to the geological age of the plant-bearing beds, enable us to thoroughly appreciate the value of a comprehensive report compiled by one who possesses a wide knowledge of palæobotanical literature. It is, however, not solely with published facts that the volume is concerned, for a large portion of it is devoted to a systematic account of recently discovered species. The Triassic floras are represented by fossils from the Connecticut Valley, Pennsylvania, Maryland, Virginia and other regions, while plants of Jurassic age are described from California, Oregon and Wyoming. One of the chief desiderata from the point of view of palæobotanical research is a careful and critical examination of the records of ancient floras, which may be of use in the consideration of the broad problems connected with plant evolution and distribution. In the treatment of work of this kind it is essential to carefully weed out such material as cannot be determined with sufficient accuracy to furnish trustworthy evidence. This obvious reflection is suggested by a perusal of the numerous determinations and descriptions contained in the volume before us. It is unfortunate that the plants from the Jurassic strata of California (the Oroville flora) are in most cases represented by fragmentary samples, and in several instances these have been referred to genera and species on evidence which cannot be accepted as satisfactory. Systematic work on fossil plants has too frequently been marred by a want of self-control on the part of authors who appear to be led away by a desire to attach names to specimens that are absolutely valueless as botanical records; we are compelled to add that the utility of the descriptive portions of this work is seriously impaired through lack of courage to discard worthless material. More than eighty specimens of cycadean stems are recorded from the Freezeout Hills of Wyoming—probably of Jurassic age. These stems are referred by Prof. Ward to a new genus, *Cycadella*, which is described as being characterised by the relatively small size of the trunks and by a dense covering of ramental tissue "exuberantly developed from the leaf-bases and extruded from the armour, massed and matted in the fossil state so as to form a thick outer covering." The exceptional development of the ramental scales suggests a comparison with the abundance of woolly hairs on the carpophylls of the recent cycadean genus *Dioon*, and constitutes an interesting feature which may serve as an index of climatal conditions.

The characters on which the cycadean stems are referred to distinct species are hardly such as to deserve specific recognition, and in looking over the numerous plates devoted to the specimens, one fails to appreciate the advantages gained by the reproduction of more than a hundred photographs, in most cases exhibiting only surface features which are often indistinctly shown and give little or no information of botanical value. Prof. Ward admits that the characters made use of in his classification are not the most satisfactory for diagnostic purposes, but we would urge that in the absence of more useful characteristics, such as might be obtained from an examination of the anatomy of the petrified stems, the application of specific names serves no useful purpose, but rather tends to confusion. Little information is given in regard to the reproductive organs; these are described as being less numerous than in other fossil cycads, but they appear to agree in position and in form with those of the *Bennettites* type.

There is no more striking feature of the Mesozoic vegetation of the United States than the extraordinary abundance of silicified cycadean stems, and no more valuable contribution could be made to our knowledge of extinct types than a comparative morphological account of the vegetative and reproductive organs of the American fossil cycadales. A foretaste of what may be expected has been supplied by Mr. Wieland, who has already published some descriptions of the reproductive organs of cycadean plants in the large collection at Newhaven; it is an extension of this kind of work that is urgently needed and for which there appears to be no lack of material.

Some pieces of coniferous wood are described by Mr. Knowlton and referred by him to *Araucarioxylon ? obscurum*, n.sp., but in this case also the data are insufficient to justify the adoption of a distinctive specific name.

Apart from these criticisms as to the methods adopted in the systematic part of the work, we can cordially congratulate Prof. Ward on the completion of the first part of a research which must be of great value to students of palæobotany. A. C. S.

NOTES.

WE are glad to notice that the daily Press is endorsing what we have for years been endeavouring to bring home to the nation, viz. a better appreciation of the advantages of science and of scientific training. A notable instance of this is to be found in a leader in the *Times* of Monday last on the anniversary of Trafalgar, in the course of which our contemporary, in speaking of the recent naval disasters and breakdowns, says that these mishaps "suggest, if they do not indicate, some failure of competence, some lack of coordinating intelligence, among those who are responsible for the structural perfection of our warships. If this were so, it would tend to show that the national failing of which we have seen too many evidences of late, of neglect of scientific training, of the practical man's contempt for scientific method, of self-satisfied contentment with the traditional, the makeshift and the second best, is beginning to find its way into the constructive and engineering departments of the Admiralty." "We have heard much of late," remarks our contemporary, "about the need for 'standardising' our machines. Let us try if we cannot 'standardise' our educational methods and our intellectual equipment generally—not, indeed, according to the 'standards' of the Education Department, but according to the standard of the best that is known, and thought, and done in the world. In the Navy of to-day," says the *Times*, "there is zeal, capacity, energy and devotion in all respects worthy of the heroic past. The only thing that seems to be wanting is what is wanting in the nation, belief in knowledge and faith in applied intelligence." We trust that at this time, when we are being outstripped in many directions by foreign rivals, and commercial invasion has come to our very doors, and orders for machinery, railway locomotives, &c., are going in increasing numbers to our more energetic and receptive kinsmen across the sea, such words of warning as we have quoted will receive due attention and be acted upon ere it be too late.

THE question of fogs in London is at last, we are glad to see, to receive attention. The General Purposes Committee of the London County Council having had under consideration a letter from the secretary of the Meteorological Office, stating that it is proposed to hold an inquiry into the occurrence and distribution of fogs in the London district and their relation to other atmospheric and local conditions, and asking for the co-operation of the Council in the conduct of the inquiry, propose "(1) That a gentleman of suitable scientific qualifications be engaged by the Meteorological Council for a limited period, to formulate instructions and a scheme of observations, and to conduct the investigation; (2) that the observations be taken at the various Fire Brigade stations, and by men of the Fire Brigade; and also, if it can be so arranged, at other institutions of the London County Council; (3) that the returns be sent from the various stations, and from any other institutions selected, direct to the

Meteorological Office; (4) that the Meteorological Council do arrange with the police authorities for observations to be taken at selected positions outside the County of London; (5) that all responsibility as to the conduct of the investigation and any published results of such investigation do rest with the Meteorological Council; (6) that a copy of the complete returns and twelve copies of a report thereon by the Meteorological Council be supplied to the London County Council, and that the London County Council do contribute a sum of 250*l*. for the investigation." The steps about to be taken are most important, and should certainly lead to very valuable results.

THE second annual Huxley lecture of the Anthropological Institute will be delivered by Mr. Francis Galton, F.R.S., at the rooms of the Society of Arts, John Street, Adelphi, on the 29th inst., at 8.30 p.m. The subject chosen by the lecturer is "The Possible Improvement of the Human Breed under the Existing Conditions of Law and Sentiment." Tickets may be obtained on application at the Institute, 3, Hanover Square, W.

THE Frankland memorial lecture will be delivered before the Chemical Society by Prof. H. E. Armstrong, F.R.S., on Thursday next at 8.30 p.m.

THE opening meeting of the session of the Institution of Electrical Engineers for the presentation of premiums and the delivery of the presidential address will take place on Thursday, November 21, instead of on November 14 as was previously announced.

ARRANGEMENTS are being made for the next congress and exhibition of the Sanitary Institute to be held at Manchester in September, 1902. Earl Egerton of Tatton has accepted the presidentship, and the use of the Owens College buildings has been granted by the senate for the sectional meetings and as reception rooms. The exhibition will be held in the St. James's Hall.

THE eleventh Congress of Russian Naturalists and Medical Men will be held in St. Petersburg from January 2 to 12, 1902. There will be sections devoted to mathematics and mechanics, astronomy and geodesy, physics, physical geography, chemistry, geology and mineralogy, botany, zoology, anatomy and physiology, geography (with a subsection relating to statistics), medicine and hygiene, and agronomy.

THE next International Geographical Congress will be held in 1904 in Washington, under the auspices of the National Geographic Society, the president of the latter, Dr. Graham Bell, having just heard from Baron von Richthofen, president of the executive committee of the last Congress, of the acceptance of the invitation to Washington which had been tendered by the Society. In consequence of the decision of the executive, and in view of the coming Congress, the October issue of the *National Geographic Magazine* contains a brief account of the meetings of the Congress which have already taken place, and gives a list of possible excursions in America, each of which would be a geographical lesson.

THE new bacteriological department of the Royal Infirmary, Bristol, will be opened to-morrow by Sir Frederick Treves, K.C.V.O., who will afterwards distribute the prizes to the successful students in the Faculty of Medicine of University College, Bristol, and preside at the annual dinner of the Medical School.

PARIS was greatly excited on Saturday last when M. Santos Dumont, with his seventh balloon, successfully rounded the Eiffel Tower and returned to the shed at St. Cloud, thirty seconds within the thirty minutes allotted by the Committee of the Deutsch Prize. At the time of the voyage the wind, according to the *Times* correspondent, was blowing at the rate of twelve or thirteen miles an hour. At one period the balloon, travelling at the rate of thirty miles an hour, appeared as though it would collide with the Tower; the aëronaut, however, was able to control its movements without any apparent difficulty, and, as has been said, the journey was accomplished within the time limit agreed upon. M. Santos Dumont is to be congratulated upon the success which has at last attended the untiring efforts put forward by him towards the solution of the problem of aërial navigation.

