THURSDAY, MARCH 3, 1892.

DEEP-SEA DEPOSITS.

Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the Years 1873–76, *under the command of Captain George S. Nares, R.N., F.R.S., and the late Captain Frank Tourle Thomson, R.N.* Prepared under the Superintendence of the late Sir C. Wyville Thomson, F.R.S., and now of John Murray, LL.D., Ph.D., &c., one of the Naturalists of the Expedition. *Report on Deep-Sea Deposits, based on the Specimens collected during the Voyage.* By John Murray, LL.D., Ph.D., and the Rev. A. F. Renard, LL.D., Ph.D., Professor of Geology and Mineralogy in the University of Ghent. Pp. xxix. and 496; with 43 Charts, 22 Diagrams, and 29 Lithographic Plates. (London: Published by Order of Her Majesty's Government, 1891.)

GEOLOGISTS have had to wait long for this very important work, but now that it lies before them, we believe that the general verdict will be that it was worth while to wait even sixteen years for a monograph so excellent in design and so complete in execution. It must not be forgotten, too, that much of the information contained in this volume has been already given to the scientific world—first in Mr. Murray's Preliminary Report on the subject, published in the Proceedings of the Royal Society; and secondly in a series of papers written by him in conjunction with Prof. Renard, and published in the Proceedings of the Royal Society of Edinburgh.

It is a most fortunate circumstance that the naturalist on board the *Challenger*, who had charge of the collection, examination, and preservation of the samples of the deposits collected by the sounding-apparatus and the dredge, as well as of those obtained by means of the tow-nets and tangles, has been able during the long period that has elapsed since the return of the vessel to England, to devote his attention to their careful study and description. In the work of dealing with this vast mass of materials, as the preface informs us, Mr. Murray has had the co-operation of Mr. Frederick Pearcey, who accompanied the Expedition, and was afterwards assistant in the *Challenger* Office, and also of Mr. James Chumley. Especially fortunate has been the circumstance that Sir Wyville Thomson and Mr. Murray were, in 1878, able to secure the aid of the eminent Belgian petrographer, Prof. Renard, who is so great a master of those microscopic methods of research which have played no unimportant part in the development of geological science during recent years. In the exact determination of the minute fragments of minerals which occur in these deposits, Prof. Renard's knowledge of the optical and chemical methods of microscopic research has proved of especial value; and the assurance that, during several months in the years 1881 and 1882, the Belgian petrographer was able to devote himself to the work of investigating these deposits will invest the mineralogical determinations with an authority which they could not otherwise possess.

The introduction to the work consists of an excellent summary of the references contained in various authors, beginning with Herodotus, Plato, and Skylax, to the supposed nature of the sea-bottom. The sagacious remarks on the subject by the Italian naturalists, who were the real founders of the science of geology in the fifteenth century, receive appreciative notice; and the earliest attempts to deal with the deposits of the deep seas, especially those of Soldani, Ehrenberg, Sir Joseph Hooker, Edward Forbes, and Prof. J. W. Bailey, have full recognition. The important memoir of Prof. W. C. Williamson on the mud of the Levant is noticed; but the authors seem to be scarcely aware how many of the later discoveries in this branch of science were foreshadowed in the remarkable monograph of the Manchester Professor. A general account of the results obtained by the chief expeditions fitted out for the study of the deep ocean and its deposits—expeditions which preceded and followed that of the *Challenger*—leads up to a division of marine deposits into "Terrigenous" and "Pelagic," a classification which, if not too rigidly applied, appears to be serviceable and even necessary.

The first chapter is devoted to the various methods of obtaining, examining, and describing deep-sea deposits, and here the general arrangements made on board the *Challenger*, which are familiar to most readers from the description given by Sir Wyville Thomson in his "Voyage of the *Challenger*," and the narrative volumes of the Report, receive very full and exhaustive treatment. The precise account of the apparatus, illustrated as it is by numerous woodcuts, cannot fail to be of great value to those engaged in fitting out similar expeditions. The study of the methods employed in the sifting, fractional decantation, and chemical examination of the several deposits is essential to the proper understanding of the results detailed in succeeding chapters of the work. The methods of analysis employed by Prof. Brazier at Aberdeen, and by MM. Renard, Sipöcz, Hornung, and Klement, in the laboratory of Prof. Ludwig, of Vienna, and in M. Renard's laboratory at Brussels, are given in full detail, and will prove of great service when the results described in the present volume come to be compared with those of future investigators.

The second chapter consists of a series of synoptical tables, occupying 114 pages, in which the nature and composition of every deep-sea deposit collected during the voyage of the *Challenger* is described. In each case the number of the station, the date, the latitude and longitude, the depth in fathoms, the temperature at the surface and the bottom are given; and these particulars are followed by (1) a general description of the material brought up; (2) the percentage of calcium carbonate; (3) a list of the chief Foraminifera present; (4) an enumeration of the other calcareous organisms; (5) the percentage of insoluble residue; (6) a list of the siliceous organisms; (7) of the minerals; (8) a description of the fine washings; the last column being devoted to additional observations. These synoptical tables are followed by a discussion of the variation of the deposits with change of conditions along the different lines of soundings and dredgings. This general summary of the results, which occupies 36 pages of the work, constitutes an admirable *résumé* of the information contained in the tables.

Chapter iii. is devoted to the description of recent marine formations and the different types of deep-sea deposits: their composition, geographical and bathymetrical distribution. All marine deposits which are not "Littoral," or formed between high- and low-water marks, or "Shallow-water," a term which the authors limit to the interval between low-water mark and a depth of 100 fathoms, are classified in this work as deep-sea deposits. They include Coral Mud, Volcanic Mud, Green Mud, Red Mud, and Blue Mud (which are classed as Terrigenous Deposits, formed in deep and shallow water close to land-masses), and the Pteropod ooze, Globigerina ooze, Diatom ooze, Radiolarian ooze, and Red Clay (which are grouped as Pelagic Deposits, formed in deep water removed from land). In the case of each of these deposits the proportions and characters of the organic and inorganic materials are given, and the results of a large number of chemical analyses, some of which are now published for the first time, are discussed. Perhaps one of the most interesting of the many valuable discussions contained in this chapter is that which deals with the proportions of the ocean-floor covered by different kinds of deposits. A map (Chart I.) is devoted to an attempt to illustrate the nature of the ocean-floor over the whole of the globe, and we cannot resist the temptation of quoting the general estimate to which the authors have been led by their laborious and patient researches. These results are based not only on the collections made during the *Challenger* Expedition, but on many obtained before and since, which have all passed through the hands of the authors; they include the materials brought up in no less than 1600 soundings from the Atlantic, 300 from the Indian Ocean, and 400 from the Pacific, all from depths exceeding 1000 fathoms. It is evident, therefore, that the map and estimates, though admittedly only approximate, are based on a mass of data such as has never been brought together before.

The total area of the surface of the globe is estimated at 196,940,700 square miles, of which dry land occupies about 53,681,400 square miles, and the waters of the ocean 143,259,300 square miles. The approximate extent of the areas of the sea-floor occupied by each type of marine deposits is given as follows:—

		Mean depth in fathoms.	Area in square miles.
	"Littoral Deposits"	—	62,500
	Shallow Water Deposits	—	10,000,000
Terrigenous Deposits.	Coral Mud	740	2,556,800
	Coral Sand	176	
	Volcanic Mud	1033	600,000
	Volcanic Sand	243	
	Green Mud	513	850,000
	Green Sand	449	
	Red Mud	623	100,000
	Blue Mud	1411	14,500,000
Pelagic Deposits.	Pteropod ooze	1044	400,000
	Globigerina ooze	1996	49,520,000
	Diatom ooze	1477	10,880,000
	Radiolarian ooze	2894	2,290,000
	Red Clay	2730	51,500,000

Some of the most striking results, which make themselves apparent from a study of this estimate and the accompanying chart, are the very wide distribution of the Foraminiferal ooze and the red clay in the Atlantic and Pacific respectively; and the remarkable manner in which the deposits of vegetable origin replace those composed of the remains of animals on the bottom of the Antarctic Ocean.

Chapter iv., dealing with the materials of organic origin, is, we are informed in the preface, entirely from the pen of Mr. Murray. The Reports of the late Mr. H. B. Brady, of Prof. Haeckel, and of Count Castracane, on the Foraminifera, the Radiolarians, and the Diatomaceæ brought home by the *Challenger* Expedition, have already supplied naturalists with the means of drawing many important deductions; but Mr. Murray still finds much to say on the subject, which is not only new, but of very great interest. In the couple of pages devoted to the description of those curious and abundant organisms the Coccospheres and Rhabdospheres, which Mr. Murray here refers without doubt to the Calcareous Algæ, we could have wished that he had been able to announce that he had succeeded in inducing some competent botanist to undertake the study of the material brought home. One of the most important discussions in this chapter is that on the disappearance of calcic carbonate in the deeper deposits. The estimate made by Mr. Murray of the mean percentage of calcic carbonate in the different deposits, as the result of a large number of chemical analyses, is as follows:—

	Percentage of $CaCO_3$.
Coral Mud and Sand	86·41
Pteropod ooze	79·26
Globigerina ooze	64·53
Diatom ooze	22·96
Blue Mud and other Terrigenous deposits	19·20
Red Clay	6·70
Radiolarian ooze	4·01

The facts cited by Mr. Murray, on the authority of Mr. John Rathay (p. 282), on the ease with which the remains of the Diatomaceæ are dissolved, are of especial importance to the geologist who is called upon to explain the origin of the silica now forming nodules and bands in beds of limestone, and which he is tempted to refer entirely to the larger organisms like Siliceous Sponges, because remains of these are sometimes preserved. All the observations made in the existing deep seas, however, point to the conclusion that the minute Diatoms and Radiolarians play a much more important part in separating the soluble silica from sea-water than do the Siliceous Sponges.

Chapter v., dealing with the mineral substances found in deep-sea deposits, is full of interest. The mineral particles which are obviously derived from the solid crust of the globe are first dealt with, and in the account of the pumice, the basic volcanic glass, and the palagonite of the deep-sea deposits, Prof. Renard exhibits alike his wide mineralogical knowledge and his skill in dealing with microscopical and often obscure materials. The coloured lithographic plates illustrating this part of the work, which have been drawn by Prof. Renard, and engraved in Vienna, are of wonderful beauty and fidelity. A list of mineral particles detected in deep-sea deposits is given, and includes all, or nearly all, the common rock-forming minerals; but it is admitted that, with respect to the very minute particles in the finest washings, a considerable margin of doubt must always exist regarding their identification. We could wish that it were possible, in the space at our command, to give a summary of the facts leading to the conclusion that materials of extra-terrestrial origin play a not unimportant part in the accumulations which are taking place on the deepest ocean-floors. We can only call attention, however, to the clear descriptions and admirable plates which illustrate this part of the subject. The exquisite drawings of magnetic spherules and of chondre upon Plate xxiii., enable the reader to judge of the real nature of the evidence relied upon, and an examination of these figures cannot but remove any lingering doubt, as to the true nature of these materials, from the minds of all those who are familiar with the minute structure of meteorites.

The last chapter of the work deals with the chemical products which are formed *in situ* upon the floor of the ocean, and here, perhaps, the interest of the work for the geologist culminates. We can only refer to the numerous and interesting problems connected with the origin of the red clay, the mode of formation of the glauconite-casts, the source of the materials and the chemical processes involved in the formation of the phillipsite and other zeolites, the manganese-nodules, and the phosphatic and other concretions. The 76 pages of text, and the admirable drawings which illustrate this part of the subject, will excite the interest of all students of the subject. They enable the reader to form a clear idea of the forms and structure of the remarkable manganese nodules, and of the ear-bones, teeth, and other objects which, in a more or less phosphatized condition, are strewn over the deepest part of the ocean-floors. In an appendix is given a report on the analysis of the manganese-nodules by Dr. John Gibson, especial attention being directed to the detection of the rarer elements by spectroscopic and other methods. While traces of barium, strontium, lithium, molybdenum, zinc, titanium, vanadium, and thallium were found, cæsium, rubidium, and the metals of the cerium and yttrium groups were sought for in vain. The quantitative analyses, as shown by the tabular statements, would appear to have been executed with every modern refinement, and were carried out, by Prof. Crum Brown's permission, in the Chemical Laboratory of the University of Edinburgh. Another appendix contains an account of the analyses which have been made of the different varieties of deep-sea deposits.

In conclusion, we may point out that the work is worthy of praise, not only for what it includes, but for what it omits. The time has not yet arrived for a full discussion of the geological bearings of many of the new and interesting facts brought to light by the *Challenger* Expedition. Theoretical discussions are, therefore, wisely kept, in the monograph before us, within very narrow bounds. It is evident that much of the work was written before the publication by Messrs. Jukes-Browne and Harrison of their interesting memoirs on the geology of Barbadoes, and before the discovery of the Radiolarian-chert of Ayrshire and other districts. These discoveries, it is true, are mentioned in footnotes, but have evidently had but little influence in moulding the views of the authors. Few geologists will be prepared to accept the views of Mr. Murray, when he endorses the conclusion of M. Cayeux that the white chalk should be classed as a terrigenous deposit. But on this and other points the views of the authors are stated with a commendable absence of dogmatism, and a manifest desire to lay before readers of the work all the facts bearing upon the questions at issue, even when they are manifestly hostile to the conclusions adopted.

We cannot bring this notice to an end without congratulating the editor of the *Challenger* Reports on the nearly approaching close of his heavy labours. Only by a worker gifted with unrivalled powers of organization, as well as with indomitable energy, could such a task have been brought to a successful termination. The mass of materials was so vast and multifarious, the interests involved in their distribution so wide and often conflicting, while personal considerations could not always be kept from exercising a disturbing influence, that it is less surprising that criticism should sometimes have been provoked, than that results so substantial, and, on the whole, satisfactory, should in the end have been attained.

The present Report forms the last of the series of splendid monographs in which the results of this famous Expedition—one which will be recorded in the history of Science as perhaps the grandest concession to her claims made up to the present time by the British or any other Government—are fully recorded and discussed. The final volume of the *Challenger* Reports, which, it is stated, will probably be published in the course of the present year, will contain lists of the organisms collected at every observing station, with other details, in the nature of a summary of results. JOHN W. JUDD.

PARASITIC FUNGI AND MOULDS.

British Fungi: Phycomycetes and Ustilagineæ. By G. Massee. (London: Reeve and Co., 1891.)

IT is a somewhat remarkable fact that no one has hitherto written a book on the British *Phycomycetes*, the common white moulds so often found growing on decaying substances or in water, or as parasites of a most destructive kind in various valuable plants; and the opportunity thus afforded to the writer of the present volume was a good one, of which, it is but fair to say, he has taken considerable advantage. The *Ustilagineæ* of this country had already been treated by Mr. Plowright, but there are sufficient differences between the works of the two authors to make Mr. Massee's book none the less noteworthy on that account.

When we consider the great variety of "white moulds," such as *Mucor*, that infest all kinds of rotting fruits and other vegetable *débris*, of parasites such as the *Phytophthora* of the potato disease, and the *Peronosporeæ* which destroy onions, vines, and other valuable vegetable produce, to say nothing of the *Saprolegnia* of the salmon disease, the *Pythium* which decimates seedlings of all kinds, and the *Empusa* which kills our house-flies in autumn, and glues their dead bodies to the window-panes —when we regard these and a host of other extraordinary and important *Phycomycetous* Fungi, it seems more and more surprising that no one has compiled an intelligible account of these things in this country; yet so it is, and the author of this little book of a couple of hundred of pages of carefully, and, on the whole, pleasantly-written matter, ought certainly to deserve the thanks of botanical readers for undertaking the difficult task, and discharging it as well as he has done.

In reviewing the work there are two parts to be noticed, and two points of view from which to criticize them: the first fifty pages or so are concerned with a general popular account of the morphology of Fungi in the wider sense, while the remainder is devoted to the setting forth of the British genera and species (so far as they have been worked up) of the two groups specially dealt with.

The general account must strike a careful reader as not only exhibiting a good deal of knowledge on the part of a writer who is wishful to put it at the disposal of all who care for it, and in a pleasant style; but also as showing what enormous advances have been made in the popular exposition of these matters within the last few years. When we look back to the systematic books on Fungi of ten to fifteen years ago, they appear hopelessly dry and uninteresting; whereas here we have a compact, neat little volume, with a store of interesting information thrown in as an introduction to the more serious detailed work which follows.

We do not mean to say that this part of the book is without mistakes or slips, either of fact (*e.g.* the statement on p. 49 regarding mutualism between Fungi and Phanerogams) or judgment (*e.g.* the reference to "phanerogamic Fungi" on p. 11). Moreover, there are evidences of careless proof-reading, as at the foot of pp. 41 and 42. But it is far more easy to pick small holes in a book like this than to do proper justice to what is good and useful in it; and we prefer to dwell on the more important positive points, than to emphasize the fewer and more trivial drawbacks.