THE death occurred last week, in his fifty-sixth year, of Dr. James Foulis, of Edinburgh. In 1872, at the suggestion of Prof. (now Sir William) Turner, he began to study the structure of the ovary and the development of the ova, more especially in reference to the then recently published work of Waldeyer. In 1874 the degree of M.D. and the gold medal for a thesis on this subject was conferred on him. The following year, having made many additional observations on the anatomy of the ovary, he contributed a paper to the Royal Society of Edinburgh on the development of the ova in man and other mammalia, which was published in the *Transactions* of the Society. Dr. Foulis published other papers, and in 1875 obtained the first award of the Prof. John Goodsir memorial prize for the encouragement of the study of anatomy and physiology.

WE regret to have to record the death of Canon Isaac Taylor, which took place on Friday last in his seventy-third year. Canon Taylor was the author of, among other works, "Words and Places," "Names and their Histories," "Etruscan Researches," "Greeks and Goths, a study in the Runes," and "The Alphabet, an account of the History and Development of Letters." He was one of the founders of the Alpine Club, and took great interest in gardening and entomology.

THE death is announced of Privy Councillor Maercker, professor of agricultural chemistry at the University of Halle.

AN interesting and valuable gift has just been made to the Ashmolean Natural History Society of Oxfordshire by Mr. Henry Willett, of Brighton, and consists of a piece of ground about five acres in extent, comprising woodland, marsh bog and water, which contains many local and rare specimens of animal and vegetable life. It is the wish of the donor that the land shall be known as "The Ruskin Plot," and that it shall be kept for all time in its natural condition. In order to ensure this a trust is being prepared which will vest the plot in the following trustees:—The Lord-Lieutenant of Oxfordshire, the Vice-Chancellor of the University, the Radcliffe Librarian, the Hope professor of zoology, the Sherardian professor of botany, and the donor. The ground in question is situated at Cothill, near Abingdon, Berks, and is meant more for observation than for collecting purposes. It is hoped that a systematic record, year by year, of a piece of ground untouched by cultivation will be of considerable interest.

AT this moment, when the metropolis is menaced by small-pox, the founding of a league which has for its objects the spread of a wider knowledge of the benefits derived from vaccination and a better understanding among the general public of the advantages arising from preventive medicine and practical sanitation, cannot but be deemed opportune. The Vaccination League has, we understand, the support of Mr. Jonathan Hutchinson, Sir Alfred Garrod, Prof. Charles Stewart and many other medical men.

A GREAT landslip has occurred in Barbados, of the extent, it is said, of 500 acres. The Boscobel district plantations and buildings have been wrecked, eighty-five houses have been swept into the sea, and 400 people are homeless. Roads have disappeared and all the landmarks are gone.

THE *Athenaeum* gives the following particulars respecting the new meteorological station which has just been established at Achariach, in Glen Nevis. The situation is such that a spur of Ben Nevis shuts in the valley to the west, and the height above sea-level is only 165 feet. The intention of the founder of the station—Mr. R. C. Mossman, of Edinburgh—is "to study the thermal conditions in the valley and on the adjacent hillsides during anticyclones in winter." It seems that in calm, cold weather and with a high barometer it not seldom happens that the mountain summits are much warmer than the valleys, which are filled with cold air chilled by radiation from the surrounding hills. The height to which this lake of cold air extends is to be the principal subject of investigation. The station is well equipped with a complete set of the best instruments.

IN addressing the Liverpool Chamber of Commerce on Monday last, Major Ronald Ross gave an encouraging account of the progress in sanitary matters which is taking place in West Africa. The governors of the coast were, he said, doing everything in their power for the great cause of sanitation, and their efforts were supported by the Colonial Office, but this sudden and delightful reform was due principally to the action of the Liverpool School of Tropical Medicine. He was still convinced that for practical purposes as a rule drainage was the proper way of dealing with malaria in large towns. In spite of letters in the papers, the fact that mosquitoes carried malaria was an absolute one. They did not propose to destroy every mosquito throughout the continent of Africa, but to reduce them in towns by getting rid of the innumerable breeding places. From six years' special study of mosquitoes he assured them that this measure would have the desired effect. Apart from malaria they proposed to do everything in their power to improve the health of the West Coast in every way. Already they had opened with the British Bank of West Africa a tropical sanitation fund, and they would begin a campaign in Nigeria when they were able to open an account for that work. In his opinion the West Coast of Africa was not so unhealthy as it had been painted by some, and his own experience proved that those who lived carefully there would most likely succeed in avoiding severe diseases. The country was opening up every day, and as it opened up so would disease tend to diminish, as it did in India and Burma before the advance of civilisation.

THE Nordenskjöld South Polar Expedition left Gothenburg on the 16th inst. on board the *Antarctic*.

DR. D. MORRIS, the Imperial Commissioner o. Agriculture for the West Indies, who has been in London for the past few weeks, has now returned to Barbados.

At the recently held annual meeting of the Royal College of Surgeons, Edinburgh, the following prizes were awarded:—The Victoria Jubilee Lister prize of the value of 100*l.*, founded by the late Dr. R. H. Gunning "for the greatest benefit done to practical surgery by any Fellow or Licentiate of the College during the quadrennial period ending June 20, 1901," to F. Mitchell Caird, of Edinburgh; the Surgical Essay prize of 100 guineas, offered by the College for "an original unpublished essay on surgery, in any of its branches on anatomy, physiology, therapeutics, or pathology, in their relations to surgery," to J. Veitch Paterson, of Edinburgh, the title of whose essay was "The Lymph Flow through the Eyeball."

THE Lecture List Calendar of the London Institution for the coming session is now ready, and includes the following addresses:—"On the Senses and Intelligence of Animals," by Lord Avebury; "The Life Period of Mountains," by Prof. G. A. J. Cole; "Optical Properties of Diamonds and Rubies," by Prof. S. P. Thompson; "Nourishment and Protection of the Young of some Animals," by Prof. C. Stewart; "Photographic Study of Clouds," by Mr. A. W. Clayden; "Conveyance of Malaria by the Mosquito," by Dr. P. Manson; "Recent Work among the Mollusca," by Prof. G. B. Howes; "The Heart," by Dr. H. Power; "The Mammoth Cave of Kentucky," by Mr. F. Lambert; "The Development of the Human Brain as an Organ of Mind," by Dr. F. W. Mott; "Colour Vision," by Mr. G. J. Burch; "Protection by Shape and Colour in Amphibia and Reptiles," by Dr. H. F. Gadow; "Inert Gases of the Atmosphere," by Prof. W. Ramsay.

ACCORDING to the daily papers a new principle in wireless signalling has been discovered by Mr. A. Orling and Mr. T. Armstrong, who last Friday gave a demonstration of the system which they have worked out. So far as we know, no description of Messrs. Orling and Armstrong's method has as yet appeared in the technical Press, and the details given by the newspapers being somewhat scanty it is difficult to form any definite idea of the probable utility of the system. We gather that the inventors rely partly, if not entirely, on earth conduction, and that they have been successful in transmitting speech in this manner. By using relays buried in the earth the range of signalling has been increased up to two and a half miles overland, a distance which, it must be admitted, is insignificant compared with Mr. Marconi's results. The system is, however, said to offer great facilities for tuning and thus to avoid the interference of messages, an advantage which should be of great benefit to it. The inventors appear to have devoted most of their attention to working out a method of controlling torpedoes or submarine boats from the shore. It may be recollected that in 1899 an account of some experiments made by Messrs. Jamieson and Trotter with this object appeared in the technical papers. These inventors used Hertz waves acting on a coherer on board the torpedo; although at the time it was said that the apparatus worked without a hitch, we have not since heard of its development or practical adoption. Messrs. Orling and Armstrong are said to have successfully guided a torpedo at a distance of six miles from shore.

AN excerpt from the *Proceedings* of the Royal Geographical Society of Australasia (Queensland) contains an illustration of the recently instituted "Thomson Foundation Gold Medal" of the Society. The medal, which is the work of Wyon, is to be awarded annually, or at such times as the council may approve, to the author of the best original contribution to geographical literature, preferential consideration being given to the geography of Australasia, provided it be, in the opinion of the council, of sufficient merit. The subject of the competition for the award of 1902 is "The Pastoral Industry of Australia, Past, Present and Probable Future," and essays must reach the Society not later than June 15 next.