The more purely systematic part of the work shows evidence of careful and conscientious industry, suggesting constant reference on the part of the author to type-specimens and authorities. Of course, it is not so interesting to the general reader, but the diagnoses are so clear, and so simply written, that we think any amateur ought to be able to follow them with the object in hand; as for professional mycologists, they will probably wonder that it could all be put so plainly—at the same time, they will suspect something is wrong with the German reference on p. 162, and will probably remark on the chapter on "Fossil Fungi." They may also inquire why *Ustilagineæ* are taken with *Phycomycetes*. The author answers this question on p. 160: he follows Brefeld in regarding *Protomycetes* as linking the two groups. The somewhat antiquated method of obtaining sections, on p. 62, had better have been omitted.

The most interesting points to the systematists will be Mr. Massee's almost consistent alterations of Plowright's authorities for the species of the *Ustilagineæ*, and his addition of one or two new ones—*e.g. Ustilago salveii* (p. 177), *Doassansia comari* (p. 198), and *Protomyces purpureo-tingens* (p. 164); they will also notice the fusion of some species kept apart by Plowright—*e.g.* on pp. 178 and 186—and the separation of the two species of *Tubercinia*, on pp. 203 and 204.

We note, also, that Massee has altered the name of Trail's *Entyloma matricariæ* to *E. Trailii*, possibly on good grounds; but we think it a mistake to use such specific names, here and elsewhere, seeing how much Fungi are in need of useful distinctive appellations.

The figures on the six plates are fairly well drawn and selected, and the references to them are useful and to the point. We have not tested the indices in detail, but they are very well planned, and appear to be accurate.

On the whole, and without being blind to its faults, we think this little book should be welcomed as a useful manual on the subject, and should certainly be in the hands of students of botany who wish to know something of British mycology.

OUR BOOK SHELF.

A Treatise on the Geometry of the Circle, and some Extensions to Conic Sections by the Method of Reciprocation. With numerous Examples. By W. J. M'Clelland, M.A. (London: Macmillan, 1891.)

THIS is a full book, written on the lines which previous works by Irish mathematicians have made familiar to us. The author acknowledges his indebtedness to the writings of Mulcahy, Salmon, and Townsend. He has also freely consulted the similar works by Cremona and Catalan, and in his treatment of the recent geometry has in many cases gone to the fountain-head in the memoirs of Brocard, Neuberg, and Tarry. Though in parts proceeding on parallel lines with Casey's "Sequel," there is a good deal of other matter not to be found in that work. The writer's object is to give a concise statement of those propositions which he considers to be of fundamental importance, and to supply numerous illustrative examples. Many of the exercises are worked out in an elegant manner, and to the major part of the others useful hints are given. Chapter i. is introductory; chapter ii., in four sections, is devoted to "Maximum and Minimum"; chapter iii., also in four sections, rapidly touches upon "Recent Geometry"; chapter iv. discusses the general theory of the mean centre of a system of points; and chapter v. treats of collinear points and concurrent lines.

Chapters vi., vii., and viii. are concerned with inverse points with respect to a circle, poles and polars (with respect to a circle), and coaxal circles. In these chapters will be found ample food for the student. Chapter ix. gives an account of the theory of similar figures, and here we specially notice the sketch of Neuberg's and Tarry's researches on three similar figures. Circles of similitude and of antisimilitude form the subject of chapter x. Here some interesting problems are solved. Inversion (chapter xi.), general theory of anharmonic section (chapter xii.), involution (chapter xiii.), and double points (chapter xiv.) close what must unhesitatingly be called a varied and ample *menu*. The work, being confessedly to a great extent elementary, of course brings before the reader much that is old; there is, however, novelty in the treatment and also in the matter. There is one feature we have omitted to mention, to which Mr. M'Clelland draws attention, and that is the application of reciprocation to many of the best known theorems by means of which the corresponding properties of the conic are ascertained. To go through all the examples would occupy more time than we can spare, but we have dipped into all parts and brought up good results. In the text we have noted one slip: p. 60, l. 12 up should be $\pi - B$. No doubt we have omitted to mark other errata. The figures, which are white lines on a black block, carry our thoughts back to old Cambridge days, when we turned over the pages of our Miller's "Hydrostatics." The geometer will find much to interest him in Mr. M'Clelland's work.

Kalm's Account of his Visit to England on his Way to America in 1748. Translated by Joseph Lucas. (London: Macmillan and Co., 1892.)

KALM was a well-known Swedish botanist and economist of the eighteenth century. In 1747 he became Professor of Economy at Åbo, and in the same year the Swedish

Government and Academy of Sciences commissioned him to go to America, the object being that he should describe the natural productions of that part of the world, and introduce into Sweden any useful North American plants which might be expected to thrive in Northern Europe. Kalm reached England in February 1748, and remained there until August, when he started for America. On his way back, in 1751, he visited this country again, staying about a month. An account of a portion of his travels he afterwards published in three volumes. The part relating to America was translated into English in the eighteenth century by J. Reinhold Forster, but the author's account of England appears now in English for the first time. The work is full of interest, and was well worth translating. Kalm first records his impressions of London and suburbs, and then takes us successively to Woodford, Little Gaddesden, and Gravesend, each of which is made a centre for a number of observations, chiefly in connection with agriculture. To students of the history of agricultural methods the work will be invaluable; but it will also give pleasure to readers with a less serious purpose, for it contains suggestive references to many aspects of English life, and the author always writes accurately and with good taste. The translator has accomplished his task with great spirit and intelligence.

LETTERS TO THE EDITOR.

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

The University of London.

IT is always a pleasure to read Mr. Thiselton-Dyer's expressions of opinion on University organization. I have before now joined my word to his in condemnation of Sir George Young's proposed "Albert" or "Gresham" Charter. Nevertheless, I must beg you to grant me space to point out some inaccuracies in Mr. Dyer's letter in your columns of February 25 (p. 392), the purpose of which seems to be to give reason for distrusting, or, at any rate, treating with little confidence, University organizations on the German or professorial model.

Mr. Dyer rightly enough appeals to his own early experience as a teacher and student. It is therefore fair to point out that this experience does not include a German University, and that the conception of it sketched by him, and of a professor's relations to his pupils therein, is entirely erroneous. Mr. Dyer cannot free his mind of the University of London tradition. He regards the German as well as all Universities as organizations for bringing candidates up to a certain pitch of examination-room performance. This is not what a German University attempts. The measure of its success is not what Mr. Dyer would suggest, but is found in the contributions to science, the new knowledge created by the professor and his students, and in the spread of a love for producing such new knowledge. Mr. Dyer attributes to Lord Sherbrooke a strange saying—namely, that professors who examine their own students are comparable to "tradesmen who sample their own goods." I can hardly credit that Lord Sherbrooke ever said anything so unmeaning. We have all heard the professor-examiner compared to "a merchant who brands his own herrings"—but this "sampling of his own goods" is a new charge.

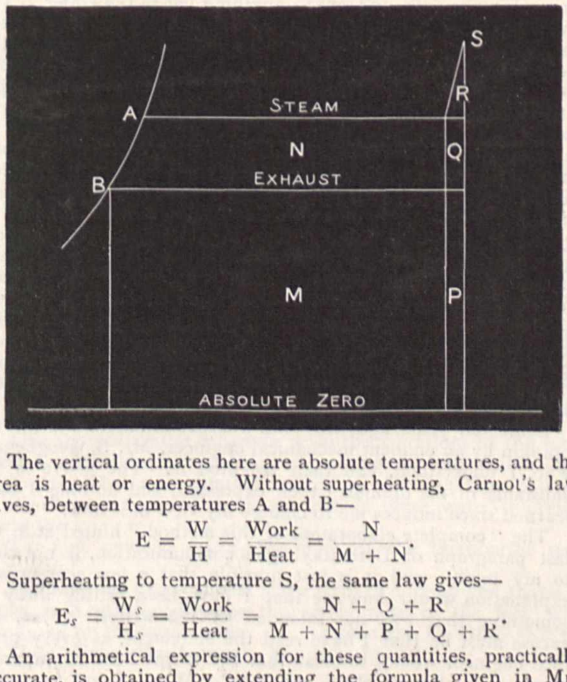
Lastly, I must point out that Mr. Dyer, by inadvertence, attributes to me a statement, or rather assent to a statement, before the Royal Commission on the proposed new University for London, which had exactly the opposite significance to that which he gives to it. Mr. Dyer says that I admitted to Sir William Thomson that "a teacher may, with judiciousness of course, and with common-sense in his teaching, teach the best that he knows" under the present University of London system. I am glad to note that Mr. Dyer has looked at the Blue-book. But if he had read more carefully he would have seen that Question 662, by Sir William Thomson, was, "Can an examiner under the London system ask the best that he knows?" and that my answer was, "Probably not." Then Sir William continued (Question 663): "But, *on the other hand*, a teacher may, with judiciousness, &c., teach the best that he knows?" to which I answered, "Yes." Then said Sir William (Question 664), "*If he is examining his own pupils* he may bring into the examination something of the best and the newest?" to which I replied, "Certainly."

It is clear enough that Sir William Thomson's proposition, to which I assented, was that, under the London system of external examiners, an examiner cannot put questions involving the best and newest; yet a teacher may and should teach the best and newest; and if, contrary to the principle of the London system, the examiner is the teacher, he *can* introduce with judgment into the examination this element of the best and newest.

Mr. Dyer has not, it seems to me, yet mastered the distinctive features of the German or professorial University system, and is, therefore, not a trustworthy guide as to its advantages and disadvantages. E. RAY LANKESTER.

Superheated Steam.

A COMMUNICATION from Lord Rayleigh, under the above heading, in NATURE of February 18 (p. 375), draws attention to a misunderstanding which has been pointed out by me on every occasion in the last twelve years when I have been explaining the thetaphi diagram in public, saying that "only the heat which superheated had its efficiency increased, according to the temperatures at which its respective portions were imparted to the working substance." Mr. Willans has also been disseminating correct views regarding this point amongst those who visit his engine-testing laboratory. The diagram given by me in my paper on thetaphi, in 1880, makes this very plain.



The vertical ordinates here are absolute temperatures, and the area is heat or energy. Without superheating, Carnot's law gives, between temperatures A and B—

$$E = \frac{W}{H} = \frac{\text{Work}}{\text{Heat}} = \frac{N}{M + N}.$$

Superheating to temperature S, the same law gives—

$$E_s = \frac{W_s}{H_s} = \frac{\text{Work}}{\text{Heat}} = \frac{N + Q + R}{M + N + P + Q + R}.$$

An arithmetical expression for these quantities, practically accurate, is obtained by extending the formula given in Mr. Willans's paper on engine trials, at the Institution of Civil Engineers—

A = steam temperature, not superheated.
B = temperature of exhaust.
S = superheated temperature.

The temperatures are all absolute, and, to suit engineers, in Fahrenheit measure, and the steam data of Regnault are adopted. The mean specific heat for the range of superheating is taken = 0·5. This will be nearly correct at high temperatures, and this is strictly in accordance with my statement that the specific heat of steam at low temperatures is 0·39 at constant pressure. The above expressions become, without superheating,

$$E = \frac{W}{H} = \frac{\left(\frac{A - B}{A + B} + \frac{1437}{A} - \cdot 7\right)(A - B)}{1437 + \cdot 3A - B},$$

and with superheating,

$$E_s = \frac{W_s}{H_s}$$

$$= \frac{\left(\frac{A-B}{A+B} + \frac{1437}{A} - \cdot 7 + \frac{S-A}{S+A}\right)(A-B) + \frac{S-A}{2} \cdot \frac{S-A}{S+A}}{1437 + \frac{S}{2} - \frac{A}{5} - B}.$$

Numerical example. Say that A = 800°, B = 600°, S = 1000°. Substituting these values, we get—

E = ·2301 without superheating,
E_s = ·2389 with superheating.

That is, less than 4 per cent. is gained by superheating 200°.

So far, I support Lord Rayleigh's view, or, rather, he says what I have been impressing upon engineers for the last twenty years. If this had been all I had to say, I would not have written now; but Lord Rayleigh adds to his statement what is to me an astounding announcement, that, "by the addition of saline matters, such as chloride of calcium or acetate of soda, . . . the possible efficiency, according to Carnot, may be increased." I hasten to call this assertion into question, because there are so many people ready to bring engines on new principles into the field of joint-stock bubbles; and I am afraid we may be having, quite apart from Lord Rayleigh, a new field engine syndicated and floated on the strength of this communication and the signature thereto, before its meaning is understood.

As I understand thermodynamics there would be no gain from superheating by a saline solution, over the usual method of superheating steam raised from pure water. The saline mixture is not the working substance. Carnot's law refers to the working substance only, and not to anything left in the boiler. The first step in evaporation from the saline mixture is to separate a particle of water from the salt. In the act of separation, the temperature of the water particle falls to the temperature due to the pressure, and at that temperature it is evaporated into steam particles, which immediately become of the same temperature as the saline mixture. These steps are followed by every particle of water, each independently of every other particle. Of course, we cannot practically test those temperatures, as the complete series is run through for each particle in a fraction of the twinkling of an eye, and immersed in a liquid of greatly higher temperature. A thetaphi diagram for this would give, at B A, and extending upwards to temperature S, a very narrow figure 8, whose loops are equal, and drawn, as in a figure 8, one right-hand and the other left-hand. The line for the reception of latent heat would be identically the same line, the horizontal through A, as when the evaporation was from pure water. It is evident, therefore, that, according to my lights, the efficiency will be precisely the same as without the salt in solution.

Some ten years ago this plan was submitted to me for my opinion by an eminent mechanical engineer, Mr. S. Geoghegan, who, I understood, had then patented it. The above is the substance of the opinion I then expressed, and nothing I have learned since induces me to change my view of it now.

The "complete elaboration of this method," hinted at in the last paragraph of Lord Rayleigh's communication, is not clear to my mind; and it is just possible that a few sentences of explanation would show me that I have been hitting away at something that was not intended by the writer. If so, my excuse must be that I have read the statement, as every practical engineer would, to mean that the latent heat is imparted along the isothermal of the superheat. When I get to understand the first sentence of the last paragraph of the communication, I may be able to confirm the anticipation of higher economy. J. MACFARLANE GRAY.

THE passage quoted by Lord Rayleigh from my book on the steam-engine, in some remarks on this subject in your number of the 18th inst. (p. 375), is taken from one of the earlier chapters, which is devoted to engines which receive and reject heat at constant temperature. When such an engine is used as a standard of perfection, by comparison with which some other engine is tried, it appears to me that the maximum and minimum temperatures of the working fluid must in the first instance be adopted as the temperatures of reception and rejection of heat; and in fact, without entering on questions reserved for discussion in a later chapter, no lower value than the maximum could well have been adopted. There is no doubt that the practice of comparing together engines with different cycles has been a source of considerable misapprehension, and very probably the language used in the passage in question may be insufficiently guarded. The use of superheated steam on this method of comparison is not a gain, but a considerable loss, for the heat might ideally all have been used at the maximum temperature, and is so used in the standard of comparison.

The practical case in which the boiler pressure is given is, of course, quite different. There is a gain by superheating, but, putting aside cylinder condensation, the gain is small, because such a small percentage of the heat is employed at temperatures above that of the boiler.

The process was originally introduced with the object of drying the steam and diminishing cylinder condensation; and now that the practical difficulties attending its use have been in great measure removed (as I am informed), by the employment of mineral oil for lubricating purposes, it may be hoped that it may be revived, and be the means of a considerable economy.

The action of superheated steam in a cylinder was explained and its economy experimentally demonstrated by Hirn some fifteen or twenty years ago. I have given the explanation briefly on p. 352 of my book, but I purposely avoided discussing questions relating to it, being of opinion that, in the present state of our knowledge, theoretical investigations are of doubtful value. I am certainly, however, under the impression that the true nature of the economy obtained by its use has for a long period been very generally recognized, though some writers in dealing with the theory of heat engines may have expressed themselves incautiously. It would, I think, be very desirable, in teaching the subject, to introduce as early as possible the idea of a mean temperature of supply. I have dwelt on the importance of this conception in the latter part of my book, and I am sure its introduction would remove many difficulties.

Greenwich, February 24. JAMES H. COTTERILL.

LORD RAYLEIGH'S interesting communication on superheated steam in your last issue (p. 375) leads me to ask whether it is generally known that solutions can be heated up to temperatures higher than 100° by passing into them steam at 100°. The late Peter Spence at the Exeter meeting of the British Association in 1869 called attention to the fact that by simply passing steam at 100° directly into a strong solution of nitrate of soda (other salts will of course answer) it was possible to raise the liquor to its boiling-point, about 121°.