AT the meeting of the Institution of Mining and Metallurgy held on Thursday last, an interesting paper was read by Mr. C. J. Alford on "Gold Mining in Egypt," in the course o. which he said that the exposure of the crystalline rocks in which the ancient gold mines of Egypt were worked, and in which search for deposits of metalliferous minerals might be undertaken with prospects of success, commenced about Jebel Zeit, at the south end of the Gulf of Suez, and extended in varying width along the coast line of the Red Sea, with few and slight interruptions for 700 miles, until it joined the mountains of Abyssinia. At Um Rus the mountain chain of crystalline rocks was about 60 miles in width from east to west, whilst 100 miles south it decreases to about 30 miles; then, in latitude 22° N., the boundary line between Egypt and the Sudan, it extended from the coast westward for fully 200 miles, and, with occasional covers of sand, all the way to the Nile. During the last twelve months the work of exploring the country and the ancient mines had been pushed on energetically. At Um Rus the exploration of one of the ancient gold mines was commenced last December, and so far the results had been decidedly encouraging. Speaking at the meeting at which Mr. Alford's paper was read, Lord Harris stated his willingness to undertake the responsibility that a gold medal, or whatever material object the council of the Institution might suggest, should be presented as a prize for the purpose they might think most useful.

ACCORDING to the *Electrician*, difficulty has for some time past been experienced in maintaining communication with the observatory on the Zugspitze mountain, 3000 metres high, on the Austrian frontier of Bavaria, throughout the year. Last September the Bavarian Postal Telegraph Administration put the matter into the hands of the Allgemeine Elektricitäts Gesellschaft, who have now solved the difficulty by establishing a wireless telegraph installation between the observatory and the post-office of Eibsee on the Slaby-Arco system. The difference in altitude between the summit of the mountain and the Eibsee post office is 2000 metres. In designing the apparatus such a wave-length was chosen, so that deflection from the surfaces of rocks, &c., on the mountain should assist rather than impede the transmission of the signals. Another difficulty which has been overcome is that of the power supplied to the apparatus. The transport of heavy batteries, &c., to the top of the mountain would have been extremely difficult, and therefore the company has designed the apparatus so that it should require a minimum of power, and the dry cells which are employed with it have proved sufficient. Instead of the wire which has been used in many recent Slaby-Arco experiments, ordinary steel rope has been employed, and this has been fixed in a slanting direction to the surface of the rocks without the assistance of either a mast or insulators. It is stated that the system has so far given entire satisfaction to the Post Office authorities.

AT the Trinidad Agricultural Exhibition specimens of sponges which had been collected on the beach of Tobago were on show. The sponges were not large, but were soft in texture, minutely porous, and the presence of large silicious spicules, so common in inferior kinds, was not apparent. They resembled very much what are sold as face sponges. In the specimens exhibited it was seen that the structure was tender and easily pulled to pieces, showing that they would not last long in use. It was explained, however, that the specimens were taken from the beach, and there was nothing to show how long they had been exposed to the rolling of the breakers, the heat of the sun, and the erosion of sand and pebbles of the beach, which would naturally tend to rot the texture of a sponge. Such, however, is the quality that it is thought, says the *Bulletin of Miscellaneous Information* (Trinidad), a trial might usefully be made by a skilled diver on the reefs where they are produced, to ascertain whether the quality would be of fair market value, if harvested direct from their habitat. Such an experiment would cost but little, and, if successful, would confer a blessing on the little Island of Tobago, so long hampered by financial difficulties. In the Bahamas the export for 1898 was valued at 97,512*l*. If the reefs of Tobago should prove as fertile of marketable sponges as those of the Bahamas, it would mean the establishment of a new and permanent industry of the highest value.

THE Essex County Council is to be congratulated on the good work done in the technical laboratory at Chelmsford by Messrs. Dymond and Hughes. The "Notes on Agricultural Analyses" just issued contain a careful account of different descriptions of soil occurring in Essex, their geological and physical characteristics, and their chemical composition. This is just the kind of work which county councils may carry out with great advantage.

THE annual report of the Connecticut Agricultural Experiment Station, just issued, furnishes a good example of the kind of work done at an American station. One half the volume consists of reports of the analyses of fertilisers, foods and other agricultural commodities; the other half deals with investigations, and discusses agricultural questions. One of the most interesting articles is on the kinds of trees most suitable for street avenues, and the diseases and accidents to which they are specially liable. Dr. T. B. Osborne continues his laborious researches upon the chemistry of vegetable proteids. A valuable bibliography of American work on plant diseases is supplied by Dr. Sturgis.

WE have received a copy of Sir Charles Todd's Report upon the Rainfall in South Australia and the Northern Territory during 1898. Monthly and yearly values are given for a large number of stations and show that, generally speaking, the small annual average over the northern districts is mostly made up of summer rains, while in the southern districts the winter rains are largely in excess. As wheat growing chiefly depends upon the latter conditions, the monthly tables are very valuable for agricultural purposes. The annual distribution is clearly shown in two maps which accompany the report.

MR. W. W. WAGSTAFFE, B.A., has printed an interesting little pamphlet on the climate and weather of Sevenoaks, based on observations for ten years (1890-99). The absolute maximum temperature was 89° in August 1893, and the lowest 5° in February of the severe winter 1894-5. The average annual rainfall is 29·75 inches, of which only about one-third fell during the daytime. The summer temperature is nearly 3° lower than London.

THE first volume of the *Journal of Hygiene* has just been completed by the issue of part iv., which maintains the high standard of its predecessors. In it Rogers discusses the seasonal prevalence of *Anopheles* and malarial fever in Bengal, and his observations support the view that the disease known as Kala-azar of Assam, the ætiology of which has been doubtful, is an epidemic malarial fever and is transmitted by *Anopheles*. Nuttall and Shipley conclude their studies on the structure and biology of *Anopheles*, their paper being illustrated by some excellent plates. Cobbett surveys the epidemiology and bacteriology of a recent outbreak of diphtheria at Cambridge, and Fulton that of the Elkton (Maryland) milk epidemic of typhoid fever. The use of "neutral red" as a test for the colon bacillus and of its presence in waters is the subject of the remaining two papers by Makgill and by Savage. These two investigators, working independently and separately, arrive at practically the same conclusions. They find that this reagent is a very delicate indicator for the colon bacillus and that a negative neutral-red reaction obtained with a sample of a water is high presumptive evidence of the absence of this organism.

THE current number of the *Berichte* of the German Chemical Society is remarkable for the number of original communications it contains, there being no less than 106, occupying 753 pages. Among these is a paper by Dr. Otto Ruff, on the existence of ammonium. It has been regarded as highly probable by many experimenters that on treating ammonium chloride solution with sodium amalgam or on electrolysing a solution of ammonium chloride with mercury as kathode, a real amalgam of ammonium with mercury is the true primary product. The problem is here attacked from a new and ingenious point of view, although with negative results. It is known that the alkali metals dissolve in liquid ammonia with the production of compounds possessing a fine blue colour. Thus a solution of potassium iodide in liquid ammonia submitted to electrolysis at a temperature of −70° C.

readily gives this blue compound at the negative pole. A solution of ammonium iodide in liquid ammonia was now substituted for the potassium salt, and then electrolysed at − 95° C., but no blue coloration was produced, hydrogen gas being steadily evolved from the commencement of the experiment. Thinking that perhaps an increase of pressure might have the desired effect the tube was sealed up, but although in one case the pressure rose to as much as 60 atmospheres before the tube burst, there was still not the slightest evidence of the existence of the radical ammonium in the free state.

THE same number of the *Berichte* contains an interesting paper, by H. Biltz, on the dissociation of the sulphur molecule. In recent years it has been shown by numerous researches that the maximum density of sulphur vapour corresponds to a molecule S_8 and not S_6 as usually represented in the text-books. But although this point is now well established, there was still a doubt as to the exact manner in which the molecule dissociated, the results of the first measurements of Biltz suggesting that the dissociation actually took place in two stages, the molecules S_8 first breaking up into S_6 and S_2, and these S_6 molecules finally splitting up into $3S_2$ molecules. In order to set this point at rest further measurements were carried out, the results of which are given in the present paper. The problem can be attacked in two ways; the densities can be determined at constant pressure, or at constant temperature with varying pressures. The latter method, giving isotherms, was selected as being capable of the greater accuracy, experiments being carried out at a temperature of 444° C. and at pressures between 14 and 540 mm. of mercury. The author concludes that only two kinds of sulphur molecules exist, S_8 and S_2, the former being the only ones present in sulphur solutions, the latter in sulphur gas at temperatures above 850° C.

A REPORT has been drawn up for the Franklin Institute on recent advances in the physics of water, by Dr. George Flowers Strading, and is published in the *Journal* of the Institute for October (pp. 257–269). It deals with the theory which assigns to water a complex molecular constitution, the maximum density and its dependence on the pressure, the relations between the pressure, volume and temperature, and the viscosity. In connection with the molecular constitution of water, the author discusses at some length Röntgen's theory, which regards water as consisting of two kinds of molecules called "ice molecules" and "molecules of the second kind." A subject somewhat allied to the above, namely the freezing points of solutions, was recently dealt with in the *Physical Review* by Messrs. E. H. Loomis and W. F. Magie.

THE *Mathematical Gazette* contains a brief account of the recent "Teaching of Mathematics" discussion by Mr. R. F. Muirhead, and a paper on the slide-rule by Prof. F. R. Barrell. We should like to see more matter of this kind in the pages of the *Gazette*, which, it may be remembered, is the organ of an association which till recently called itself the Association for the Improvement of Geometrical Teaching. The present is an opportune time for the Association to resume the functions expressed by its old title, and the fact that many of the members are engaged in teaching mathematics on conventional lines would add to the value of any opinions expressed in the *Gazette*.

IN a note contributed to the Lombardy *Rendiconti*, xxxiv. 16, Signor Alberto Dina compares the hysteresis in iron under a rotating, an alternating, and a statical magnetic field. In the first the magnitude of the inducing force remains constant and its direction varies, in the second and third the direction remains constant while the magnitude varies. The third case is distinguished from the first and second by the property that the complete cycle takes place much more slowly. The present experiments differ from those previously made in that the same body has been used in measuring each of the three kinds of hysteresis. The table of results shows clearly the behaviour of these different forms of hysteresis for equal induction; while the "alternating hysteresis" is always greater than the "statical hysteresis," the "rotatory hysteresis" lies between both of them until $B = 10,000$ units approximately; it then becomes equal to the statical, and afterwards less, and both the percentage difference and the absolute difference increase as the induction increases. These experiments were performed with iron of low permeability, and it is suggested that similar experiments with soft iron might yield interesting results.

IN addition to papers dealing with meteorological and physical subjects, Nos. 1 and 2 of the *Bulletin* of the Moscow Society of Naturalists for 1901 contain an important article by J. J. Gerassimow on the influence of the nucleus on the growth of the cell, and also one by Prof. D. Sernoff on the morphological nature of the tail-like appendages occasionally met with in the human race. After describing, with illustrations, several examples of these appendages, the latter author comes to the conclusion that they are teratological and in no sense atavistic.

IN the *Biologisches Centralblatt* for October, Dr. G. von Linden commences an account of his investigations into the structure of wings of insects, especially the Lepidoptera during the pupal stage, in relation to their origin and their bearing on the phylogeny of the different groups. The subject has been taken up where it was left by Schäfer, van Bemmelen, Haase, Urech and Eimer, and the theory of the latter that the original type of coloration in Lepidoptera was in the form of longitudinal stripes, while a uniform coloration is the final development, is confirmed. The bearing of the investigation on classification is left for a later communication.

IN the *Victorian Naturalist* for September Mr. W. Macgillivray concludes his notice of North Queensland birds, while Mr. R. Hall gives a further instalment of his notes on undescribed nests and eggs of Australian birds.

WE have received a copy of a paper by Miss N. Evans on the habits of the common grey mosquito of Calcutta (*Culex fatigans*), published in the August issue of the *Proceedings* of the Asiatic Society of Bengal. It is shown that the adult female may live for about five weeks, during which it may feed five times, when it selects by preference the blood of the house-sparrow. The latter fact suggests the possibility of this insect being a carrier of a definite blood-infection.

THE additions to the Zoological Society's Gardens during the past week include a Black-headed Lemur (*Lemur brunneus*), a Yellow-cheeked Lemur (*Lemur xanthomystax*) from Madagascar, presented by Mr. S. Neven Du Mont; two Arctic Wolves (*Canis occidentalis*) from New Mexico, presented by Mr. William Ruston; three Shaw's Gerbilles (*Gerbillus shawi*), a Dwarf Jerboa (*Dipodillus campestris*) from North Africa, presented by Mr. J. S. Whitaker; a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, two White-fronted Capuchins (*Cebus albifrons*) from South America, a Green-headed Tanager (*Calliste tricolor*) from South-east Brazil, two Dinca Finches (*Dinca grisea*) from Chili, a South Albemarle Tortoise (*Testudo vicina*) from the Galapagos Islands, a Rough Terrapin (*Nicoria punctularia*) from Northern South America, two Annulated Terrapins (*Nicoria annulata*) from Western South America, two Menobranchs (*Necturus maculatus*) from North America, two Dark Green Snakes (*Zamenis gemonensis*), a Four-lined Snake (*Coluber quatuorlineatus*), European; ten Snake Fishes (*Polypterus senegalus*) from the White Nile, East Africa, deposited; a Black-faced Spider Monkey (*Ateles ater*) from Eastern Peru, eight Golden Plovers (*Charadrius pluvialis*), European, purchased.

OUR ASTRONOMICAL COLUMN.

THE SPECTROSCOPIC BINARY CAPELLA.—The *Lick Observatory Bulletin* No. 6 contains the final values adopted for the orbit of the spectroscopic binary system of Capella. The reductions are from thirty-one observations of the radial velocity of the solar-type component, made with the Mills spectrograph between 1896 September 1 and 1900 September 27. On most of the plates the spectra of the two components are distinguishable, that of the principal star being of the solar type, whereas that of the secondary component is intermediate between the solar and Sirian types. The ranges in velocity are as follow:—

Principal star $+4\cdot2$ to $+55\cdot7$ kilometres per second.
Secondary „ -3 „ $+63$ „ „

Therefore the ratio of the two masses will be as $1\cdot26 : 1$.

The solar-type component is estimated to be about half a magnitude brighter photographically than the blue component, while in the visual region of the spectrum the solar component is probably a whole magnitude the brighter of the two.

In consequence of observations with the 36-inch refractor under good conditions failing to show the duplicity of star, it is probable that the distance between the components is not greater than $0''\cdot06$.

The following are the final adopted elements, with their several probable errors:—

$\omega = 117°\cdot3 \pm 18°\cdot3$.
$\mu = 0\cdot060403 \pm 0\cdot000014$ radians.
$= 3°\cdot46082 \pm 0°\cdot00081$.
$T = -17\cdot4 \pm 5\cdot3$ days, the actual date being 1899 September 1·5.
$e = 0\cdot0164 \pm 0\cdot0055$.
$K = 25\cdot76 \pm 0\cdot12$.
$U = 104\cdot022$ days $\pm 0\cdot024$ days.
$a \sin i = 36{,}847{,}900$ kilometres.
$V = +30\cdot17 \pm 0\cdot104$ kilometres per second.

NEW SOUTHERN ALGOL-VARIABLE.—Mr. A. W. Roberts announces that observations made at Lovedale confirm the variability of the star,

R.A. = 10h. 16m. 44s. }
Decl. = $-41° 43'\cdot8$ } 1875.

The observations suggest the following elements:—

Period = 1d. 20h. 30m. 2s.
Epoch of Min. = 1900, Jan. 1d. 15h. 10m. (G.M.T.)
Limits = 10·0–10·9 magnitude.

The actual light changes are completed in 3h. 20m., and there appears to be no stationary period at minimum. The ascending and descending phases are equal, each occupying 1h. 40m. (*Astronomical Journal*, vol. xxii. No. 508.)

SPECTRUM OF NOVA PERSEI.—In the *Astronomische Nachrichten*, Bd. 156, No. 3741, Father Sidgreaves summarises as follows the results of his examination of recent photographs of the spectrum of the Nova Persei:—

All hydrogen lines are now relatively weak, excepting the doubtful line $H\epsilon$.

λ5007 much stronger than $H\beta$ or $H\gamma$. Great width.
4958 prominent broad band.
4718 grown from a weak to strong band.
4713 strong line on edge of 4718.
4688 rather weak broad band.
4640 gradually weakened like hydrogen.
4364 very prominent band, stronger than $H\gamma$, crossed by three bright lines.
3969 ?$H\epsilon$. As strong as all other hydrogen lines together.
3869 stronger than 3969.

All these, with the exception of 4718, which shades off on red side, are broad with sharp edges. The structure of bands 3969 and 3869 very remarkable, being crossed by four strong lines of the same relative intensities and at the same intervals. This is also shown in the line 4364.

MICROMETRIC OBSERVATIONS OF NEPTUNE AND ITS SATELLITE.—In the *Astronomical Journal*, vol. xxii. No. 508, Prof. E. E. Barnard gives a series of micrometer measures of the satellite of Neptune extending over the period 1889 August 12—1901 February 5, made with the 40-inch refractor of the Yerkes Observatory. Many observations had been recorded previously, but it has been pointed out by Prof. Hall that only continuous measures of this object are of value. For the majority of the observations a power of 700 diameters was employed.

On three occasions it was possible to obtain good measures of the diameter of the planet, the reduced value being

$$d = 2''\cdot436 \text{ (at mean distance} = 30\cdot0551).$$

A note is made of the fact that the planet, when seen under the best conditions, always appeared round and free from markings.