Superheated steam is frequently used for heating up liquors in chemical processes on the large scale, but where a slight dilution is no disadvantage, the simpler operation of heating with ordinary low pressure steam might be adopted more generally than it is. Spence used steam in this way for the purpose of extracting sulphate of alumina from alum shales.

G. H. BAILEY.

The Owens College, Manchester, February 22.

Poincaré's "Thermodynamics."

PERMETTEZ-MOI de repondre en quelques mots à l'article que M. Tait a consacré à ma thermodynamique, non que je veuille prendre la défense de mon imprimeur, ou réfuter des reproches généraux, contre lesquels ma préface proteste suffisamment.

J'abuserais ainsi de votre hospitalité et de la patience de vos lecteurs; je me bornerai donc à discuter une seule des critiques de M. Tait, et je choisirai celle que ce savant paraît regarder comme la plus importante et qu'il a formulée avec le plus de précision. Je commence par en reproduire le texte:—

"Even the elaborate thermo-electric experiments of Sir W. Thomson, Magnus, &c., are altogether ignored. What else can we gather from passages like the following?—

"' . . . Si l'effet Thomson a pu être mis en évidence par l'expérience, on n'a pu jusqu'ici constater l'existence des forces électromotrices qui lui donnent naissance. . . . '"

Rappelons d'abord que, dans l'étude des phénomènes électriques et thermiques qui se produisent au contact de deux métaux, il faut soigneusement distinguer trois choses:—

(1) Le phénomène calorifique connu sous le nom d'effet Peltier. Dans le cas d'un métal unique mais inégalement chauffé, le phénomène correspondant s'appelle *effet Thomson* et se manifeste par un transport de chaleur.

(2) La différence de potentiel vraie ou force électromotrice de contact.

(3) La force électromotrice apparente ou différence de potentiel entre les couches d'air voisines de la surface de deux métaux.

L'effet Thomson a été mis en évidence par l'expérience. M. Tait croit qu'il en est de même de la différence de potentiel *vraie*.

Ou la phrase que j'ai citée plus haut n'a aucun sens, ou elle signifie qu'il me blâme d'avoir dit le contraire.

Or cette manière de voir ne soutient pas un instant d'examen. Nous n'avons aucun moyen de mesurer la différence de potentiel vraie.

Les méthodes électrostatiques ne nous font connaître que la différence de potentiel *apparente;* les méthodes électrodynamiques ne nous font connaître que la somme des forces électromotrices vraies dans un circuit *fermé*.

Enfin les méthodes indirectes, fondées sur l'écoulement ou sur les phénomènes électrocapillaires, ne sont pas applicables dans le cas qui nous occupe. H. POINCARÉ.

The Theory of Solutions.

IT seems that, unfortunately, the period of misconceptions, whose victim the theory of solutions is, has not yet ended. For, after an explanation from my side of the theory of solutions as I understand it, Mr. J. W. Rodger, my critic, asserts (NATURE, p. 342) that "it cannot be admitted that a number of exact relationships constitutes a theory." From his further remarks, it must be concluded that he designates by the name *theory* what I would name a *hypothesis*, and that, according to him, van 't Hoff's application of the "gaseous laws" to solutions involves the hypothesis that there exists no interaction between the solvent and the dissolved substance.

It was therefore in vain that I stated in my letter, in italics, that many properties of the solutions, according to the new theory, "*can be treated entirely independently of the question of a possible interaction between the parts of the dissolved substance and the solvent*"; it was in vain that I pointed out that all the laws concerning these properties are solely consequences of the one law relating to the volume energy to be gained by making up a solution. This law, whose expression is $pv = RT$, in its various applications to solidification, vaporization, osmosis, &c., of solutions, is the issue of a great many special laws, the whole of which I name the new *theory* of solutions. Such a complex of laws, grouped around and derived from a main law, is what I call a theory; and if the theory, as in the present case, is everywhere in accordance with experience, the main law is to be regarded as correct. There is nothing of hypothetical nature in this theory, for, if once the main law, $pv = RT$, is given (by osmotic experiments or otherwise), all the special laws are merely thermodynamical consequences of it. And, I repeat, the main law involves no hypothetical assumption upon the mutual *rôle* of solvent and dissolved substance, but is solely the condensed expression of a great number of experimental facts

Mr. Rodger asks why I did not state clearly in my book that, in my opinion, interactions between solvent and dissolved substance were possible. I can only reply that on suitable occasions I have done so. Besides the sentences quoted by Mr. Rodger himself, I have devoted (pp. 251, 252) half a page to the evidence that considerable interactions take place in salt solutions on dilution. But as the existence of such interactions, as I have shown, is of no consequence in the statement of the general laws, I have treated them as secondary, however interesting they may be as experimental facts, and I am more than ever persuaded by this discussion that I was right in doing so. For I have not written my book for readers prepossessed by some non-existing chemical theory of solutions, but for such as wish plainly to learn what is known about solutions.

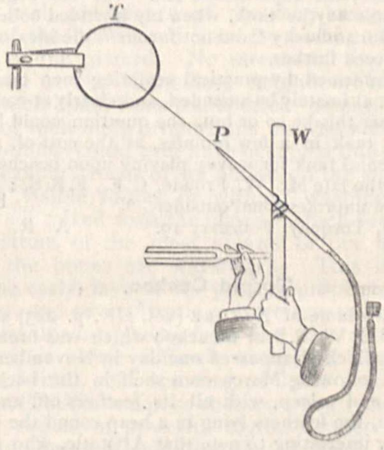
Similar remarks are to be made as to the definition of solutions as mixtures. Even in the case of interactions, if, *e.g.*, hydrates are formed in a solution, the solution is finally a mixture of the hydrates and the remaining solvent. For the contrary assumption—that the whole of the solvent is combined with the dissolved substance, that, *e.g.*, in a somewhat diluted solution of common salt, there exist compounds, as $NaCl + 1000 H_2O$—is in such a degree at variance with all known facts that I did not think it worth while to discuss such an idea.

Lastly, Mr. Rodger terms the application of the formula of van der Waals to solutions as in general "highly questionable" and as "meaningless," if it is admitted that "something of the nature of a chemical reaction" between solvent and dissolved substance may occur. Mr. Rodger may convince himself from my book that this application is limited to cases in which I do not suppose the occurrence of chemical reactions. The reasons of his doubts as to the validity of this application I cannot remove, because he has not stated his reasons. But it may be permitted to me to feel some doubts as to the validity of his reasons. For no other than van der Waals himself has taken up this very question, and has discussed (of course much more fully than I was able to do) the application of his formula to solutions, including also the case of interactions between the substances. His papers on this subject are inserted in the *Zeitschrift für physikalische Chemie*, v. p. 133, and viii. p. 188; and also in the *Archives Néerlandaises* of 1889 and 1891.

Leipzig, February 16. W. OSTWALD.

A Lecture Experiment on Sound.

THE following experiment may be of interest to your readers. A piece of glass tubing is drawn out to a fairly fine point, P, attached by string crosswise to a short lath of wood, W, connected by india-rubber tube to water-tap, and a jet of water directed on to a tambourine, T.



A tuning-fork held in one hand is made to touch the lath held in the other while vibrating, and the whole moved nearer to or further from the tambourine.

At a certain distance the note of the fork will be produced on the tambourine (this of course is not a new experiment). While this was going on, the lath, jet, and fork were slowly moved towards the tambourine, and I was able *to sound the octave below*.

This showed that at a certain point the vibrations of the fork were not individually capable of separating the fine stream into drops, but that two complete vibrations did so; thus half as many drops per second were set free as there were vibrations from the fork.

The fork gave $C = 512$; the note on the tambourine was $C = 256$.

Probably the drops at that stage were of a dumb-bell shape—since at a greater distance the actual note of the fork was produced on the tambourine. REGINALD G. DURRANT.

The College, Marlborough, February 13.

The Formation and Erosion of Beaches, &c.

AS you have more than once permitted me to discuss the problem of sea-waves in your columns, I venture to point out that in your interesting article on Signor Cornaglia's work on sea beaches (p. 362), in your summary of the causes which affect beaches, sand-banks, &c., you have omitted the very important one of wind-raised surface currents. Sea-waves, tidal-currents, and river-currents can be observed, and their effects recorded; but it is the occasional, irregular, and sometimes powerful wind-raised current, prevalent during storms, which performs such erratic feats, and deludes the unwary observer. For instance, a beach may resist the sea for years, yet in a few hours it may be stripped bare to the solid rock. Shells may be covering the bottom a mile off shore, undisturbed by on-shore gales; a storm, with wind and waves apparently much the same as usual, may sweep them all on shore. One beach will be invariably kept clear of shells which will be found off shore, while another beach will have a constant supply, and for no obvious reason.

The causes which affect the movement of sand and silt are so numerous, and their resultant effects so well balanced, that if one of the former be increased or diminished the combined result may be completely reversed. I have just come across an interesting instance. For more than twenty years I kept a 6-ton boat in the tidal harbour here, where, when at her moorings, she took the ground in all weathers twice a day without any damage whatever. Since the erection of the new harbour arm, the silt has been cleared out of the harbour, leaving a hard bottom, and the coxswain of the lifeboat informs me that a boat moored in my old berth sprung a leak in a few days and had to be removed. The mode of accumulation of sand on the Torre Abbey beach is also changed in character. I cannot but think that it is a pity experiments are viewed with disfavour. The Torquay inlet and harbour works were eminently adapted for reproduction in an experimental tank. The then local surveyor, who had practically planned the new works, was anxious to carry the experiments out. We had begun to consider the details of the tank, when my intended colleague told me that superior authority "did not favour" the idea, and it was useless to proceed further.

I am now informed by practical seafaring men that the present plan must ultimately be amended, and clearly at considerable cost. Whether this be so or not, the question could have been decided in a tank in a few minutes, at the cost of, say, £15. The experimental tank for waves playing upon beaches was the suggestion of the late Mr. W. Froude, C.E., F.R.S.; so it is no mere fad of an unprofessional outsider.

Southwood, Torquay, February 19. A. R. HUNT.

Torpid Cuckoo.

IN the last volume of NATURE (vol. xliv. p. 223) an account is given by "E. W. P." of a cuckoo which was brought up in a house, and which disappeared one day in November, and was found in the following March on a shelf in the back kitchen, "still alive, and asleep, with all its feathers off, and clothed only in down, the feathers lying in a heap round the body."

It is rather interesting to note that Aristotle, who firmly believed that some birds hybernate, seems to have come across cases of birds in a similar condition. In his "History of Animals" (Book viii., chap. xviii.), he says, "Many kinds of birds also conceal themselves, and they do not all, as some suppose, migrate to warmer climates; but those which are near the places of which they are permanent inhabitants, as the kite and swallow, migrate thither; but those that are farther off from such places do not migrate, but conceal themselves; and many swallows have been seen in hollow places *almost stripped of feathers*; . . . for the stork, blackbird, turtledove, and lark hide themselves, and by general agreement the turtledove most of all, for no one is ever said to have seen one during the winter. At the commencement of hybernation it is very fat, *and during that season it loses its feathers*, though they remain thick for a long while." I have adopted the translation in Bohn's edition. The italics are mine.

A. HOLTE MACPHERSON.

51 Gloucester Place, Hyde Park, W., February 22.

A Swan's Secret.

Now that the breeding-season for birds is coming near, it would be interesting to note if the following sight I saw last spring is common to swans. A pair of swans built on an island on the River Wey, which runs through our grounds, and I stood on the bank opposite their nest, and watched for a view of the cygnets, which were just hatched out. The male bird presently picked up an empty half egg-shell lying beside the nest, and carefully carried it to the edge of the water, some 20 feet from where the nest was built, and proceeded to fill it with mud, and then pushed it into the river, where it sank to the bottom. He then fetched the only other remaining piece of shell, and did the same. On returning to his nest the last time, he placed a few sticks across the small track he had made, as if to conceal his actions. Evidently this process had been done to each piece of shell, as no other pieces were to be seen, although five cygnets were hatched out.

JESSIE GODWIN-AUSTEN.

Shalford House, Guildford, February 22.

A Simple Heat Engine.

MR. FREDERICK SMITH described in NATURE of January 28 (p. 294) a simple heating machine, which he constructed with a nickel disk, so that when heated before a magnet it began to revolve. A similar heating machine was shown by Prof. Dr. T. Stefan, Vice-President of the Imperial and Royal Academy in Vienna, in the course of a lecture to his students, among whom I was, in the year 1885. A memoir on it appeared in the publications of the above-named Society. The machine was thus constructed: nickel plates were fixed on a wheel, like that of a water-mill, and a magnet was placed before it. By heating a nickel plate before the magnet, it was repulsed by the magnet, and a succeeding plate was attracted, so that the wheel commenced to rotate.

So much I thought it necessary to communicate about the priority of such a heating machine.

KONSTANTIN KARAMATE.

Buccari next Fiume, Austria, Nautical School, February 18.

New Extinct Rail.

[*Telegram.*]

I HAVE just obtained from the Chatham Islands a nearly perfect sub-fossil skull of an extinct Ocydromine rail, closely resembling the Mauritian *Aphanapteryx*, five and quarter inches long, beak arched, slender, very pointed, for which I propose the specific name *Hawkinsi*. HENRY O. FORBES.

Canterbury Museum.

ON A RECENT DISCOVERY OF THE REMAINS OF EXTINCT BIRDS IN NEW ZEALAND.

A DEPOSIT of moa bones, larger than has been found for many years, has just been discovered near the town of Oamaru, in the province of Otago, in the South Island of this colony. Their presence was indicated by the disinterring of a bone during the ploughing of a field, by the proprietor of which the circumstance was communicated to Dr. H. de Lautour, of Oamaru. This gentleman, who is well known through his papers on the diatomaceous deposits discovered by him in his district, at once inspected the spot. Finding that the deposit was large, he first secured, through the kindness of the proprietor, the inviolability of the ground, and then telegraphed the information to the Canterbury Museum. I lost no time in proceeding to Oamaru with one of my assistants, and superintended the digging out of the bones in a systematic manner. The site of the deposit was at Enfield, some ten miles to the north-west of the town, on ground elevated several hundred feet above the level of the sea, in a shallow bayleted hollow, into which the unbroken surface of the expansive slope gently descending from the Kurow hills to the open vale of the Waireka (a stream that rises further to the west) has sunk here for some 7 to 8 feet below the general level, and which, proceeding with a gentle gradient valleywards, becomes a ditch-like conduit for a tributary of the Waireka. In the centre of this depression, which does not exceed 10 to 12 yards in width, the ground was of a dark brown colour, damp and peaty. On removing the upper layer of soil for a depth of 3 to 4 inches round where the bones had first been brought to the surface, and whereon was strewn abundance of small crop-stones, a bed of very solid peat was reached, and firmly embedded in it were seen the extremities of numerous *Dinornis* bones, most of them in excellent preservation, though dyed almost black. Further digging showed that certainly many of the skeletons were complete, and had been but slightly, if at all, disturbed since the birds had decayed. Owing, however, to the close manner in which they were packed together, and especially in which the limbs were intertwined, it was rarely possible to extricate the bones in the order of their relations, or to identify with certainty the various bones of the same skeleton, each bone having to be extracted as the circumstances of the moment directed. In many cases, again, only the pelvis and femora could be traced *in situ*, the vertebræ and remaining leg-bones being indistinguishable in the general agglomeration. It seemed evident that the birds had not died in an erect posture, but more probably with their limbs bent under them or in the same plane with the body. In some instances, beneath the sternum were found, lying quite undisturbed, the contents of the stomach, consisting of more or less triturated grass mingled with crop-stones. The quantity of these smoothed, rounded (chiefly white quartz) pebbles—in size from about that of a bean to that of a plum—mingled with the bones was enormous, and would, if collected, have formed more than a cart-load. Except where the bones were, there were no pebbles of any sort, no small stones nor even sand, anywhere around. The nearest place where pebbles of the same composition are to be found is, I was informed, several miles distant.