APPEARANCE OF THE PHOTOGRAPHIC IMAGE OF NOVA PERSEI.—MM. Flammarion and Antoniadi contribute a further article respecting the photographic image of Nova Persei to the October issue of the *Bulletin de la Société Astronomique*, which is specially interesting in that it is illustrated by drawings and reproductions from the photographs obtained, showing exactly the appearances presented. These have already been described; the suggested explanation by Dr. Max Wolf ascribing them to the objective not being corrected for some special radiation emitted by the Nova does not appear to have been definitely settled yet, but the great intensity of the ultra-violet lines in its spectrum, together with the fact of the existence of the newly observed line about λ 342, would seem to support this supposition.

RECENT PROGRESS IN WATERWAYS AND MARITIME WORKS.

THE fourteen papers presented to the section of Waterways and Maritime Works at the International Engineering Congress at Glasgow were for the most part descriptive of important recent works carried out in various parts of the world, as, for instance, the Dortmund and Ems Canal, the Assuan Reservoir Dam across the Nile, the improvement of the Lower Mississippi, the Chicago Drainage Canal, the breakwaters for sheltering the entrance to the River Nervion, the Zeebrugge Harbour Works, and recent improvements in the lighting and buoying of the Scottish and French coasts. Some papers, moreover, dealt with the gradual extension and recent progress of works commenced many years ago, as, for example, the improvement of the River Clyde and its estuary and the works of Glasgow Harbour, recent improvements in the navigable condition of the Sulina branch and outlet of the Danube, and the lighting of the Chinese coast.

Some of these works furnish, for the most part, a record of the steady development and extension of methods of execution, constituting in the end a very notable advance, of which, however, the stages have been numerous and gradual; whilst other works present distinctly novel features, exhibiting a very definite progress in engineering science, and therefore of somewhat special interest, as will be briefly indicated.

The lift at Henrichenburg, on the Dortmund and Ems Canal, for raising barges of 950 tons from one reach of the canal to another, 46 feet higher, in a single operation, illustrates the novel principle of supporting the trough, carrying the barge, on several floats immersed in wells; and the whole structure is so perfectly balanced that the introduction of a small quantity of water into the trough at the top causes it to descend, and the abstraction of some water from the trough when at the bottom makes it ascend, the actual transit being effected in two and a half minutes, though the whole operation of transferring a barge from one reach to the other occupies about twelve and a half minutes on the average. This system of simple flotation, in place of the older system of hydraulic lifts, consisting of two counterbalancing troughs, each supported centrally on a hydraulic piston which even for raising barges of from 300 to 400 tons has had to be given a diameter of $6\frac{1}{2}$ feet, has enabled these canal lifts, with their important advantages over locks of saving largely both time and water, to be adopted for vessels of more than double the tonnage of those raised by the older canal lifts.

The large excavations required for the Chicago Drainage Canal led to the adoption of excavators and dredgers of unusual size, the bucket of some dipper dredgers having been given a capacity of six cubic yards; whilst the removal of large masses of earthwork to the sides of the canal trench gave rise to the introduction of novel types of plant. These consisted of cableways suspended from high travelling towers on each side of the canal, along which skips conveyed the earthwork from the excavations to the spoil banks on either side; conveyors forming a bridge stretching across the channel, with cantilever arms projecting over the spoil banks on each side, carrying a steel travelling belt which conveys the material to the depositing ground; cantilever conveyors running on rails along one bank of the trench, with one arm dipping down into the excavations and the other rising over the spoil bank, up which incline a trolley is drawn for disposing of the earthwork; inclined planes leading to a travelling bridge with an open roadway extending over the spoil bank, through which wagons drawn up the incline deposit their load; and, lastly, high-power revolving derricks and other machinery for the rapid and economical removal and deposit of the excavations.

The novelty of the reservoir dam in progress at Assuan across the Nile consists in the one hundred and eighty sluices by which it is pierced affording a waterway of 24,000 square feet, through which the whole flow of the Nile in flood-time will be discharged, amounting to a maximum of 475,000 cubic feet per second with a velocity of 20 feet per second. These openings will be closed for storing up water for summer irrigation, by counterbalanced sluice-gates working on free rollers, which can be readily raised or lowered against a considerable head of water.

The deepening of the navigable channel by about 3½ feet outside the Sulina mouth of the Danube since 1895 by dredging, giving an available depth of 24 feet, shows that it is possible under favourable conditions to cope with the deposits of a minor channel of a deltaic river by means of dredging, at any rate for a time; though it must be anticipated that eventually the accumulations of deposit in front of the mouth will necessitate an extension of the jetties, to enable an improved scour across the advancing delta to aid dredging in the maintenance of the depth of the outlet channel.

The injuries caused during two successive winters to the superstructure on the top of a rubble mound, forming the main breakwater in progress for sheltering the approach to the River Nervion leading to the port of Bilbao, exposed as this breakwater is to the full force of the waves rolling in from the Bay of Biscay during north-westerly gales, has led to the adoption of a novel method of depositing blocks of concrete of unusual size for the purpose of providing a secure foundation for the superstructure in this exposed site, where the breakwater extends into a depth of about 50 feet at low tide. The method comprises the construction of metal caissons to serve as a lining for the blocks, which are ballasted with concrete, floated out into position, and sunk in place by filling them with water, after which they are filled as rapidly as possible with large concrete blocks, and with concrete in mass in the interstices and on the top, so as to constitute a solid block, the largest blocks thus formed at the Bilbao Harbour Works having a weight of about 1500 tons. These blocks, laid in a row on the top of a rubble mound at a depth of about 16½ feet below the lowest low water, within the shelter of the original rubble mound with its capping of large concrete blocks, have proved a perfectly stable foundation for the superstructure which is being erected upon them. This system is being extended at Zeebrugge Harbour in the North Sea, at the entrance to the Bruges Ship Canal, where steel caissons have been constructed and lined with concrete, which are to be floated into position in calm weather one by one for the foundations of sea and harbour walls along each side of a quay, and an outer solid breakwater; and these blocks, when completed, will rest on the sea bottom, and weighing from 2500 tons up to 4400 tons, will emerge about 2½ feet out of water at low water of spring tides, so that a solid superstructure can be readily built upon them.

Remarkable progress has been achieved in recent years in the extension of appliances for the more efficient lighting of minor shoals, outlying reefs, and navigable channels. The ease of rotation obtained by floating the illuminating apparatus on an annular mercury bath, has enabled the system of group flashes, giving a distinctive character to each light, to be extended to beacons exhibiting a continuously burning light for three or four months, by rotating the light apparatus by an electric battery placed in a chamber in the beacon. The increased speed of rotation, moreover, rendered possible by the floating on a mercury bath, has enabled the number of panels of lenses to be reduced and their size increased, and consequently a brighter flash to be exhibited. Various improvements also have been effected in the lights themselves. Thus carbonised wicks have been devised which enable a light to continue burning without being attended to for a considerable period, with only a moderate deterioration in intensity; incandescent lamps have been adopted, fed by oil gas or petroleum vapour, which provide an excellent light; and acetylene is being experimented upon by the French Lighthouse Service, and the danger of explosion having been overcome by using very small tubes for supplying the burner, it appears likely to furnish a very bright, serviceable light. Special attention has been lately devoted to reducing the divergence of the light exhibited by lightships from the vertical, as with a considerable rolling of the vessel in a storm the light is liable to be obscured for a time. As it has been ascertained by observation that the waves in severe storms have a fairly definite period of oscillation in any particular locality, the special period of oscillation of the waves where a lightship is to be placed is ascertained; and the vessel is so designed, and its weights adjusted, that its period of roll may differ materially from the oscillation of the waves at its station; and the roll of the lightship is further checked by giving it a large draught and deep bilge keels. Moreover, the light and its accessories are supported on a sort of compound pendulum, with weights so adjusted at the bottom and above the light that the oscillation of the pendulum differs from the roll of the vessel, and the stability and consequent visibility of the light is thereby increased.

Altogether the papers furnish interesting indications of some of the advances being achieved in the execution of waterways, maritime works, and the lighting of shoals and channels; and the prospect of important extensions of waterways is manifested by the Dortmund and Ems Canal, forming merely the first instalment of a waterway intended to connect most of the rivers of Prussia, and the proposal of a Russian engineer for constructing a deep waterway to connect the White Sea and the Baltic, capable of being traversed by large seagoing vessels.

ITALIAN GEOLOGY.[1]

AN elaborate memoir, containing results of a study of the rocks and geology of the basin of the Sesia with the exception of its lower portion, the Strona valley and the western portion of the Orta lake, has lately been issued. The authors remark that, having made traverses of this region in several directions, noting many stratigraphical details, they were obliged to recognise the impossibility of the task of determining the "absolute chronological value" of the different formations. Neither does their microscopic examination of the rocks help them more to unravel the stratigraphical problems. This is a result which is not infrequent where petrographical methods are treated as paramount. Petrography, as I have frequently laid stress upon, is but *an aid* to geology, a valuable one, I admit, but inferior to good and accurate field-work, lithology, and a wide general knowledge of the surrounding region, and especially of the habits in other regions of the same class of rocks.