Four trenches, or pits, in all, were sunk. The dimensions of the first, which was excavated entirely in peat, did not exceed 3 feet square and $3\frac{1}{2}$ to 4 feet in depth. When it was exhausted of its treasure, a second search was made about 20 to 25 feet higher up the hollow. The dimensions of this pit extended to about 7 feet square and to the same depth as the first. Two more trenches, a few feet apart, were dug at about 30 yards still further up the depression. They were not so large as the other two, but they extended down to about the same depth, $3\frac{1}{2}$ to 4 feet, the bottom of both being (as it was in the second) a bluish clay, with which, in the pit furthest up, was sparingly mingled a small deposit of the finest silt. In the first pit portions of both *Cnemiornis* and *Hæpagornis* bones were found in abundance, and remains of several hundreds of moas of all ages. It was from the second pit, however, that the largest deposit of moa bones was obtained, and the most perfect specimen of food remains from beneath a sternum. Here, also, numerous bones of the giant buzzard and of the great extinct goose were exhumed, and a cranium as large as, if not slightly larger than, that of *Cnemiornis*, but of a species with complete bony orbits, as in the Cape Barren goose, and indistinguishable from *Cereopsis*. Bones from other parts of New Zealand, now in my possession, which I hope shortly to describe, indicate with certainty that several species of *Cnemiornis* formerly existed in this colony. Some of these bones are remarkable for their slender elegance, and indicate species less in size and lighter in build than *Cnemiornis calcitrans*. Among the bones so far examined, I have observed no remains of *Aptornis*, of *Ocydromus*, or of *Notornis*; but I possess an adult tibia of a rail smaller than *Porphyrio melanotus*, yet larger than any other existing New Zealand species. The tarso-metatarsus of a species of *Anas*, about the size of *Anas finschi*, the metatarsus and sternum of *Apteryx Oweni*, and crania of *A. australis*, are among the bones recovered at Enfield, in addition to the metatarsus of a *Biziura*, somewhat larger than *Biziura lobata*, the musk duck of Australia, an interesting species for which I have proposed the name of *Biziura de Lautouri*, after the gentleman to whom I am indebted for the acquisition of these bones. There are still other bones which I have not yet been able to identify. The *Dinornis* remains belong chiefly to the species *elephantopus* (of unusually large proportions), to *ingens*, and to *rheides*. Very fine specimens of pelves and sterna have been obtained, with numerous crania more or less perfect. In this second trench the excavation penetrated through the peat into a bluish clay charged with water (which was, indeed, reached in all the diggings at about 4 feet below the surface), and into this clay the bones just protruded, but no more. The osseous remains dug from the last two holes belonged to the same species as those from the others. Digging and probing the ground beyond the boundaries of the trenches showed us that we had exhausted their contents; while the probing of the ground in the neighbourhood for a considerable radius around, and in other peaty spots not far off, failed to afford indications of other deposits. The number of perfect femora of *Dinornis* brought away exceeded 600; a large number were so decomposed as to fall to pieces in the handling; while a great many others disintegrated, after removal from the ground, on exposure to the atmosphere. I believe I do not over-estimate, therefore, in saying that from 800 to 900 moas at least were entombed in this shallow hollow. So many moas (leaving out of the reckoning the other species of birds) could not by any possibility have found standing-room, however crowded together, in the entire area of the depression. It would appear evident, therefore, that they did not perish all at one time. To account for their burial in such numbers in areas so circumscribed seems to me at present impossible. That their bodies were entire when they were deposited is clear, from the presence in such abundance of the crop-stones, from the position of the bones, and from the finding of the intact contents of the gizzard. No stream of any size could find origin in the immediate neighbourhood, and no stream which could have transported the entire carcasses of birds of such huge proportions as *Dinornis ingens* or *D. elephantopus* could ever have occupied this ravine-head without leaving traces of its action on the surface which would be visible to-day, or without washing away the very fine silt mixed with the clay on which the bones lie, in the bottom of the most upland of our excavations. None of the bones are waterworn. This little hollow was, in the early days of its present proprietor, very wet and boggy, and several springs have origin in it. If the moas made this a highway from one part of the country to another, it seems difficult to believe that birds so powerful of limb, and standing at least 10 to 12 feet in height, could stick fast in so shallow a bog; and to conjecture why eagles of powerful flight, slender rails, small ducks, and comparatively light-footed kiwis also should become ensnared. Driven by fire in the surrounding bush—which may have covered the country then, for the plough has, I am informed, brought to light the stools of many large trees at no great distance, while logs of wood were found among the bones—did they, in a struggle for life in a narrow space, trample each other to death? The presence of the strong-winged *Harpagornis* in considerable numbers seems to militate against this explanation, and no calcined bones have been discovered. An explanation offered some years ago, to account for the presence of a great number of moa and other bird bones in a somewhat similar situation in the Hamilton swamp—that during severe winters these birds congregated at the springs rising warmer from below, and were overtaken by a severe and fatal frost as they stood in the water—appears unsatisfactory in the present case, as there are numerous springs and equally boggy ground near at hand, round which no remains can be found, and so close to the sea such excessive frosts are now unknown. That these were individuals who, during an excessive drought, arrived at the springs too far exhausted to revive—an occurrence common enough in Australia—and that the water there was charged with poison, have also been offered as explanations. But the permanence of glacier rivers, highest in the hottest seasons, precludes the idea of animals dying of thirst in this island, or at all events in this locality so near to the great snow river Waitaki. Poisoned water-holes or exhalations of carbonic acid might be a sufficient reason, yet in those springs elsewhere where bones have been found chemical analysis has failed to detect any substance harmful to life in their waters at the present day. Not a single indication of human intervention was observed. No bones were discovered which had been broken in their recent state; neither kitchen-middens, nor remains of ovens or of native encampments, occur anywhere near the deposit.

One piece of egg-shell dug out of the highest trench is not sufficient evidence on which to base the supposition that the spot was frequented as a nesting-place.

At Glenmark, in the north of this province, the historic spot where the original (somewhat larger than the present) find of *Dinornis reliquiæ* was dug out by my predecessor, the late Sir Julius von Haast, the bones of numerous species of birds besides moas were found. Their occurrence in the situations where they were discovered, and the way in which they were lying—entire bodies with their sterna covering crop-stones *in situ*—have been explained by the supposition that the moas were overtaken by a fierce and sudden storm, and their entire carcasses piled by wind and flood into vast heaps, an explanation against which the presence here also of the same powerful buzzard and other flying birds rises as an objection. Yet there is nothing either in the situation or the disposition of the bones to make it impossible; still I cannot help feeling that that cannot be the true explanation which satisfies only one instance out of so many assemblages of dead birds of nearly always the same species in situations almost similar. I hope, however, that when I have made a thorough examination of all the localities where, and the conditions under which, moa remains have been found, in the light of the personal experience gained in the exhumation of the present deposit, and when I have completed the identification (on which I am now engaged) of the smaller bird bones associated in them with the moa bones, some light may have been gained on this at present mysterious episode in the history of the ancient Avians of New Zealand.

HENRY O. FORBES.

Christchurch, New Zealand.

THE BLUE HILL METEOROLOGICAL OBSERVATORY.[1]

THE *Annals* of this high class Meteorological Observatory for 1890 are of more than usual interest, since we have here presented not only the observations of the year, which are made with remarkable fulness and exactness, but also a well presented and discussed *résumé* by Mr. Clayton for the lustrum ending with 1890, together with an account of the hourly and other observations made at the Signal Service Station at Boston. The Observatory is situated about ten miles south of Boston, on the summit of a peaked hill 640 feet above the sea, and as the ground falls down from the buildings in every direction for several hundred feet, the Observatory occupies a unique position among Observatories in the investigation of some of the more important phenomena of meteorology.

The hourly means of atmospheric pressure show for all the months the double tide well marked. The chief maximum steadily recedes from 10 a.m. in winter to 8 a.m. in summer, and the chief minimum advances from 2 p.m. in winter to 5 p.m. in June. The evening maximum shows a slight tendency towards displacement in the same direction as the afternoon minimum, and the night minimum a similar displacement in the same direction as the morning maximum. A third barometric maximum, which is generally met with in middle latitudes, is particularly well marked at this place.

But the important position of this Observatory appears in the most striking manner on comparing the hourly barometric results of 1890 from the Blue Hill with those from Boston for the same year. The Blue Hill Observatory is situated on a true peak, but the station at Boston is in the mouth of the rather broadish valley which stretches northward from the town. The result is that, though the places are only about ten miles apart, the diurnal fluctuation at Boston is 0·017 inch greater than on the top of Blue Hill. In June, when this feature of the pressure is at the annual maximum, the following are the hourly results, where the plus sign indicates that pressure at Boston rose above its daily average by these amounts, expressed in thousandths of an inch, greater than did pressure on the Blue Hill above its daily average; and the minus sign that it fell lower by these amounts at the former than at the latter place.

	Diff.		Diff.		Diff.
1 a.m.	+ 2	9 a.m.	+ 6	5 p.m.	− 5
2 ,,	+ 3	10 ,,	+ 1	6 ,,	− 7
3 ,,	+ 8	11 ,,	− 1	7 ,,	− 5
4 ,,	+ 10	Noon	− 4	8 ,,	− 5
5 ,,	+ 10	1 p.m.	− 3	9 ,,	− 8
6 ,,	+ 10	2 ,,	− 5	10 ,,	− 4
7 ,,	+ 7	3 ,,	− 5	11 ,,	− 2
8 ,,	+ 6	4 ,,	− 7	Midnight	− 1

The explanation is that, during the night, cold air-currents flow down the sides of a valley and accumulate below, and thus a higher pressure is maintained in valleys during the night; but, on the other hand, during the day the valleys become more highly heated by the sun, and under the strong ascending currents thereby generated, pressure falls lower than in open situations. The amounts increase in proportion to the daily range of temperature, and as the mean velocity of the wind diminishes. This diurnal variation is greatest in the deep valleys of Switzerland and other mountainous regions, and, though small in amount is a well-defined and steady fluctuation in the valley of the Thames, as shown by a comparison of the Kew and Greenwich barometers. A weak point in the meteorological publications of the Signal Service of the United States is the all but complete absence of the results of the hourly phenomena of meteorology. In filling up this hiatus, the Blue Hill Observatory will prove of the greatest service, as offering a truly normal Observatory, at which, from its mere position, several disturbing elements affecting diurnal phenomena are eliminated.

During the whole year, the time of occurrence of the minimum temperature is very near sunrise; and it is interesting to note that the maximum occurs at all seasons from 2 to 3 p.m., approaching in this respect the time of the maximum at truly high-level Observatories, or at Observatories situated on peaks. For the five years, the mean monthly temperatures deduced from the maximum and minimum thermometers exceed those deduced from the hourly values every month, the smallest excess being 0°·2 in December, and the largest 1°·2 in August, the mean for the year being 0°·7.

The prevailing winds are north-westerly from February to April, southerly in May, and westerly and north-westerly for the other months. These winds are ruled by the different distributions of atmospheric pressure over the Atlantic and America in the respective months; these being in winter the low pressure round Iceland, and the high pressure over the United States and Canada; and in summer the high pressure in mid-Atlantic, together with the low pressure over the Middle States. The hourly frequency of each wind has been worked out for the lustral period, with results that are very suggestive. The period is sufficiently extended to give fairly good averages, from which accidental phenomena may be regarded as eliminated; and the result is more completely attained by the height of the Observatory above the surrounding country all round removing from the observations the more purely local causes of disturbance. The mean, hourly frequency of each wind shows a clear tendency of the wind to veer around the compass each day. Thus, the greatest frequency of southerly winds occurs at 8 p.m., south-westerly at 10 p.m., westerly at 1 a.m., northerly at

[1] "Annals of the Astronomical Observatory of Harvard College," vol. xxx., Part 2, "Observations made at the Blue Hill Meteorological Observatory, Mass., U.S., in the Year 1890, under the direction of A. Lawrence Rotch, Esq." With Appendices. (Cambridge: University Press 1891.)

5 a.m., north-easterly at noon, easterly at 2 p.m., and south-easterly at 7 p.m., and this occurs winter and summer, and is independent of the sea breeze.

This points plainly to a cause in daily operation, which the unique position and work of the Blue Hill Observatory enable us to deduce from a comparatively few years' observations. This cause is the diurnal barometric tide, with its two maxima and minima, which, as regards the Blue Hill, are more pronounced over the land to westward than over the ocean to eastward, and become still more pronounced on advancing southward into lower latitudes and westward into more inland situations. Thus, at 9 a.m., the time of the morning maximum, pressure at the Blue Hill is 0·023 inch above the daily mean; at New York, 0·028 inch; at Philadelphia, 0·031 inch; and at Washington, 0·035 inch. Now at this physical instant, 9 a.m. local time, this atmospheric tide becomes relatively less and less on advancing eastward across the Atlantic, and at Kew (about 2 p.m. G.M.T.) pressure is 0·012 inch below its average. From its position with respect to this wide-spread shallow diminution of pressure, northerly and north-easterly winds attain their diurnal maximum frequency at this hour. Again, at the Blue Hill, pressure falls to the daily minimum at 3 p.m. (local time), after which it continues slowly to rise; and, while rising, pressure is relatively lower to the westward. From its position in the north-easterly segment of this wide-spread area of lower pressure, the south-easterly winds at the Blue Hill attain their daily maximum frequency at 3 p.m.

The mean maximum velocity of the wind, about the rate of twenty-two miles an hour, occurs from November to March, and the minimum, nearly fifteen miles an hour, from June to August. As regards the hourly velocity of the wind, the records show the occurrence of the daily maximum at 3 p.m., being the hour of occurrence generally, except at high-level Observatories; but the time of the minimum, 8 a.m., is markedly different. This peculiarity arises from the curious but highly interesting fact that the Blue Hill shows a secondary maximum immediately after midnight, or the time when the daily maximum velocity occurs at high-level Observatories, thus linking the Blue Hill Observatory with both high and low level Observatories.

There are also published valuable results of humidity, cloud, sunshine, rain, gales, thunderstorms, and visibility of distant objects, for which we must refer to the Report itself. As the Meteorological Service of the United States has recently taken a new departure, it is to be hoped that Mr. Rotch, who has generously established this Observatory, and has its admirable work well in hand, will yet see his way to the continuance of the tabulation and publication of the hourly values of the elements, which cannot but prove to be of essential service to the Department in carrying out certain developments of American meteorology which, it is understood, are under consideration.

GUSTAV PLARR.

ONE of the older generation of mathematicians has lately passed away in the person of Dr. Gustav Plarr, who died at Tonbridge on January 11, of bronchitis following influenza. He was born on August 27, 1819, at Kupferhammer, a country house near Strasburg. He was educated at the Gymnase and at the University in that city, whence he proceeded to Paris University, where he obtained his diplomas as Licentiate of Sciences and as "Docteur ès Sciences Mathématiques." Among his close friends at school and at the University was M. Wurtz, while M. Gerhardt, another great chemist, was among his Strasburg contemporaries. Dr. Plarr for some time meditated a life of chemical research, but found that his health would not permit of prolonged laboratory work. After taking his doctorial degree, he was for some time mathematical master at a College at Colmar, and, on the Chair of Mathematics becoming vacant in the University of Strasburg, was one of the candidates for the post. He was strongly supported by the Strasburg academic party, especially by M. Sarrus, the outgoing Professor, but clerical influences were at work against him, and a Parisian was finally imposed on the little Germanizing University.

In 1857, Dr. Plarr married an English lady, and during his honeymoon in Dublin was introduced to Sir William Rowan Hamilton, the originator of the Quaternion method, and became thenceforth a devoted student and exponent of the work of that great genius.

The British Association met at Dublin in the autumn of 1857, and Dr. Plarr was one of the eight foreign men of science who were that year elected "Corresponding Members." Whewell, Hamilton, Vignoles, and Brewster were, we believe, his sponsors on this occasion. The paper then communicated by him to the Mathematical Section of the Association will be found at p. 101 of the Report.

The other seven men of science elected at this meeting were Barth, Bolzani, d'Abbadie, Loomis, Pisani, and the two Schlagintweits. Of these, only Herman Schlagintweit survives. Indeed, at the time of his death, Dr. Plarr was one of the half-dozen oldest living "Corresponding Members" of the British Association.

In the Franco-German war of 1870, Kupferhammer was burnt by the French, in order to dislodge Prussians who had been able thence to command the sluices of the moat round Strasburg. Dr. Plarr accordingly came to reside among his wife's relatives, first at St. Andrews, and then at Tonbridge.

Since 1870, Dr. Plarr's time was almost exclusively devoted to the study of Quaternions. In 1882–84 his French translation of Prof. Tait's Treatise was published by Gauthier-Villars. Several papers by him, on abstruse points connected with the Quaternion method, were communicated to the Royal Society of Edinburgh. Beside these there is a very interesting piece of ordinary analysis connected with Spherical Harmonics.

Modest, unambitious, studious, simple in his habits to the verge of asceticism, Dr. Plarr was of a type rare in these days and in this country. Although a man of wide scientific culture, and of many literary interests, he was content to be a pioneer in a realm of thought for which there is necessarily no popular sympathy at present. Quaternions, indeed, were to him the mathematics of the future, and he was to the last happy in the thought that he had assisted, however obscurely, in their development.

NOTES.

TWO international scientific Congresses are to be held at Moscow in August. One will relate to anthropology and archæology, the other to zoology. There will be exhibitions in connection with both Congresses, and appeals have been issued for the loan of objects which are likely to be useful and interesting. Among the things wanted for the Anthropological Congress are phonograms of the language and songs of different races. French will be the official language of the two meetings. The more important papers will be printed before members come together, so that discussion may be facilitated.

THE death, on February 20, of Prof. Hermann Kopp is announced. He died at Heidelberg, after a long and painful illness, in the seventy-fifth year of his age.

THE well-known botanist and philologist Stephan Endlicher was buried in 1849 in a churchyard near Vienna. This churchyard is about to be closed, and it is proposed that Endlicher's remains shall be removed to the new central cemetery of Vienna, and that a suitable monument to him shall there be erected. At present, his grave is not marked even by an ordinary tombstone. An influential international Committee has been formed for the purpose of giving effect to the scheme. Those who desire to associate themselves with it should send subscriptions as soon as possible to the K.K. zoologisch-botanische Gesellschaft, Vienna, I, Herrengasse 13.

MR. W. SAVILLE-KENT, who has been absent from England during the past eight years, acting in the capacity of Inspector and Commissioner of Fisheries to various of the Australian Colonial Governments, and most recently to that of Queensland, is now in London, and will be occupied for the next few months, chiefly at the British Museum, South Kensington, in working out the corals and other natural history materials collected by him on the Great Barrier Reefs. Associated with the materials in question is an extensive series of photographs of coral reefs and coral animals taken from life, some few of the more early acquired of which were exhibited at last year's *conversazione* of the Royal Society. Selections from the completed series will be shortly published in association with a work, on the fishery and natural history products generally of the Great Barrier district, that Mr. Saville-Kent has in preparation. Mr. Saville-Kent is under engagement with the Government of Western Australia to proceed to that colony towards the end of the current year, to investigate and report upon the pearl and pearl-shell, oyster, and other indigenous fisheries, with a view to their more profitable development. This engagement is likely to occupy him for some two years, when he proposes to return permanently to England.

PROF. HUXLEY AND PROF. RAY LANKESTER have each written to the *Times* on Lady Blake's proposal that a marine biological station should be established in Jamaica as a memorial to Columbus. Prof. Huxley points out that "animal life is indescribably abundant and varied in the intertropical seas," and hopes that the scheme will meet with cordial support here and in the United States. Prof. Ray Lankester is also of opinion that a good permanent laboratory for the study of marine life should be established in the tropics; and he thinks that "no position is more favourable for this purpose than the coasts of Jamaica." He urges, however, that a definite set of proposals should be made in Jamaica for the realization of the Columbus Laboratory. His opinion is that "the Government of Jamaica should initiate the scheme, and make the proposed laboratory part of a biological and physical survey of the coasts of the island." What is chiefly needed is "an efficient, well-trained naturalist, who must be paid at least £700 a year for his services (less than a lawyer or a sanitary officer), and a Government gunboat with crew, &c., and two or three special fishermen and attendants." A suitable building, Prof. Lankester thinks, could easily be obtained.

THE members of the Geologists' Association will make an excursion to Hornchurch on Saturday, March 5, Mr. T. V. Holmes acting as director. They will visit sections on the new railway between Upminster and Romford. The early date of the excursion has been rendered necessary by the state of the most important section. The first cutting to be visited is that between Upminster Station and the Ingrebourne. It shows London Clay capped by gravel and loam belonging to the highest terrace of the Thames Valley deposits in this district. Crossing the Ingrebourne, the line enters another cutting north-east of Hornchurch. In this cutting boulder clay has been seen for a distance of 300 yards, resting in a slight hollow on the surface of the London Clay, and capped by gravel belonging to the highest terrace of the Thames Valley beds. The greatest thickness of boulder clay seen in this cutting is 15 feet, and it is hoped that the sloping now going on may not have advanced so far at the date of the excursion as to have destroyed every clear section. At Butts Green there is a good section of London Clay capped by sand and gravel. Nearer Romford the cuttings are not sufficiently advanced to be worth visiting. The total walking distance is three miles.

A WORK of considerable interest to meteorologists has been published in the Memoirs of the Physical Society of Geneva, containing the detailed observations made under the directions of H. B. de Saussure on the *Col du Géant*, at Geneva, and at Chamounix simultaneously, from July 5 to 18, 1788. The means only, and these only for a part of the observations, were published in his "Voyages dans les Alpes" (Neuchatel, 1779–86). These valuable observations, which have been carefully revised by his grandson, Henri de Saussure, have often been asked for, and we believe have only lately been discovered. They include values taken several times daily of pressure, temperature, humidity, wind, cloud, electricity, magnetism, &c., together with general remarks upon the weather.

FROM a recent statistical study of the wheat harvests of Ohio (summarized in *Science*), it appears that the average yield of wheat is increasing in the northern and central sections of the State, while it is at a standstill, and at far too low a point for profit, in the southern and south-eastern counties. Geologically, there are three bands running across the State from north to south—that in the east (nearly a third of the whole), over coal-measures; next to it, a narrower strip of Waverly rocks (sandstones and calcareous shales); then the western half, over limestones. The two latter are covered with a bed of glacial drift, which is, however, a good deal modified by the underlying rocks. In the northern portion, the counties over the Waverly rocks show a larger average yield (in forty-four years) than those over limestones and the coal-measures, and they also show a higher rate of increase. In the middle and south, the limestone counties show the larger yield; and in the middle (not the south), the larger rate of increase. The counties over the coal-measures are inferior in yield per acre in each belt, the difference increasing as we come south. The hilly character of the ground is supposed to be the chief cause of this lower yield. Some 48 million bushels were harvested in Ohio in 1888. The area devoted to wheat is approaching 3 million acres, and represents 12 per cent. of the area in farms in the State. The average yield is thirteen bushels per acre (in England it is about twenty-eight bushels), but in the northern and middle parts it is steadily growing. The production is keeping far ahead of any possible consumption within the State.

AN important Conference of fruit-growers was held last year in Sydney, the chair being occupied by the Hon. Sydney Smith, Minister of Mines and Agriculture in New South Wales. It lasted several days, and the report of the proceedings, which has now been issued, ought to be of great service to fruit-growers in all parts of the colony. The President, in his concluding speech, said the Government were both proud and anxious to assist the agriculturists of the country. All that was required was the co-operation and assistance of those engaged in the industry, in order that they might know in what direction this assistance would be most useful. He felt sure a great deal of good would come from the discussions during the Conference, and he hoped the members would hold Conferences in their own districts. He was most anxious to see the local Agricultural Societies holding meetings every month, where papers could be read and different important questions discussed, as he was certain this would do good, and he sincerely hoped his suggestion would be acted upon, as they might rely upon the assistance of the Department. The Government, as they knew, had already granted pound for pound to the Agricultural Societies, and they were willing to do still more. On that year's estimates £5000 was set apart for national prizes throughout the whole colony, and he believed these prizes would be worth winning.

THE prevalent notion that the mistletoe is injurious to the apple or other tree on which it grows is disputed by Dr. G. Bonnier, the Professor of Botany at the Paris Sorbonne, who maintains, not only that this is not the case, but that it is actually beneficial to its host, the relationship being not one of simple parasitism, but rather one of symbiosis. He determined from a series of observations on the increase in the dry weight of the leaves, that, while in summer the mistletoe derives a large portion of its nutriment from the host, in winter these conditions are reversed, and the increase in weight of the mistletoe is less than the amount of carbon which it has obtained from the atmosphere—in other words, that it gives up to its host a portion of its assimilated substance.

AT a meeting of the Royal Botanic Society on Saturday last, Dr. R. C. A. Prior presented ripe seeds of *Araucaria imbricata*, the monkey-puzzle tree of Chili, collected from a large tree growing in the open air at Corsham, Wilts. He mentioned that in this country the plant, though common, seldom ripens its seeds. It was first introduced here 100 years ago by Mr. Menzies, a Scotch botanist, who accompanied Vancouver's expedition in search of a passage between the Atlantic and Pacific Oceans. In returning from their attempt they put in at Valparaiso, and were hospitably entertained by the Viceroy of Chili. While dessert was on the table Menzies observed some nuts he had not seen before. Instead of eating his share he saved them, and, taking a box of soil back with him on board ship, succeeded in raising five plants, which he brought to England, and these formed the stock from which most of the large trees now growing in various parts of the country have sprung.

SOME time ago Mr. G. Brown Goode, of the U.S. National Museum, delivered before the Brooklyn Institute a lecture on "The Museums of the Future." This lecture has now been printed, and is well worth reading. Mr. Goode's main idea is, that "the people's Museum should be much more than a house full of specimens in a glass case." "It should," he says, "be a house full of ideas, arranged with the strictest attention to system." This conception he expresses epigrammatically by defining a Museum as "a collection of instructive labels, each illustrated by a well-selected specimen." In the course of the lecture he offers many instructive and interesting remarks on the Museums of the Old World.

THE first number of the new *Zeitschrift für Anorganische Chemie*, edited by Prof. Krüss, of Munich, was issued on February 27.. As its title implies, the new journal is devoted exclusively to the inorganic branch of chemistry, and the names of the distinguished chemists throughout Europe and America whose co-operation the editor has been fortunate in securing would appear to promise well for its value and success. The first number, now before us, contains the following six original memoirs: "Phosphorus Sulphoxide," by T. E. Thorpe and A. E. Tutton; "The Double Acids of Heptatomic Iodine," by C. W. Blomstrand; "The Action of Hydrogen Peroxide upon certain Fluorides," by A. Piccini; "Ammoniacal Platinum Compounds," by O. Carlgren and P. T. Cleve; "Preparation of Tungstates free from Molybdenum," by C. Friedheim and R. Meyer; "A Lecture Experiment," by C. Winkler.

A NEW *Physical Review* has been started by the publisher J. Engelhorn, of Stuttgart. The editor is L. Graetz. The object of this periodical will be to make German readers acquainted with the work being done by physicists in other countries. It is intended that it shall serve as a sort of supplement to the well-known *Annalen der Physik und Chemie*.

WE are glad to welcome the first number of *Natural Science*, a monthly review of natural history progress. The object of the editors will be "to expound and deal in a critical manner with the principal results of current research in geology and biology that appear to be of more than limited application." Articles are contributed to the first number by Mr. F. E. Beddard, Mr. J. J. H. Teall, F.R.S., Mr. A. S. Woodward, Mr. R. Lydekker, Mr. J. W. Davis, Mr. G. A. Boulenger, Mr. J. W. Gregory, Mr. G. H. Carpenter, and Mr. Thomas Hick. The publishers are Messrs. Macmillan and Co.

MESSRS. EASON AND SON, Dublin, will issue in April the first number of the *Irish Naturalist*, a monthly journal of general Irish natural history, and the official organ of all the natural history Societies in Ireland. The editors will be Mr. George H. Carpenter and Mr. R. Lloyd Praeger.

A NEW instalment (vol. i. No. 10) of the *Records of the Australian Museum* has been issued. These *Records* are edited by Dr. E. P. Ramsay, Curator of the Museum, and embody the results of a great deal of serious scientific work. The present number contains the following papers:—"On the Occurrence of the Genus *Palæaster* in the Upper Silurian Rocks of Victoria," by R. Etheridge, Jun. (plate); "The Operculate Madreporaria Rugosa of New South Wales," by R. Etheridge, Jun.; "Notes on the Structure of *Pedionomus torquatus*, with regard to its Systematic Position," by Dr. Hans Gadow.

MESSRS. BLACKIE AND SON have issued an enlarged edition of the well-known "Concise Dictionary of the English Language," by Dr. Charles Annandale. The new matter consists partly of a supplement giving definitions of additional words, partly of several new appendices or lists for general reference.

THE General Report of the operations of the Survey of India Department, administered under the Government of India during 1889–90, has been issued. It has been prepared under the direction of Colonel H. R. Thuillier, R.E., Surveyor-General of India. The Report relates to trigonometrical, topographical, forest, cadastral, and traverse surveys. There is also an account of electro-telegraphic longitude operations, tidal operations, and geographical surveys and reconnaissances.

THE following are the arrangements for science lectures at the Royal Victoria Hall during March:—March 1, Dr. W. D. Halliburton, on "Nerves"; March 8, Prof. Reinold, on "Sound and Music"; March 15, Dr. Tempest Anderson, on "Iceland"; March 22, Prof. Weldon, on "Soles and other Sea-Fishes"; March 29, Mr. A. Smith Woodward, on "Elephants."

A PAPER upon the preparation of amorphous boron is contributed by M. Moissan to the current number of the *Comptes rendus*. It was shown in a communication to the Académie des Sciences upon February 15 that the substance hitherto regarded as amorphous boron is a mixture of that substance with large quantities of impurities, formed by the combination of the boron at the moment of its liberation with a portion of the metal used to replace it and with the substance of the vessel in which the reaction is performed. M. Moissan now describes a method by which he has succeeded in obtaining boron in a state of almost perfect purity. The reaction which he employs is that of metallic magnesium upon boric anhydride, a reaction previously studied by several observers, and most recently by Prof. Winkler, who employed the magnesium in the quantity calculated to remove all the oxygen from its state of combination with the boron. M. Moissan shows that if only one-third of this quantity of magnesium is employed, the yield of free boron is very much enhanced, and the impurities are only such as can be removed. He confirms Prof. Winkler's statement that two borides of magnesium are capable of formation, one of which is unstable, and, as shown by Messrs. Jones and Taylor, is decomposed by water with evolution of a mixture of hydrogen and boron hydride, while the other is permanent both in the presence of water and acids. It is this stable boride, which M. Moissan has obtained in good crystals, which is so difficult to remove from the substance which has hitherto been considered as amorphous boron, and its formation should be avoided as much as possible. When magnesium and boric anhydride in the proportions above indicated—convenient quantities being 70 grams of the former and 210 grams of the latter—are heated to redness in a closed crucible, a somewhat violent reaction occurs, the crucible becoming vividly incandescent. Upon cooling, a reddish-brown mass is found, which is readily detached from the crucible, and is impregnated throughout with crystals of magnesium borate. The interior portion is then powdered, and successively treated with water and hydrochloric acid, alcoholic potash, hydrofluoric acid, and lastly with distilled water. This product, even after such exhaustive treatment, upon drying *in vacuo*, is found to contain only 95 per cent. of boron. In order to remove the 5 per cent. of the stable boride, the product is again heated to redness in the midst of a large excess of boric anhydride, and the extraction and washing repeated as before. The percentage of boron is by this means raised to 98·3 per cent., the remaining impurity being a mere trace of the boride and 1·3 per cent. of nitride of boron. These remaining impurities have finally been eliminated by employing a crucible rendered impenetrable to the furnace gases, the nitrogen of which rapidly causes the formation of nitride, by means of a mixture of titanic acid and charcoal. In addition to the laborious method above indicated, by which tolerably large quantities of pure boron may be obtained, M. Moissan further shows that it may be prepared in smaller quantities by the reduction of boric anhydride by magnesium in a stream of hydrogen, when, after extraction, a pure product necessarily free from nitride is obtained. And lastly, M. Moissan describes an electrolytical method of preparing it. Fused boric acid is rendered a good conductor of electricity by the addition of 20 per cent. of its weight of borax. Upon passing through the fused mixture a current of 35 amperes, a little sodium is liberated at the negative pole, and combines with the platinum electrode to form an alloy, while amorphous boron and oxygen are liberated at the positive pole. The greater portion of the boron, owing to the high temperature of the reaction, recombines with the oxygen with most brilliant incandescence, but a portion escapes combination, and may be isolated in the pure state as a chestnut-coloured powder.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus* ♂) from West Africa, presented by Mr. George W. Bowles; a Toque Monkey (*Macacus pileatus*) from Ceylon, presented by Mr. Arthur Wallis; a Bauer's Parrakeet (*Platycercus zonarius*) from South Australia, presented by Mr. Edward F. Baillou; two Alpine Accentors (*Accentor collaris*), European, presented by Lord Lilford, F.Z.S.; four Coqui Francolins (*Francolinus coqui* 2 ♂ 2 ♀) from South Africa, presented by the Hon. F. Erskine; a Green Toad (*Bufo viridis*), six Painted Frogs (*Discoglossus pictus*), European, three Moorish Toads (*Bufo mauritanica*) from Tunis, purchased.

OUR ASTRONOMICAL COLUMN.