The authors have, as they but too justly point out, to contend with the absence of any known fossiliferous horizon, or in fact any stratigraphical standard formation as a datum to work from. In addition a large mass of volcanics traverse the Valsesia between the two principal crystalline formations and produce uncertainty in the limits of each, further disturbing the already complex stratigraphical arrangement and masking the relations of one to the other. At the commencement of the paper is a bibliographical list of fifty-three memoirs dealing with the locality in question.

It was found convenient for the petrographical studies to divide the rocks of the higher basin of the Sesia into five groups:—

(1) Gneiss of Strona (with an appendix on the granites).
(2) Massive augitic and hornblendic rocks.
(3) Gneiss of Sesia (including the schists of Rimella and Fobello).
(4) Greenstones (pietre verde) properly so called.
(5) Gneiss of Monte Rosa.

The authors deserve much credit for not venturing beyond the old nomenclature of Gerlach and Parona, the earlier students of this region.

Under the first group are included mica-schists with silli-

1 "Ricerche Petrografiche e Geologiche sulla Valsesia," by E. Artini and G. Melzi (*Mem. del R. Istituto Lombardo di Sc. e Lett.*, vol. xvii. pp. 219-392; pl. xxii.).

manite, gneisses, biotitic granular, with two micas, scaly with microcline, fine grained biotitic, nodular amphibolic, dioritic, augito-hornblendic and fine-grained tormaliniferous; augitic granulites, amphibolites, olivine and serpentiniferous rock and calciphyres (*i.e.* crystalline calcitic rocks containing more or less various silicates). In the appendix is included an examination of the granitites of Roccapietra, Quarna, and some vein granites.

The second group comprises diorites—micaceous, augitic and hornblendic; norites—simple and with hornblende; gabbros—simple and with garnet and with olivine; peridotites, pyroxenites and hornblendites are represented by lherzolites, harzburghites and websterites. The banded gabbros and stronalites are represented by banded augitic gabbros, banded hornblendic gabbros, stronalites. Basic dyke rocks, as spessartites, amphibolites and dioritic schists, are each given their share of microscopic researches. Some interesting observations are offered concerning the occurrence of schistose structure in these rocks.

Under group three are included light-coloured schistose gneisses, mica-schists and prasinitic rocks. A notable fact in this formation is the presence of thick bands and big masses of truly massive granitoid rocks intercalated between the more schistose kinds. These are of different types in which the characteristic element may be microcline, quartz, or of the type of an augite-horneblende diorite. Though not attaining any notable development, still the nodular or *eyed* gneisses are interstratified with the other rocks of this formation, especially at Valle de Carcoforo and other localities.

Another member of this group which owes its structure to dynamic metamorphism is the finely-banded gneisses in the Val Grande. The structure of the limestones, calciphyres and schists of Rimella and Forbello are each carefully described.

The fourth group, included under the name of greenstones (pietre verde), though of less importance from the point of view of mass, present undoubtedly the most varied characters, such as prasinites, amphibolites, amphibolic schists, eclogites, serpentine, and oliviniferous rocks, calc-schists and saccharoidal limestones, garnetiferous mica-schists, and light-coloured gneisses and quartzite schists.

The final or fifth group, or gneisses of Monte Rosa, are remarkable for their uniformity of composition. The variations seem to consist chiefly of a porphyroidal, schistose, banded or tubular structure, passing by gradations to microgneisses and mica-schists.

The petrographical description of this large number of divers rocks and their varieties is very detailed, and appears to be done with much care. It is, of course, quite impossible to give even in outline a review of this in the space at our disposal. A clearer idea of the varied rock-structures is afforded by the large number of admirable photo-micrographs which the authors have executed themselves, and which are extremely well reproduced in the twenty plates devoted to this part of the subject.

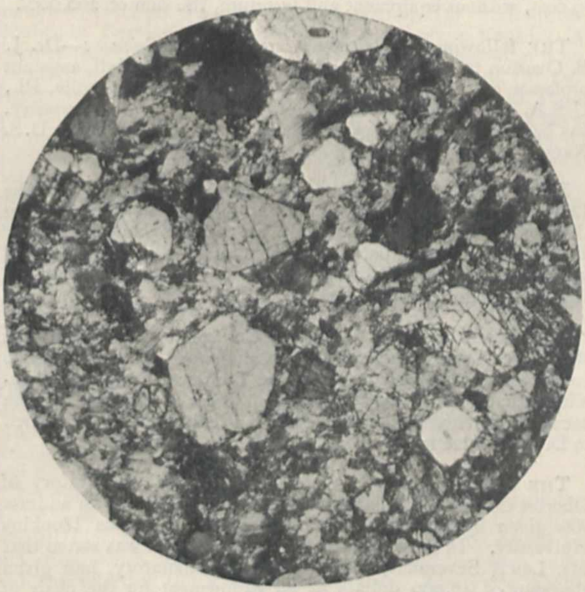


FIG. 1.—Calcifiro a Wernerite, con struttura clasticoporfirica.

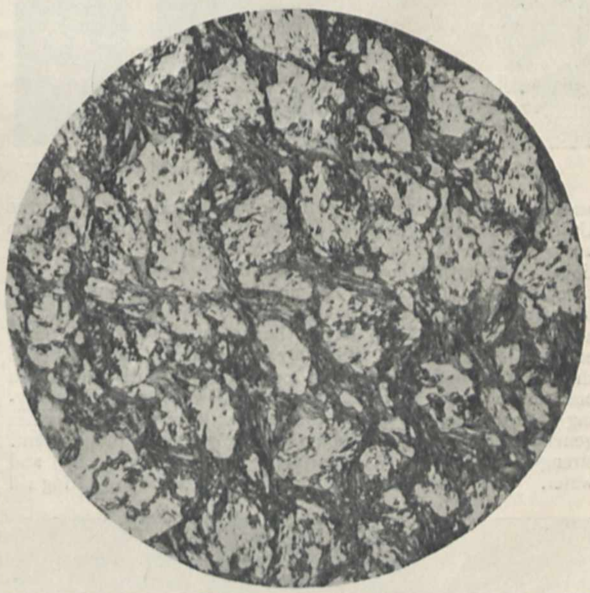


FIG. 2.—Prasinite Cloritica, struttura microocellare.

The second section of the memoir is devoted to the geological characters of the rocks. Unfortunately, the authors are able to add little that is new, or add any facts of general interest. Observations of dip are recorded, as well as contact-phenomena between rocks of divers mineralogical and chemical composition. These physico-chemical effects seem to be most variable—highly developed at one spot, and hardly to be remarked at others; no attempt, however, is made to explain these variations.

The authors deny the absence of contact effects, as asserted by Schaefer and Salomon, and between the basic eruptive rocks and the gneiss of Strona, and give some striking examples. As to the basic eruptive rocks, the authors show they are posterior to the Strona gneiss, and discuss their relative age to the Sesia gneiss. The other groups are treated rather from the point of view of their petrographical characters than from their geological aspect.

Cleavage and foliation, the effects of dynamo-metamorphic processes, is well developed in one part of the region, and quite absent in another; but few details of the types of foliation, and other changes, are offered the reader. The difference o interpretation of the relative ages and relations of the Strona and Sesia gneisses, with Parona, is fully portrayed in a tabular form of Messrs. Artini and Melzi's views.

The greenstones of this region the authors collegate, and even consider to be identical, with the greenstones of the Western Alps, lately pronounced by the *Comitato Geologico* to be Triassic and Liassic; whilst the gneiss of Monte Rosa they consider as Palæozoic or even Archaic.

A good geological map in colours of the region under consideration is given, and another coloured plate is devoted to sections. This work represents a great deal of patient labour in a difficult region, and, altogether, the authors are to be congratulated on their work. A little more charity to their opponents might here and there be allowed. It might also suggest itself to their mind that Germany does not hold a monopoly of petrographical research; that in France, and even in poor little England—not to speak of America, Norway, and other countries—many problems that are concerned in this memoir have been tackled, the published results of which might afford them some additional information.

H. J. JOHNSTON-LAVIS.

THE FUMIGATION OF FRUIT TREES.