THE WARNER OBSERVATORY.—"The Warner Observatory is distinctively a private institution built for the purposes of original discovery rather than the ordinary routine work of most other Observatories." This sentence begins a recently-published history and work of the Warner Observatory, Rochester, N.Y., from 1883 to 1886. Under such favourable conditions as these, it is not wonderful that a considerable amount of work should be done. Mr. Lewis Swift is the Director of the Observatory, and, upon assuming command, he selected the discovery of new nebulæ as his principal field of labour. The first unrecorded nebula was found on July 9, 1883. Since then more than 400 others have been detected; and their positions and descriptions have been published from time to time in four catalogues. The observations are now brought together, and will therefore be more useful than heretofore. In the volume containing them are printed the Warner prize essays. One of these, by Prof. Lewis Boss, treats of "Comets: their Composition, Purpose, and Effect upon the Earth"; and there are several others on the coloured skies seen about the time of the Krakatão eruption. Mr. Henry Maine endeavours to show that a physical connection existed between these red sunsets and solar activity. The Rev. S. E. Bishop, of Honolulu, also describes the brilliant glows in question; ascribing them to the introduction of finely divided matter into the higher regions of the atmosphere.

MEASUREMENT OF SOLAR PROMINENCES.—In *Comptes rendus*, tome cxiii. p. 353 (1891), M. Fizeau pointed out that the velocities attained by solar prominences were comparable with the earth's orbital velocity, and remarked that, on account of this circumstance, prominences must suffer a displacement from their true position. If this were so, and the argument appeared to be sound, then the apparent heights reached would have to be increased or diminished according to the velocity with which the prominences were projected. Mr. Henry Crow has pointed out an apparent error in this reasoning (*Astronomy and Astro-Physics*, January, p. 90). He says:—"The author here neglects the fact that, at any given instant, each point of the solar disk and of the prominence, whether in motion or at rest, is sending to the observer rays, all of which are affected by the same correction for aberration. I say the 'same' correction, since the change in celestial longitude or latitude from one part of the sun's surface to another would affect the aberration quite inappreciably. If there be relative motion among the parts of the prominence, then, since at any instant aberration affects all these parts to the same extent, the prominence will be projected upon the slit of the spectroscope in its true proportions." So the study of the solar surface is apparently not to be complicated by the introduction of a new correction. In this connection it may be remarked that, in a letter dated February 12, Prof. Hale writes: "You may be interested to know that I have just succeeded in photographing all the prominences around the sun with a single exposure."

THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE Australasian Association for the Advancement of Science held its fourth annual meeting at Hobart, Tasmania, from January 7 to 14 inclusive. The meeting was in every way successful, and the proceedings afford ample and most satisfactory evidence that much excellent work is being done among our Australasian kinsfolk in every branch of science. The President was His Excellency Sir Robert Hamilton, Governor of Tasmania. The people of Hobart accorded to the members of the Association a most hearty welcome, and did everything in their power to make the occasion a pleasant and memorable one. Visitors from a distance had the advantage of being able to travel both by sea and land at greatly reduced fares, and everything of scientific interest in Tasmania was clearly explained for them in a capital hand-book issued from the Government Printing Office. Mr. Robert Giffen attended the meeting, and was cordially received. He delivered a lecture to the members of the Association on "The Rise and Growth of the British Empire."

Great credit is due to the Hobart *Mercury* and other local papers for the enterprise they displayed in reporting the proceedings.

At the meeting of the general Council on January 7, the chair was taken by Baron von Mueller, past President, as Sir James Hector, the retiring President, was prevented by ill health from being present. It was formally decided that the fifth annual meeting of the Association should be held at Adelaide, and practically decided that the sixth should be held at Brisbane. Prof. Tate will be President of the Adelaide meeting.

On the evening of the 7th Sir Robert Hamilton delivered his presidential address before a large audience in the Town Hall. He presented an interesting sketch of the history of the Royal Society of Tasmania, and suggested many sound reasons why all intelligent persons in Australasia should do their utmost "to hasten the advent of the time, which is undoubtedly approaching, when science will form a much more integral part of the life of the people than it does at present."

It is impossible for us to give a full account of the proceedings of the meeting; but the following notes may suffice to indicate the wide range of the work done in the various Sections.

SECTION A.

MATHEMATICS, PHYSICS, AND MECHANICS.

Prof. Bragg, Adelaide, was President of this Section. He chose as the subject of his presidential address, "Mathematical Analogies between various branches of Physics." About fifty years ago, he said, Sir William Thomson showed that there existed between several branches of physics a very close analogy—the analogy was so exact that the solution of any problem of any one theory was at the same time the solution of the problem in any other. The list of analogies might be still further increased by the addition of certain other theories, which were to some extent imaginary, yet important in that they were simple to realize, and therefore of great use in presenting to the mind the usual means of grasping the other problems. It was a matter of the greatest interest that so wide and so perfect an analogy should exist, and for that reason the analogy would be a fit subject for an address. There were other grounds for its fitness. It was of the greatest assistance in physics to follow up this analogy, and examine carefully its nature. It was a common remark that analogies were dangerous things, and the remark was often true enough. But the danger lay only in an imperfect knowledge of the extent to which calculations might be made upon the analogy, and could be avoided once and for all by amending the imperfection. Moreover, the student of electricity and magnetism could hardly avoid the use of some sort of analogy, for these theories deal with quantitative relations between things of the real nature of which we are completely ignorant, and most minds could not for long consider these relations in mere symbols, but must finally give them some sort of form. He then explained the nature of the problem, and proceeded to show the measure of analogy that exists between various theories of physical science.

A paper by Sir Robert Ball, on "The Astronomical Explanation of a Glacial Period," was read by Sir R. Hamilton, and a hearty vote of thanks was accorded to His Excellency and to the author. Mr. A. B. Biggs, Launceston, read a paper on "Tasmanian Earth Tremors." Mr. C. W. Adams, Dunedin, dealt with a graphic method of showing the relation between the temperature of the dew-point and the temperature of the air for any given climate. Mr. George Hogben, Timaru, N.Z., read the report of the Committee on "Seismological Phenomena in Australasia." This Committee had begun its work by making a compilation of the records of all previous earthquake shocks throughout Australasia, and these records were now nearly complete, except for Queensland and Western Australia. It had also provided for as accurate a system of observations in the future as was possible under the circumstances, by means of memoranda to be forwarded from various telegraph offices. The system adopted was, with the necessary modifications, that which had been in use with success in New Zealand for some time past. The Secretary explained what had been done in New Zealand by this means in the determination of earthquake origins, and of other facts about earthquakes, and pointed out that it was as part of a world system of observations that the observations in Australasia are likely to be most useful. With that aim in view the Committee proposed to extend their observations to the islands of the Pacific, and so to establish a connection, if possible, with what was being done in South America and in Japan. An important step was also taken in the adoption of a common standard of intensity—the Rossi-Forel scale, as used by Swiss and Italian seismologists, being that agreed upon. It was pointed out that the system now adopted throughout Australasia had led to the fixing of five of the chief origins of disturbance in or near New Zealand, among them (during the past year) of the origin of most of the Cook's Straits shocks.

Mr. A. McAuley, Ormond College, Melbourne, contributed a paper on "Quaternions as a Practical Instrument of Physical Research." He indicated the power of the method by six examples:—(1) A theorem in potentials illustrated by applying it to a general electrical problem. (2) Two examples in curvilinear co-ordinates. (3) A quaternion proof of a well-known theorem of Jacobi's of great utility in physics. (4) A generalization of one of the well-known equations of fluid solution. (5) The well-known particular system of the differential equation expressing the conditions of equilibrium of an isotropic elastic solid subject to arbitrary bodily forces. (6) A short criticism of Prof. Poynting's theory of the transference of energy through an electric field.

Papers were read by Mr. W. H. Steele on "The Conductivity of Solutions of Copper Sulphate"; by Mr. R. W. Chapman on "The Dodging Tide of South Australia," containing a summary of the work done by the Committee on Tidal Observations; and by Archbishop Murphy, Hobart, on "Solar Phenomena and their Effects."

Mr. H. C. Russell, F.R.S. (Government Astronomer, N.S.W.), read a paper on "The Grouping of Stars in the Southern Part of the Milky Way." He pointed out the advantages of the photographic method of studying star distribution, and discussed the evidence offered by a large number of photographs taken by himself. The results he had obtained tended to diminish the value of the rifts in the discussion of stellar distribution. The interest of this paper was much enhanced by the exhibition of a large collection of photographs.

Mr. R. L. J. Ellery, F.R.S. (Government Astronomer, V.), read a paper describing some of the difficulties occurring in the photographic charting of the heavens, more especially regarding the determination of stellar magnitude. He also spoke of the desirableness of establishing tidal observations in Tasmania. He drew attention to the incompleteness of the tidal records for Tasmania, and moved a resolution urging the Government to establish several more tide gauges, especially on the north coast. This resolution was seconded by Mr. H. C. Russell, and carried unanimously.

Mr. R. B. Lucas read a paper on the unification of standards of weights and measures, in which the condition of legislation in regard to this important matter, with suggestions for the unification of standards throughout the colonies, and recommendations for a central depot with central administration, was specially considered.

Captain Shortt (Meteorological Observer, Hobart) read a short paper advocating a particular method of determining longitude at sea from observations of the maximum altitude. The paper gave rise to a very interesting discussion.

The President of the Section moved "That the Section telegraph its congratulations to Sir W. Thomson on his elevation to the peerage." This was seconded by Mr. Ellery, supported by Mr. Russell, and carried unanimously.

SECTION B.

CHEMISTRY AND MINERALOGY.

Mr. W. M. Hamlet, Government Analyst, of New South Wales, presided over this Section. In his opening address he dealt with the progress of chemistry in Australasia. Having described the difficulties with which chemists in Australasia have to contend, he said that in spite of them work had been done. He mentioned the discovery of the alkaloids brucine and strychnine in the fruits of *Strychnos psilosperma*, by Prof. Rennie and Mr. Goyder, of Adelaide; also the work done by Mr. J. H. Maiden, of Sydney, in the examination of Australian kinos, gums, and barks. Chief amongst Mr. Maiden's researches was his work on wattle bark, which he found contained from 15 up to 46 per cent. of tannic acid. These barks were proved to be invaluable for tanning purposes, and their cultivation proved easily remunerative to the agriculturist. Mr. Kirkland's discovery of gallium and indium in some specimens of blende were referred to, as were the highly-interesting investigations of different minerals by the Rev. J. Milne Curran, of New South Wales. Reference was also made to researches being made by observers who were seeking to find out the actual state of combination in which elements occur in different ores. Much of this kind of work needed to be done, and if such questions were investigated by men who knew what they were doing, it would go a long way towards facilitating the operations attempted in the smelting works, where it is often expected that carbonates, sulphides, chlorides, and oxides should each and all yield to the same treatment.

The following papers were contributed by Mr. J. B. Kirkland, Assistant Lecturer and Demonstrator of Chemistry, University of Melbourne :—(1) "Notes on the Electrolysis of Fused Salts of Organic Basis"; (2) "Occurrence of the New Elements Gallium and Indium in a Blende from Peelwood, New South Wales"; (3) "Notes on the Volatility of Magnesium"; (4) "Lecture Experiment on Gaseous Diffusion." A paper on "The Analysis of the Cavendish banana (*Musa Cavendishii*) in Relation to its Value as a Food," by W. M. Doherty, was also read. Profs. Liversidge, Jackson, the President, Messrs. Clemes, Wilsmore, and Taylor took part in an interesting discussion that followed the reading of these papers.

Papers were contributed by Mr. W. M. Hamlet on "The Oleo-refractometer in Organic Analysis"; by Mr. A. H. Jackson on "The Analysis of Storage Battery Plates"; by Mr. A. J. Sachs on "The Jarvis Field Mineral Waters of Picton, New South Wales"; and by Mr. Mingaye on "Some Mineral Waters of New South Wales."

Mr. A. Liversidge, F.R.S., Professor of Chemistry, University of Sydney, read a paper on "The Rusting of Iron." It was usually stated in books upon chemistry, he said, that iron rust consisted of the hydrated sesquioxide of iron; but on examining a very large number of specimens of rust from very many different places, and from iron articles of various kinds, and formed under very varied conditions, he found that in almost every instance the rust contained more or less magnetic oxide; in fact, in some cases the rust, although presenting the usual "rust brown" colour and appearance, was, when powdered, practically wholly attracted by the magnet. The specimens which first drew his attention to the subject were some large scales of rust obtained from the rails of an old tramway at Clifden Springs, in Victoria, and he was led to collect and examine these on account of their resemblance to the crust so often present on metallic meteorites. On crushing this rust in a porcelain mortar and testing it with a magnet, it was found to be practically wholly attracted, the small quantity of iron magnetic oxide present being mechanically inclosed, lifted and removed by the magnetic particles (in consequence of the magnetic particles being joined end to end, parallel to the lines of magnetic force and forming a mesh-work inclosing the non-magnetic matter); but by repeatedly applying the magnet, and especially under water, the magnetic powder was fairly-well separated from the non-magnetic powder. Bright iron wire, plates, rods, nails, &c., were artificially rusted in many ways with free access of oxygen, and in almost every instance a large amount of magnetic oxide was formed.

Prof. Liversidge also read a paper on "The Presence of Magnetite in Certain Minerals."

Some notes on the analysis of water from Lake Corangamite were given by Mr. A. W. Craig and Mr. N. T. M. Wilsmore. Notes on a "Natural Bone Ash," from Narracoorte, South Australia, were given by Mr. N. T. M. Wilsmore (Melbourne University). This was an account of a fossil guano which might be successfully used for making cupels for silver assays, &c. Other papers read were "Minerals of East Gippsland," by Mr. Donald Clark; and "Notes on the Exudations yielded by some Australian species of Pittosporum," by Mr. J. Marden. A Committee was appointed to make a complete census of the minerals of Tasmania for the next meeting of the Association.

SECTION C.

GEOLOGY AND PALÆONTOLOGY.

Prof. T. W. E. David, of Sydney University, President of this Section, delivered an address on volcanic action in Eastern Australia and Tasmania, with special reference to the relation of volcanic activity to oscillations of the earth's crust, and to heavy sedimentation. The evidences of volcanic action in past geological time in East Australia and in Tasmania were reviewed historically, commencing with the oldest known lavas—the Snowy River porphyries—and concluding with the most recent—those of Tower Hill, near Warrnambool, in Victoria. The geological age of the former has been established as being lower Devonian, whereas the occurrence of the skeleton of a dingo under beds of volcanic tuff at the latter locality shows that those volcanic rocks are of recent geological age. Special reference was made to the vast development of contemporaneous lavas and tuffs in the Upper Palæozoic coal-fields of New South Wales, at Raymond Terrace, near Maitland, and at Kiama, in the Illawarra coal-field. Proofs were adduced to show that the lavas and tuffs at the latter locality were erupted prior to the deposition of the Bulli coal-measures, as marine fossil shells of Permo-Carboniferous age have been found in the volcanic tuffs of that series. The great plateau of diabasic greenstone, which occupies so large an area in the south-eastern portion of Tasmania, was considered by the author to be probably of later origin than the Mesozoic coal-measures of Fingal, Jerusalem, &c., and then the Palæozoic coal-measures of the Mersey coal-field. The greenstone forming the upper portion of Mount Wellington was, in the author's opinion, of later origin than the New Town coal-measures near Hobart. He considered the greenstone to be a variety probably of gabbro, which had burst through the marine mudstones and overlying coal-measures in the neighbourhood of Hobart in the shape of broad dykes and vosses, and which had spread over the top of the measures in the form of a thick broad capping. If this view were correct, there would be underneath the tiers of greenstone large areas of coal-measures which might contain workable seams of coal, undamaged by the overlying greenstone. A brief description having been given of the basaltic lavas of Tertiary age in Australia and Tasmania, the relation of the various manifestations of volcanic activity to oscillations of the earth's crust and to heavy sedimentation was next examined. The evidence collected by Australian and Tasmanian geologists showed that volcanic action had taken place most frequently after periods of prolonged subsidence had culminated in a compensating re-elevation of the land. Instances were cited to prove that in many cases the subsidence which preceded volcanic outbursts was directly due to the local loading of the earth's crust with thick masses of sediment, the weight of which bulged the earth's crust downwards, displacing in the process the lighter granitic magma which is considered to immediately underlie the earth's crust, and bringing the under surface of the crust in proximity to the heavier basic magma. This was suggested as an explanation of the fact that the products of volcanic action from such areas of subsidence were usually basalts rather than rhyolites or obsidians, both of which last are derived from the granitic magma.