THE systematic way in which fruit crops are protected from insect pests and other natural dangers in California has often been mentioned in these columns. Among the enemies of citrus plants are scale insects, or bark lice, and mites, to the consideration of which an article, by Mr. C. L. Marlatt, is given in the U.S. Year Book of Agriculture for 1900. The natural predaceous enemies of scale insects are various species of ladybirds, such as the Australian ladybird, which was introduced into California to control the fluted and black scales. The black

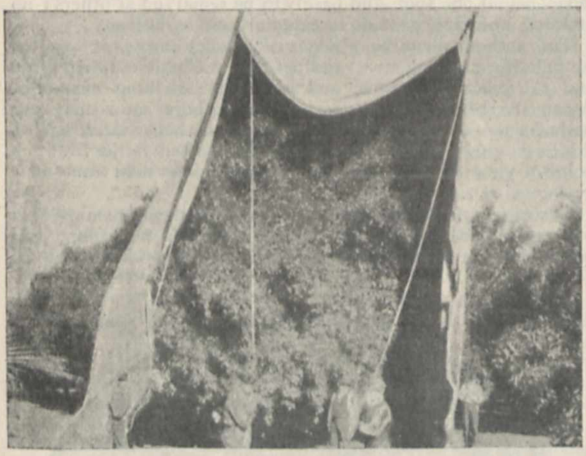


FIG. 1.—Tent carried over tree by the falling of pulleys.

scale has been completely controlled on certain ranches in the United States by its ladybird enemy, and this control has been brought about by the entire cessation of all insecticide operations. But until this condition of things exists on all the ranches, or at least until the natural enemies of scale insects have been fully studied, it is necessary to depend upon spraying and fumigation to keep down the insect pests. The most effective means of doing this is by subjecting infected plants to the fumes of hydrocyanic acid gas. The treatment consists in enclosing a tree at night with a tent as shown in the accompanying illustrations, and filling the tent with the poisonous fumes generated by treating refined potassium cyanide (98 per cent. strength) with commercial sulphuric acid (66 per cent.) and water. The treatment is particularly successful in getting rid

FIG. 2.—Tent in position for fumigation.

of the black scale (*Lecanium oleae*, Bernard) and California red scale (*Aspidiotus aurantii*, Maskell). The tents under which the trees are fumigated are drawn over the trees by means of pulleys, and some of them have diameters of more than seventy feet. To the fruit-grower who leaves things to chance, the work involved in the manipulation of such a protective process may appear excessive, but the cost must be regarded as insurance against loss due to defective crops, and the results obtained in California show that the expenditure of money and energy is fully justified.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MRS. ANNA HOUGH has offered 40,000 dollars to the University of Southern California at Los Angeles on condition that the balance of 100,000 dollars be raised. The University recently obtained from Mrs. Hough the sum of 25,000 dollars on like conditions.

DR. JAMES MUSGROVE, formerly lecturer in anatomy, was on Wednesday, the 16th inst., installed in the chair of anatomy endowed by the late Marquis of Bute, and instituted under the recent new ordinances in connection with the University of St. Andrews.

UNIVERSITY fellowships, each of the value of 100*l*., have been awarded at the Victoria University, Manchester, to Drs. E. N. Cunliffe (Owens College) and G. W. Gelderd (University College), both of whom are undertaking research work during the coming year.

IN the expectation of further considerable grants by the local counties authorities, the council of the Birmingham University has, it is understood, authorised the Buildings Committee to prepare plans and specifications for necessary buildings, estimated to cost, without equipment and furniture, the sum of 200,000*l*.

THE following appointments are noted in *Science*:—Dr. J. B. Overton to be professor of biology, Dr. J. H. Hall, assistant professor of physics, each at Illinois College, Jacksonville, Ill., U.S.A., and Mr. F. B. Littell, of the U.S. Naval observatory, has been appointed to a professorship of mathematics in the U.S. Navy.

DR. J. BISHOP TINGLE, instructor of chemistry at the Lewis Institute, Chicago, formerly lecturer in chemistry at Gordon's College, Aberdeen, and at the Merchant Venturers' Technical College, Bristol, has been appointed professor and head of the newly organised department of chemistry at the Illinois College, Jacksonville, Ill., U.S.A.

THE new Municipal Technical College at Sunderland has started with the enrolment of 600 students. This number so largely exceeds the reckoning of the Technical Education Committee that the Borough Council, in order to provide for the necessary increase of the staff, will, it is expected, be compelled to have recourse to its rating powers.

THE dedication of the Severance Chemical Laboratory of Oberlin College took place on September 26, when an address was given by President Ira Remsen, of the Johns Hopkins University. In the course of the proceedings it was stated that Mr. Lewis Severance, the donor of the laboratory, had given the sum of 40,000 dollars as an endowment for the chair of chemistry.

AT a recent meeting of the governors of the Durham University College of Science, Newcastle, the principal of the College submitted his report, in which he stated that the fund for the completion of the College buildings amounted to 31,000*l*. The suggestion of their treasurer, Dr. Hodgkin, that a suitable memorial to Lord Armstrong would be to erect a statue upon some prominent site, and to dedicate the College to his memory, had received the hearty support of Mr. Watson-Armstrong, and was cordially adopted by the council. They resolved to ask the University to consent to a change of name, and to invite subscriptions to an Armstrong memorial fund. A public meeting was held, resolutions were adopted approving of the scheme, and upwards of 20,000*l*. was promised towards it.

SPEAKING at a meeting held on Wednesday, the 16th inst., to inaugurate the third winter session of the London School of Tropical Medicine, Dr. Manson said that the school wished to fulfil two functions, viz., the education of the practitioner who proposed to devote his life to practice in the tropics, and the attempt to advance medical science as regarded tropical disease. How far they had been able to fulfil those undertakings it was for those present to say. As regarded the educational part of their work he could claim that they had had a distinct success although they began with a certain amount of trepidation and anxiety. They had succeeded in overcoming financial difficulties and professional opposition, the first mainly through the assistance and countenance of Mr. Chamberlain and also with the assistance of the managers of the Dreadnought Hospital. From the first their student attendance was a fair one; but session after session the numbers of students asking for admission had increased, and now the applications were much more numerous than the accommodation they had to offer would allow them to admit. The mere physical space at their disposal was not sufficient to accommodate those who came to study there, and their appeal that day had for its object the removal of that obstacle to their success. The accommodation must be doubled if the school work was to go on. They wanted their laboratories very much enlarged; they wanted a lecture room, a room for a museum, and a good library. All these things were very necessary if the school was to go on and prosper. The work which the students of the school were doing warranted him in appealing for funds on its behalf. As instances of such work Dr. Manson referred to the investigation conducted by Dr. George Low in the West Indies respecting elephantiasis, the work of Dr. Durham and Dr. Myers in Brazil last year, and the new expedition of Dr. Durham to Christmas Island. The English Government, said the speaker, was very niggardly in regard to such matters compared with the German Government. Prof. Koch had forwarded to him, at his request, the following particulars of the subsidies granted to investigators working in connection with medical expeditions sent out under the auspices of the German Government:—"(1) Prof. Frosch in Brioni (Istria), (2) Staff-doctor Bludau in Lussinpiccolo (Istria), (3) Staff-doctor Vagedes in German South-West Africa, (4) Staff-doctor Dempwolff in New Guinea, (5) Staff-doctor Ollwig in German East Africa, (6) Dr. Krulle in the Marshall Islands. Further expeditions to Togo and Kameruns are being planned. The expeditions 1 to 5 have for their collective object, in the first place, the investigation of malaria, and form regular continuations of any malaria expeditions made to Italy, Dutch India, and New Guinea. Expedition No. 6 has for its object the investigation of syphilis and its different forms in the South Sea Island groups. The European expeditions 1 and 2 receive 20 marks (1*l.*) daily allowance, besides compensation for the various travelling expenses, outlay for the laboratory, &c. The "outside Europe" (foreign) expeditions receive 40 marks (2*l.*) daily, besides compensation for travelling expenses and outlay for scientific objects (books, instruments, complete laboratory arrangements, their upkeep, &c.), with a further 1000 marks (50*l.*) for personal equipment." The treatment thus accorded to German scientific expeditions was very much more generous than anything done for similar expeditions in this country, and he trusted that the school would receive generous accessions to its funds.

IN distributing the prizes at the Royal Technical Institute, Salford, on Friday last, Sir Henry Roscoe said it had often puzzled him to account for the singular apathy with regard to education which in times past, and to some extent even now, had characterised the average Englishman. Surely one would think that he of all men, dependent as he was for his very existence on his successful solution of problems relating to industry and commerce, would have felt it not merely an advantage, but an absolute necessity, that his knowledge and training should be as perfect and widespread as possible, just because the arts and trades which he practised had their foundation in artistic or scientific principles, and could only flourish satisfactorily under the guidance of those principles—that was, under educated effort. Whilst other countries—notably Scotland, Germany, the United States, Switzerland and France—long ago established their national system of schools, England up to 1870 was without one. Whilst Italy, Scotland, Germany and France in earliest times founded Universities which had remained as Universities of and for the people, the older Universities of Oxford and Cambridge had gradually become mainly high schools for privileged persons, and ceased to do for England what the Scottish Universities did for Scotland—that was, to be the Universities for all classes of the population, rich and poor alike. It must be the aim of the reorganised University of London to do for London's six or seven millions what the Scottish Universities had done for four millions of Scotsmen, and to become a real University for the people. England, however, was awakening. A new era in the history of English education began, first, in the foundation of the local University colleges, and, secondly, in 1890, in the passing of the Local Taxation (Customs and Excise) Act. The fact of the allocation of a sum of upwards of 750,000*l.* to technical and secondary education was an event unparalleled in the financial history of this country, and was in itself a proof of this awakening. That this act of the Government was appreciated was shown by the fact that the local authorities generally at once availed themselves of the opportunities thus presented. No less than upwards of 3,000,000*l.* had been expended by municipal and local authorities in providing technical schools throughout the land. Moreover, this progress had been unchecked by reverses or by waning interest; on the contrary, it had been continuous, universal and rapid. Still, much remained to be done. "Organise your secondary education" had been the cry from Matthew Arnold's day to our own. Yet nothing had been done in this direction by Parliament, with whom the duty lay. It was true that beginnings had been made; local authorities in some instances—and here he must name those of Manchester—had taken the matter into their own hands and had realised how necessary it was to consolidate and coordinate the education of various kinds existing in their midst, and actually had done so in advance of national action. The country had, he thought, made up its mind and would back any sensible plan for putting this part of our educational house in order. Let them unite in urging immediate action. Let them be satisfied with one thing at a time. If they saw that to put forward and to carry a measure which would bring about that which all desired—namely, that the various forms of educational effort should be organised as one compact whole—was at the present moment beyond the range of practical politics, let them not fail to secure the organisation of a part. This seemed to him to be common sense.