Mr. W. J. Clunies Ross read a paper entitled "Remarks on Coral Reefs." Mr. W. J. C. Ross read a paper "On the Discovery of two Specimens of Fossil Lepidodendrons in the Neighbourhood of Bathurst, New South Wales, and the Inferences to be drawn from their Occurrence." One specimen was from the gravel of the Macquarie River, but its source was too uncertain to be of much value. The other specimen, although not actually found by the writer *in situ*, was received by him from the finder, who was able to point out the exact place from which it was obtained. This was about ten miles to the east of Bathurst, in some one of a series of beds of grit and quartzite forming the sides of a short valley, at the head of which there was a succession of three waterfalls over hard bands of quartzite, the uppermost fall being over a massive conglomerate. The grit bands contained abundant casts of Brachiopods, Spirifer, and Rhynconella, and the whole series of beds was coloured on the geological sketch map of the colony as Silurian. The late Mr. Wilkinson, however, classed the beds as Siluro-Devonian; and a very similar series at Rydal on the Western Railway Line was mapped by him as Devonian. Rydal was at least sixteen miles in a straight line from the locality at which the fossil was found. Near Rydal there were beds containing a Lepidodendron considered by Dr. Feistmantel and Mr. Carruthers as *Lepidodendron nothum*, and to be of Devonian age. Mr. R. Etheridge, Jun., however, questioned the identification of the species, and seemed to think it was *Lepidodendron australe*, McCoy, which was generally considered to be Lower Carboniferous. It was pointed out that the fossil now found was almost certainly derived from the grit beds containing Devonian Brachiopods, and was probably of that age. If it were taken as Carboniferous, then a rearrangement of the generally received geology of a large part of New South Wales would be necessary. As bearing on the probable Devonian age of the fossil, attention was called to the fact that in the Lower Carboniferous beds of Strand, N.S.W., there were two species of Lepidodendron, viz. *L. Veltheimianum* and *L. Volkmannianum*. The fossil in question did not resemble either of these forms, but appeared to be either *L. nothum* or *L. australe*, and, whichever it was, it was likely to be older than the Strand beds, and therefore can hardly be younger than Devonian. The specimens in question were exhibited, and the opinion of geologists desired on the questions raised.

Mr. J. H. Harvey discussed "The Application of Photography to Geological Work." He urged the desirability of having a photographer attached to every Geological Survey, and the importance of conducting the photography of the various surveys in a systematic and uniform manner. He submitted a scheme in connection with the same, which, without a great increase in the present expense, would, he considered, vastly increase the value of the survey.

Among the remaining papers were the following: "Sample of Cone-in-cone Structure found at Picton, New South Wales," by Mr. A. J. Sachs; "Notes on the Permo-Carboniferous Volcanic Rocks of New South Wales," by Prof. T. W. E. David; "Notes on the Advantages of a Federal School of Mines for Australasia," by Mr. J. Provis.

SECTION D.

BIOLOGY.

Prof. W. Baldwin Spencer, of the Melbourne University dealt in his presidential address with the fresh-water and terrestrial fauna of Tasmania. He described the various species found in Tasmania, and the distribution of these in other parts of Australia, showing that, in such forms as the fresh-water fish, reptiles, and amphibia, those found in Tasmania and some in Victoria were very closely allied. He dealt with the original introduction of the ancestors of the present animals of Australia, and the way in which the descendants of these had become distributed over the various parts, including Tasmania.

Prof. Hutton, of Christchurch, New Zealand, read a paper on "The Origin of the Struthious Birds of Australasia." The struthious birds—that was, the ostriches, emus, cassowaries, and kiwis—were confined to the southern hemisphere, except the African ostrich, which ranged into Arabia, and they were supposed to have originated in the northern hemisphere and migrated southwards. But by this hypothesis there were great difficulties in explaining how the struthious birds reached Australia and New Zealand without being accompanied by placental mammals. Also the struthious birds of New Zealand, including the lately extinct moas, were smaller, and make a nearer approach to the flying birds, from which the struthious birds were descended, than did any of the others, and they should expect to find the least altered forms near the place of origin. The tinamus of Central and South America, although flying birds, resembled the New Zealand struthious birds in several particulars; and as a former connection between New Zealand aud South America was shown by the plants, the frogs, and the land shells, it seemed more probable that the struthious birds of Australasia originated in the neighbourhood of New Zealand from flying birds related to the tinamus, and that they spread from thence into Australia and New Guinea, rather than that they should have migrated southwards from Asia. Probably the ostriches of Africa and South America have a different line of descent from the struthious birds of Australasia, and might have originated from swimming birds in the northern hemisphere.

Prof. Spencer read a paper "On the Habits of Ceratodus, the Lung Fish of Queensland." This fish, he stated, lives only in the Burnett and Mary Rivers in Queensland, and belongs to a small group which may be regarded as intermediate between fishes on the one hand and amphibia on the other. The swimming bladder present in ordinary fishes has become modified so that it functions as a lung. In Africa, Protopterus, a form closely allied to Ceratodus, makes for itself a cocoon of mud, in which during the hot, dry season it lives and can breathe by means of its lung. The Ceratodus, however, does not appear to do this, and probably never leaves the water. It comes continually to the surface, and passes out and takes in air, making a faint spouting noise. The author suggested that the lung was of the greatest service to the animal, not during the hot, but during the wet season, when the rivers were flooded, and the water thick with the sand brought down from the surrounding country. With regard to its food, Ceratodus appeared to be herbivorous, feeding, at all events largely, on vegetable matter, such as the seeds of gum-trees which tumble into the water.

Papers were contributed by Mr. F. M. Bailey, Government Botanist of Queensland, on "Queensland Fungus Blights"; by Colonel W. V. Legge on "The Geographical Distribution of Australian Limicolæ"; by Mr. John Shirley on "A Rearrangement of the Queensland Lichens"; and by Mr. A. F. Robin on "The Preservation of Native Plants and Animals."

Mr. W. A. Weymouth contributed a classified list of Tasmanian mosses, based on Hooker's "Flora of Tasmania" 1853–59), Mitten's "Australian Mosses" (1882), Bastow's "Mosses of Tasmania" (1886), and his own collections (1887–91), as determined by European specialists.

SECTION E.

GEOGRAPHY.

Captain Pasco, R.N., President of the Section, referred in his opening address to early discoveries in Australia. The exploration of the island of Tasmania, and the opening up of its varied resources, were begun by Sir John Franklin. He might be recognized as the founder of the Royal Society of Tasmania, and distinguished himself in 1842 by crossing the island from New Norfolk to Macquarie Harbour. Half a century ago Australia was considered to be a vast desert, containing possibly an inland sea, but Stuart, McDowall, Gregory, Forest, Giles, and others had dissipated that idea by exploring the continent from one side to the other. He further dealt with the tides and currents of the ocean, and their effects generally upon the earth, the temperature and saltness of sea-water, and the direction and force of the currents and times of high and low water. He concluded by saying there was still a considerable area of this globe to be subdued and peaceable dominion obtained within the Antarctic Circle. Though Sir James Ross unfurled the British banner on an island contiguous to the continent or extensive archipelago (as the case might be), yet almost a blank upon the map awaited the enterprise of the Anglo-Saxons located in the southern hemisphere to emulate their forefathers in the north by opening up the frozen zone.

Mr. James M. Clymont, Koonya, Tasmania, read a paper on "The Influence of Spanish and Portuguese Discoveries during the First Twenty Years of the Sixteenth Century on the Theory of an Antipodal Southern Continent." Mr. D. Murray gave an account of Mr. Lindsay's expedition in Western Australia under the auspices of Sir Thos. Elder, giving extracts from his despatches, narrating the journey from Fort Mueller to Queen Victoria Springs, and thence to the Frazer Ranges. Want of water had been a great and unexpected difficulty. There seemed to have been a complete drought for at least a year over this part of the continent. In the discussion ensuing, the question of artesian wells was raised, and Mr. Murray explained that while some of these wells in South Australia were unfit for irrigation purposes, owing to the superabundance of salts of soda, yet they were good enough for stock, &c., and that both further north and further east over large areas the wells gave water suitable for all purposes.

Papers were contributed by Dr. Frazer, on "Volcanic Phenomena in Samoa in 1886"; by the Rev. J. B. W. Woollnough, on "Iceland and the Icelander"; by Captain Moore, R.N., on "A Magnetic Shoal near Cossack, W.A."; and by Mr. A. C. Macdonald, on "The Life and Works of Sir John Franklin."

An elaborate and valuable paper on "Recent Explorations and Discoveries in British New Guinea," was read by Mr. J. P. Thomson. Referring to the natives, Mr. Thomson spoke of their numerous tribal divisions, and of the almost correspondingly different languages or dialects spoken by them. Even in localities separated by only a few miles, the dialects spoken differ the one from the other in some cases considerably. The Motu, which is the language spoken and taught by the missionaries at Port Moresby, is understood over a considerable area, both east and west of that place, but outside that neighbourhood changes and variations occur, so that at the head of the Great Papuan Gulf, and in the Fly Basin, the Motu language is a foreign tongue. The same applies to the eastern end, and to the islands adjacent thereto, where the philological variations are numerous and conflicting. While in the one case the people met with in the highland zones of the Owen Stanley Range spoke a dialect akin to that of the Papuan, those encountered on the Upper Fly River expressed themselves in a tongue, every word of which apparently differed from that spoken by the tribes of the lower regions, and from that spoken by any known coastal community, notwithstanding that the people themselves exhibited no evidence of possessing distinctive characteristics of race, the only marked contrast being in lightness of colour. In the western division the same diversity of speech is met with, where neighbouring tribes are unable to hold intercourse one with the other, even if friendly, by reason of incompatibility of language. No doubt this may in some measure be accounted for by local environment; constant civil intertribal war being the means of isolating communities, so that no friendly intercourse is held, by reason of which, together with other attendant causes, an incongruity of language may have unknowingly been established. With reference to geology, Mr. Thomson said it was somewhat remarkable that the general geological features of British Papua are in a very considerable degree identical in character with those of Australia, several specimens being coincident with those of the Silurian series from gold-fields in New South Wales, while some of the fossiliferous rocks were obtained from beds of clay similar to those at Geelong and Cape Otway in Victoria. Mineral areas of great value might yet await discovery by the penetrating eyes of British pluck and enterprise in Papua.

SECTION F.

ECONOMICS AND SOCIAL SCIENCE AND STATISTICS.

Mr. R. Teece, President, chose for the subject of his opening address, "The New Theory of the Relation of Profit and Wages." Papers were contributed by Mr. Alfred de Lissa, Sydney, on "The Organization of Industry"; by the Hon. N. J. Brown, Tasmania, on "The Incidence of Taxation"; by Mr. H. H. Hayter, Government Statistician, Victoria, on "Disturbance of Population Estimates by Defective Records"; by Mr. A. J. Ogilvy, on "Is Capital the Result of Abstinence?"; by Mrs. A. Morton, Tasmania, on "The Past Attitude of Capital towards Labour, and the Present Attitude of Labour towards Capital"; by Mr. T. A. Coghlan, Government Statistician, N.S.W., on "The Wealth of Australasia"; by Mr. A. J. Taylor, Hobart, on "The Value of Labour in relation to the Production of Wealth regarded from the Standpoint of a Physicist"; and by Mr. E. P. Nesbit, South Australia, on "Insanity and Crime."

SECTION G.

ANTHROPOLOGY.

The Rev. Lorimer Fison, President, said in the course of his opening address that in anthropological study the two main things required were first a patient continuance in collecting facts, and second the faculty of seeing in them what is seen by the natives themselves. But the natural tendency to form a theory as soon as a fact was seized, and looking at facts in savagery from the mental standpoint of civilized man, would lead investigators into fatal mistakes. The best way to gain information was to live with the natives, learn their language, and gain their confidence, or get information from the men living amongst them. References to aborigines, their manners and customs, in books, might be collected and classified by many readers, and thus facilitate investigation. In conclusion he dwelt upon the magnificent and all but untrodden field afforded by British New Guinea and its outlying groups of islands; and two extremely valuable books—the Rev. Dr. Codrington's on "The Melanesian Tribes," and "The Maori Polynesian Comparative Dictionary," by Mr. Edward Tregear, of New Zealand—were recommended for study.

The Rev. Dr. Gill, who has spent thirty-three years as a missionary in the Hervey Islands, read papers on "The Story of Tie and Rie" and "The Omens of Pregnancy," the latter having reference to superstitions still current in the island of Mangaia.

A paper on "New Britain and its People" was read by the Rev. B. Danks. According to the author, the bush people differ very much from the coast tribes, the latter being evidently invaders and conquerors.

Some interesting details as to "Sydney Natives Fifty Years ago," were given by the Rev. W. B. Clarke. Among other papers were the following: "Group Marriage and Relationship" and "The Nair Polyandry and the Dieri-Dieri Pirauru," by the Rev. L. Fison; "The Samoa and Loyalty Islands," by the Rev. S. Ella; "The Cave Paintings of Australia," by the Rev. J. Matthew; "The New Hebrides," by the Rev. D. Macdonald; "The Origin of the Sense of Duty," by Mr. Alex. Sutherland; "Notes on the Taunese," by the Rev. W. Gray.

SECTION H.

SANITARY SCIENCE AND HYGIENE.

Prof. W. H. Warren, of the University of Sydney, gave in his presidential address a sketch of sanitary engineering from its earliest days, and then proceeded to discuss the various schemes which have been proposed for disposing of the sewerage of towns.

Dr. James read a paper on "Cremation as a Step in Sanitary Reform." Papers were also contributed by Dr. E. O. Giblin, on "The Etiology of Typhoid"; by Miss Violet Mackenzie, on "Physical Education and Exercise in Schools"; by Dr. Barnard, on "Infection in Disease"; and by Dr. A. Moulton, on "Sewerage of a Seaside City."

SECTION I.

LITERATURE AND FINE ARTS.

This Section, although it assembled for the last time at the Hobart meeting, proved to be very popular. The President, Prof. Morris, of the University of Melbourne, referred in his opening address to the subject of Universities in Australia. He urged that it was not wise to multiply Universities. "In this matter," he said, "the law of supply and demand cannot be trusted, if it ever can be in the matter of education; and the Legislatures should be very careful not to permit the promiscuous conferring of degrees. Let them increase teaching facilities as much as generosity may make possible; do not lower the standard, as at least in the higher education competition does. In America there are five or six degree-giving Universities to every million inhabitants, and a degree by itself has no value. If Australia were one country, as it ought to be, two Universities would probably be quite enough, or, better still, even one, but it would need to be arranged somewhat on the pattern of the University of New Zealand, with teaching bodies in different places, but one uniform standard of examination for each degree. This would lead to emulation between the different teaching Colleges, and would surely have happy results. Unfortunately Australia is not one, and at present it looks as if, in spite of the wishes of the people, our absurd divisions were likely to continue. Yet it is worth consideration whether the Universities might not agree upon a common standard, and arrange that the courses in the Universities of the different colonies should be parallel and homogeneous. Educated men should be the first to show that the day of discord is over, and to welcome the arrival of unity and co-operation."

Among the contributions to the proceedings of this Section were papers on "Elementary Science in Primary Schools," by Mr. James Rule, senior inspector of schools, Tasmania; "Secondary Education in Australia," by Mr. Percy A. Robin; and "The Rationale of Examinations," by Mr. F. J. Young. A Committee was formed to establish a Home Reading Union for Australia.

SECTION J.

ENGINEERING AND ARCHITECTURE.

Mr. C. Napier Bell, President, referred in his opening address to sanitary engineering. In Australia, he said, the best attention of engineers should be devoted to sanitary engineering; first, to cleanse the towns, and second, to save the sewage to irrigate the land. On this subject Australian engineers should pause before copying the practice of Europe, which, enjoying an abundant rainfall, has never felt the same necessity for irrigation, and has had abundant stores of fossil manure to draw upon. Water irrigation was even more important, and he foresaw for engineers a noble task in providing irrigation for Australia. After dealing with the irrigation works of the older countries, he touched upon the importance of mining and electrical engineering. Then he remarked the neglect of warming and ventilation by architects and engineers, and argued that in the climate of Australia the art of cooling must certainly become as important as that of heating. In conclusion, he explained the necessity for sound theoretical and scientific knowledge in the engineer, and said that if the people of the colonies would entertain the honourable ambition, once more popular than now, of being remembered to the distant ages of the future, they must emulate those mighty peoples of the past who left imperishable records of their life in the ruins of their vast public works.

Among the papers read in this Section was one by Mr. Edward Dobson, on "The Evidence for the Prevalence of Human Habitations in Prehistoric Times." It was devoted to showing that, whilst rectangular forms prevailed in the early buildings of the East and in North America, the circular form had prevailed through Africa (with the exception of the Nile Valley) and through Switzerland and Northern Europe, in

Lapland and Greenland, and inquiry was raised as to the causes of these facts.

Mr. A. North read a paper on "The Truthful Treatment of Brickwork."

At the closing meeting of the Council, on February 14, the following general officers were appointed:—Treasurer, Mr. H. C. Russell, Sydney; Secretary for Tasmania, Mr. A. Morton; for New Zealand, Prof. Packer, Prof. Thomas, and Mr. D. B. Brandon; for Victoria, Mr. A. H. S. Lucas; for Queensland, Mr. J. Shirley.

THE DRAPER CATALOGUE OF STELLAR SPECTRA.