ON Tuesday last Mr. R. B. Haldane, K.C., M.P., delivered an address at University College, Liverpool, on "The Function of a University in a Commercial City," in the course of which he compared the position of education in this country with that in others, notably in Germany. Throughout the industrial world of Germany they found science applied to practical undertakings by men who had learned, if not in the Universities and high technical schools, at least under teachers produced by those institutions. This was true of a multitude of trades. In electrical engineering, in the manufacture of chemicals, in the production of glass and of iron and steel, and of many other articles for which Britain used to be the industrial centre, we were rapidly being left behind. A striking case was that of the aniline colours discovered and first produced in England and manufactured out of English coal tar. The industry had almost wholly shifted to Germany, although the dyers in this country were the largest consumers. The reason for this was that in Germany the manufacture had been fostered by research in the University laboratories and by careful teaching in the technical schools, with the result that great producing institutions, such as the Badische Anilin Fabrik, had an endless supply of directors and workmen trained in a fashion which we had not the means to imitate. But the school was in Germany by no means the only point at which the professor came to the aid of industry. Too little was known in this country of the type of institution sometimes called the "Central-Stelle," which had no parallel among our business men. This establishment, which was maintained by subscription at a cost of about 12,000*l.* a year, was presided over by one of the most distinguished professors of chemistry in the University of that city, with a staff of highly-trained assistants. To it were referred as they arose the problems by which the subscribers in their individual work were confronted. By it was carried on a regular system of research in the field of production of explosives, the fruits of which were communicated to the subscribers. The great manufacturers were in constant communication with the establishment, in which they took the keenest interest. In this country, it was needless to say, there existed nothing of the kind. And yet we had to compete with the Germans, not only at home, but in such important markets for explosives as South Africa, where their use was the life of the huge mining industry. Proceeding, Mr. Haldane alluded to the German academic institutions and compared them with the University system of this country, and made a number of suggestions which, if carried out, would, in his opinion, tend towards a better system of education and be for the benefit of the country. The conclusion of the whole matter, said Mr. Haldane, seemed to be that we could establish in Great Britain and Ireland a system of teaching of a University type, with the double aim of the system of Germany, and that without injury to quality in culture.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, October 1.—Mr. Charles Bailey, president, in the chair.—Mr. W. E. Hoyle exhibited two ethnological specimens from Demerara, formerly in the possession of the Manchester Natural History Society, under the name of "fish-arrows." They are about 4 feet long, slender, and apparently made from the wall of some hollow reed, with nodes at regular intervals. At one end is a barbed point of wrought iron, the other end being stained a dark brown for about four inches. The use of these weapons is somewhat difficult to determine; they are too thin and flexible either to shoot from a bow or to throw with true aim. Instruments of a similar kind have, however, been used for catching fish by baiting the barbed end and sticking the other end into the bed of the stream among the reeds.—Mr. Cecil P. Hurst sent specimens of *Diotis candidissima*, Desf., a disappearing British plant, which he collected recently on the sandy bars separating two inland lakes from the sea on the south-eastern coast of county Wexford, Ireland. He described its habitat on the shores of Lady's Island Lake and Tacumsin Lake, and on the coast from Carnsore Point westward, and referred to its recorded occurrence in nine of the comital areas in the South of England, from all of which, including the Channel Islands, it has disappeared. It was found very sparingly on the south-western coast of Anglesey in the years 1894 and 1896.

PARIS.

Academy of Sciences, October 14.—M. Bouquet de la Grye in the chair.—New series of experiments relating to the action of hydrogen peroxide solution upon silver oxide, by M. Berthelot. A thermochemical comparison of the action of acids upon oxide of silver before and after the action of hydrogen peroxide. The results are regarded as proving conclusively that a peroxide of silver is formed in this reaction, and that the evolution of oxygen is due to the decomposition of this compound.—On the variation of races and species, by M. Armand Gautier. Experiments by Molliard, and by Charabot and Ebray, on the influence exerted by the attack of certain insects on the development of certain plants, and the researches of Daniel on grafting, are held by the author to prove that the Darwinian principles of the influence of medium, of adaptation and of natural selection are insufficient to explain the profound and rapid modifications which have here taken place.—Two new hæmogregarians of fishes, by MM. A. Laveran and F. Mesnil. A detailed description of two new parasites of the sole and blenny, to which the names *Haemogregarina bigemina* and *Haemogregarina Simondi* are given. The paper is illustrated with seventeen drawings of the parasites in various stages of development.—The influence of variations of temperature on the evolution of experimental tuberculosis, by MM. Lannelongue, Achard and Gaillard. Neither a moderate degree of cold nor slight variations of temperature have any marked influence upon the development of experimental tuberculosis in guinea-pigs. On the other hand, brusque variations of temperature, although compatible with the life of healthy guinea-pigs, have accelerated in a remarkable manner the course of the disease.—On waves which may persist in a viscous fluid, by M. P. Duhem.—The elliptic element of the comet 1900*c*, by M. Perrotin. Measurements of the position of this comet, which was discovered by Giacobini on February 11, have been made in the observatories of Nice, Lick, Besancon, Algiers, Heidelburg and Strasburg, and show that it belongs to the curious group of periodic comets supposed to have been captured by Jupiter. The return of this comet may be expected in about seven years.—On the periodic integrals of binomial differential equations, by M. A. Davidoglou.—On the points of inversion of solutions, by M. Albert Colson. It is known that the specific heat of a solution is not the mean of the specific heat of its constituents, and hence it follows that the heat of solution and the heat of combination are variable, and at a fixed temperature some heats of solution change their sign. For solutions of common salt this point of inversion is found to be at 52° C.—The action of urea upon pyruvic acid. Homoallantoic acid and pyruvil, by M. L. J. Simon. It is shown that in this reaction, which has been previously studied by Grimaux, there is an intermediate compound formed, homoallantoic acid, and that the formation of pyruvil is due to an internal condensation of this compound.—The nitro-derivative of pentaerythrite, by MM. Leo Vignon and F. Gerin. The pentaerythrite, $C(CH_2OH)_4$, was prepared by the interaction of aldehyde, formaldehyde and lime water, and was found to possess no reducing power towards Fehling's reagent. The nitric ester was prepared and found to be the tetra-derivative; it was devoid of reducing power, and hence it is probable that the nitric esters which do possess reducing power have a constitution which is different from that usually ascribed to them.—On the free phase of the evolutive cycle of the orthonectides, by MM. F. Caullery and F. Mesnil. —Marine poisons and the burrowing habit, by M. G. Bohn. It has been found that sea-water in which certain red algæ have been growing is very poisonous, but that it loses this poisonous property on filtering through sand. Burrowing animals have thus the double advantage of mechanical and chemical protection.—On the eruptive rocks of Tilai-Kamen (Ural), by MM. L. Duparc and F. Pearce.—On a green colouring matter extracted from the blood of animals poisoned by phenylhydrazine, by M. Louis Lewin. The green substance, for which the name of hemoverdine is proposed, is not apparently a phenylhydrazine derivative, but a product of metamorphosis of hæmoglobin.—The spectrum of this substance is absolutely different from that of hæmoglobin or of any of its known transformation products.—The microphyte of the Piedra, by M. P. S. de Magalhaes.—On the mechanism of the formation of fine pearls in *Mytilus edulis*, by M. Raphael Dubois.

DIARY OF SOCIETIES.

SATURDAY, OCTOBER 26.

ESSEX FIELD CLUB (Essex Museum of Natural History, Stratford), at 6.30.—Mimetic Insects: Prof. R. Meldola, F.R.S. (Illustrated by Natural Colour Photographs.)

THURSDAY, OCTOBER 31.

CHEMICAL SOCIETY, at 8.30.—The Frankland Memorial Lecture: Prof. H. E. Armstrong, F.R.S.

FRIDAY, NOVEMBER 1.

GEOLOGISTS' ASSOCIATION, at 8.—A Conversazione in the Library of University College, Gower Street.

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