THE Observatory of Harvard College has played a prominent part in the development of astronomical photography. It was here, on July 17, 1850, that Prof. Bond obtained the first photographic image of a star, and from that time forward much important work has been accomplished, culminating in the Draper Catalogue of the photographic spectra of 10,347 stars. The progress of this latter branch of astronomical work has been but slow, and it is a remarkable fact that its extraordinary development during the last few years has followed from the revival by Prof. Pickering of the method of observation first employed by Fraunhofer in 1824. Accounts of the progress of the work have been published from time to time, and have been noticed in our columns. A complete account of the "Preparation and Discussion of the Draper Catalogue," which has recently been issued, forms vol. xxvi., part i., of the *Annals of the Astronomical Observatory of Harvard College.*

The earlier attempts to photograph the spectra of the stars were made with spectroscopes having slits, although, from the time of Fraunhofer, it was recognized that a slit was not an essential part of a stellar spectroscope. In 1863, Dr. Huggins succeeded in photographing the spectrum of Sirius, but none of the characteristic lines were visible. In 1872 Dr. Henry Draper, to whose labours in the field of astronomical photography the Draper Catalogue forms a fitting memorial, succeeded in obtaining a photograph showing four lines in the spectrum of Vega. Dr. Huggins again took up the work, and since 1879 has obtained a considerable number of photographs, none of which, however, appear to show anything approaching the amount of detail now obtainable. In all these attempts the spectroscope was attached to the eye end of the telescope, so that the image of the star was formed on the slit, a cylindrical lens being interposed in order to give width to the spectrum.

In the method which has been so pre-eminently successful, the slit and collimator, which form an essential part of an ordinary spectroscope, are dispensed with, the rays from a star already possessing the necessary parallelism and its image being almost a perfect slit without length. It is only necessary, therefore, to fix a prism in front of the objective of a telescope, and to introduce some means of widening the spectrum, to obtain a complete stellar spectroscope. For eye observations the necessary width is obtained by the use of a cylindrical lens in conjunction with the eye-piece of the telescope. For photographic work, the prisms are so arranged that the spectrum lies along a meridian, and it is then only necessary to allow the driving clock to be slightly in error to obtain a widened spectrum. The clock error must of course vary according to the magnitude and declination of the star.

The great advantage of the "slitless spectroscope" depends upon the fact that every scrap of light passing through the object-glass is utilized; with the ordinary spectroscope it will seldom happen that all the light passes through the slit, and it is further reduced by absorption in the lenses and prisms of the spectroscope. Further, on account of the large focal length of the telescopes employed, a high dispersion is obtained even with a prism of small angle; and a large number of spectra can be photographed at a single exposure. Prof. Pickering has photographed the spectra of as many as 260 stars on the same plate, and the labour involved in the construction of the Draper Catalogue has thus been enormously reduced. Indeed, the whole of the 10,347 spectra were photographed on 585 plates. The improvement in photographic processes has undoubtedly done much to facilitate the work, but it is lamentable that the "wholesale" method was not applied twenty years ago, for even with the less perfect processes then in vogue, our knowledge would have been much advanced.

An important feature of Prof. Pickering's work is the method of enlargement of the negatives, which renders the fainter lines clearly visible. "The negative is covered by a diaphragm, having a slit in it which is made to coincide with the spectrum. An image is then formed by an enlarging lens in the usual way. A cylindrical lens is next interposed near the enlarging lens, with its axis perpendicular to the lines in the spectrum. The width of the latter may thus be increased indefinitely without changing the length. In the case of faint stars very narrow spectra only can be obtained. Their energy is so feeble that they are capable of decomposing the silver particles only if allowed to fall upon them for a long time. In the enlargement the energy of the sun is substituted for that of the star, and thus an indefinite number of silver particles may be decomposed." (Introduction, p. xix.) The original negative may, perhaps, be compared to a "relay" in electrical apparatus.

The preparation of the Draper Catalogue involved five different steps, which are thus stated on p. 74:—

I. Measurement of the spectra on each plate, including the determination of their positions, intensities, and the classes to which they belong.

II. Identification of each spectrum with that of a star in the Durchmusterung or other catalogue.

III. Reduction of the measures of brightness to the scale of the Harvard Photometry.

IV. Catalogues of plates.

V. Preparation of the final catalogue, bringing forward the places of all the stars to 1900, including various methods of checking and correcting the results.

That a catalogue of spectra may be of service to astronomers, a sound system of classification is essential, and this, as far as possible, should have some reference to chemical or physical constitution. The notable classifications which were suggested by eye observations were those of Secchi, Vogel, and Lockyer, but it is not surprising to find that the greater detail shown on the photographic plates requires modifications of these in order that all the spectra may be included. A detailed but somewhat arbitrary classification has been adopted by Prof. Pickering, the chief merit of which is that it readily lends itself to translation into other systems. Varieties of Secchi's first type are indicated by the letters A, B, C, D, those of the second type by the letters E to L, of the third type by M, and of the fourth type by N; bright line stars are referred to as O, planetary nebulæ as P, and other spectra as Q. Of the varieties of the first type, A includes all the stars with spectra similar to Sirius, and B those with spectra of the Rigel type, in which, in addition to lines of hydrogen, there is a small number of strong lines of which the origins are at present unknown.

Results of special interest, such as the discovery of bright lines in the spectra of variable stars of long period, have already been referred to in NATURE, and we shall now confine ourselves to the more general results. As some of the most interesting spectra belong to stars of small magnitude, it is necessary to be very guarded in making generalizations. Still, the fact that Prof. Pickering's researches have extended in some cases to stars of the ninth and tenth magnitude perhaps justifies the assumption that all types of spectra are now included. We cannot do better than let Prof. Pickering speak for himself.

"The general conclusion derived from the study of these spectra, is the marked similarity in constitution of the different stars. A large part of them—those of the first type—have a spectrum which at first sight seems to be continuous, except that it is traversed by broad dark bands due to hydrogen. Closer inspection shows that the K line is also present as a fine dark line. If the dispersion is large and the definition good, many more dark lines are visible, as stated above. These lines may be divided into two classes—first, those which predominate in many stars in the Milky Way, especially in the constellation of Orion; and, second, those present in the solar spectrum. Nearly all the brighter stars may be arranged in a series, beginning with those in Orion, in which the auxiliary lines are nearly as intense as those due to hydrogen. Other stars may be found, in which these lines successively become fainter and fainter, until they have nearly disappeared. The more marked solar lines then appear, become stronger and stronger, and the hydrogen lines fainter, until they gradually merge into a spectrum identical with that of the sun. At least, several hundred lines appear to be identical, and no differences can be detected. Continuing the sequence, the spectra pass gradually into those of the third type. Certain bands become more marked, and the spectra of the third type may be divided into four classes. In the fourth of these classes the hydrogen lines are bright instead of dark. This spectrum seems to be characteristic of the variable stars of long period when near their maximum. As stated above, it has led to the detection of several new variable stars, and has been confirmed in many of the known variables. Slight peculiarities are noticed in the spectra of many stars, so that they cannot be arranged in an exact sequence; but these deviations are not sufficient to affect the general law. The number of stars not included in the above classification is very small. A few stars like γ Cassiopeiæ, β Lyræ, and δ Centauri resemble the stars of the Orion type, but some of the lines are bright instead of dark. Stars of the fourth type, whose spectra appear to be identical with that of carbon, are not included in the above classification. Other stars, whose spectra consist mainly of bright lines, like those of the planetary nebulæ, may be included with them in a fifth class. It also appears that the position of the lines in both cases is probably identical with that of corresponding lines in stars of the Orion type." (Introduction, p. xvii.)

It would be difficult to find fault with the masterly way in which Prof. Pickering and his assistants have done their work. Our chief source of complaint, which no doubt arises more from impatience than anything else, is the lack of detail with regard to the spectra themselves. For investigations to which such a work as the Draper Catalogue should naturally lead, a mere estimation of the type of spectrum serves for little more than a determination of the relative numbers and distribution of the spectra of the various types. For the present, however, this is practically all that Prof. Pickering tells us. We are left quite in the dark, for instance, as to what is actually seen in the photographs of the spectra of stars of Secchi's fourth type, although we are informed that the photographic spectra are as characteristic as the visual. It would be interesting too, to know the differences in the sub-divisions of Secchi's third type.

All stars north of − 20° of the fourth magnitude and brighter have been photographed on a large scale with the 11-inch refractor, and a discussion of these will occupy a subsequent volume of the "Annals." This will be awaited with interest by all who are engaged in researches in astronomical physics.

We are delighted to find that the work of the Henry Draper Memorial is to be extended beyond the mere routine of photographing stellar spectra. "A broader field has been assigned to the Henry Draper Memorial by Mrs. Draper than was at first proposed. Instead of confining its work to the study of the spectra of the stars, their physical properties in general will be investigated. The liberal support given to it should give yet more striking results in the future than have hitherto been attained." (Introduction, p. xxiv.)

Laboratory work has already been commenced, and to aid the study of spectra in the electric arc, a 10-h.p. dynamo has been generously presented by the Edison Electric Co.

In the final chapter the Draper Catalogue is discussed with reference to the visual observations of Vogel and Konkoly. A similar comparison has already been given in NATURE, vol. xliv. p. 133, by Mr. Espin, and we need not further refer to it. We regret to find, however, that a discussion of the photographic spectra in relation to the new classification suggested by Mr. Lockyer has not been included.

It will be a source of gratification to Mr. Lockyer to find that his suggestion that stars of the Wolf-Rayet type are the first results of nebulous condensations is fully confirmed by Prof. Pickering's work. Their spectra greatly resemble those of the planetary nebulæ, the chief difference being that the characteristic nebula line near wave-length 500 is absent. This, Mr. Lockyer explains, is due to increased temperature, and this view is strengthened by the fact that the line was seen only during the later stages of the visibility of Nova Cygni. Nebulæ and bright line stars form Group I. of his classification.

So far, this is the chief point where the Draper Catalogue throws any additional light on Mr. Lockyer's views, and further discussion must be reserved until more details of the spectra are published.

The "distribution of spectra" forms the subject of chapter vii., and we gather that the stars down to magnitude 6·25 are distributed as follows among the different classes of spectra:—

Class A ...	0·61	Class K ...	0·18
,, B ...	0·02	,, M ...	0·013
,, F ...	0·12	"Peculiar" ...	0·007
,, G ...	0·05		

"According to Secchi's classification, placing Classes A, B, and F in the first type, G and K in the second, and M in the third, we have of the first type 0·75, of the second 0·23, of the third 0·01, peculiar 0·01" (p. 151).

To study the distribution in space, the sky was divided into 48 zones, and the results are thus summarised on p. 152. "It appears that the number of stars of the second and third type is nearly the same in the Milky Way as in other parts of the sky. Considering, therefore, only the stars whose spectra resemble that of our sun, we should find them nearly equally distributed in the sky. The stars of Class A, on the other hand, are twice as numerous in Region M (through which the Milky Way passes) as in Region N (an equal area away from the Milky Way), and in the case of Class B this ratio exceeds four. The Milky Way is therefore due to an aggregation of stars of the first type, a class to which our sun seems to bear no resemblance as regards its spectrum. Spectra of Class B seem to conform still more closely to the region of the Milky Way, although probably they are not sufficiently numerous to materially affect its light. The Milky Way must therefore be described as a distinct cluster of stars to which, from its composition or age, the sun does not seem to belong."

The statement that the sun bears no resemblance to stars like those which chiefly constitute the Milky Way is not quite so precise as it might be. The lines in the spectra, so far as we know them, indicate the same substances in each, and the tendency of evidence is to show that the sun is a type of what the stars of the Milky Way will become.

Not the least interesting part of the researches connected with the formation of the Draper Catalogue is that dealing with the determination of photographic magnitudes. Elaborate investigations have been carried out by Prof. Pickering with his usual skill and care, and we hope to refer to them in some detail on another occasion.

No satisfactory method of applying the slitless spectroscope to the determination of velocities in the line of sight, except in the special case of a spectroscopic binary, has yet been devised, and this branch of research must therefore be carried out in the usual way.

A. FOWLER.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—We regret to notice that the Savilian Professor of Geometry (J. J. Sylvester, Hon. D.C.L.), has had to apply for leave of absence and dispensation from the performance of statutory duties on account of ill-health. Mr. J. Griffiths, Fellow and Tutor of Jesus College, will lecture on the "Recent Geometry of the Circle and Triangle" for the Professor.

At a meeting of the Hebdomadal Council, Rev. W. Inge, Provost of Worcester College, and Rev. W. W. Jackson, Rector of Exeter College, were elected to be members of the Delegacy for the Training of Teachers under the provisions of the Statute approved by Convocation, November 24, 1891; and in a Congregation holden February 23, Joseph Wells, Fellow of Wadham College, and George R. Scott, Fellow of Merton College, were likewise elected members of the same Delegacy.

In a Convocation holden on March 1, Mr. Henry Balfour, Trinity College, was appointed Curator of the Pitt-Rivers Museum, to hold office until December 31, 1898, and during that period to enjoy the same status in regard to the University Museum as the Professors teaching in the Museum, and to receive a stipend of £200 a year from January 1, 1892. The Curators of the University Chest were authorized to expend a sum not exceeding £150 a year from January 1, 1892, for seven years, on assistance and current expenses in the Pitt-Rivers Museum.

CAMBRIDGE.—Mrs. Phillipps offers to the University a sum of £2000 to found an "Arnold Gerstenberg Scholarship" in memory of her brother. The Scholarship is to be held by men or women who have passed the examination for the Natural Sciences Tripos, and intend to pursue the study of mental and moral philosophy.

A grant of £40 has been made to H. Kynaston, B.A. of King's, from the Worts Fund, to enable him to investigate the geology of the Eastern Alps in the ensuing summer.

Prof. Foster is appointed an Elector to the Downing Professorship of Medicine, to the Professorship of Zoology, and to the Professorship of Botany; Prof. Dewar an Elector to the Professorship of Chemistry; Prof. Liveing an Elector to the Jacksonian Professorship; Prof. G. H. Darwin an Elector to the Cavendish Professorship of Physics; Prof. Sir G. G. Stokes an Elector to the Professorship of Mineralogy; Dr. J. Hopkinson an Elector to the Professorship of Mechanism and Applied Mechanics; Prof. Ray Lankester an Elector to the Professorship of Zoology; Mr. W. H. Hudleston to the Woodwardian Professorship of Geology; and Dr. Gaskell an Elector to the Professorship of Physiology.

At the Congregation on February 25, graces for the establishment of two lectureships in Agricultural Science, one of which should be held by a Director of Agricultural Studies, were rejected by 103 votes to 91. A grace for the appointment of a Syndicate to consider the question of degrees in science was rejected by 154 votes to 105. The latter was opposed by a number of the teachers in natural science, as tending to place their students in a position of isolation, and perhaps of inferiority, as compared with others.

The Rev. W. M. Campion, D.D., Fourth Wrangler in the Mathematical Tripos of 1849, and formerly an Examiner for the Mathematical and Moral Sciences Tripos, was on February 23 unanimously elected President of Queen's College, in succession to the late Dr. G. Phillips.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 25.—"Note on the New Star in Auriga." By J. Norman Lockyer, F.R.S.

Since my note of February 11, observations of the new star have only been possible at Kensington on seven evenings—namely, February 11, 12, 13, 16, 22, 23, and 24. The 13th and 22nd were the only two very fine nights.

The star now appears to be fading. In the photograph of the region taken on February 3, the Nova appeared to be brighter than χ Aurigæ (magnitude 5·0), but in that taken on February 23 it is not brighter than the companion to this star, which is fainter than sixth magnitude. No marked diminution in brightness was noticed before February 22.

The colour has not appreciably changed since the star was first observed.

Photographs of the spectrum were attempted on all the dates named. Those of February 11, 12, 16, and 23, however, were insufficiently exposed, but they show that the dark lines were still more refrangible than the accompanying bright ones, and that the same lines were present as in the previous photographs. A plate was exposed for 2 hours 35 minutes on February 24, but no impression was obtained. The photograph taken on February 13 is identical with those referred to in the notes which I have already communicated to the Society. In the three photographs of February 22, there appears to be a slight diminution in the intensity of the H and K lines, but otherwise there is no decided change.

There is no evidence of revolution during the twenty days of observation. In all the photographs the dark lines are more refrangible than the bright ones, and the relative velocity deduced from those of February 3, 7, 13, and 22 appears to be about 600 miles per second. As this only represents the velocity in the line of sight, we are still ignorant of the real velocities of the two bodies. The constant relative velocity indicated by the displacement of the bright and dark lines may be regarded as confirming the supposition that two meteor-swarms or comets have collided, the velocities being so great, and the masses so small, that neither was captured by the other.

The relative velocity of 600 miles per second seems at first sight to be abnormally great, but if we regard each of the component swarms as moving at the rate of 300 miles per second, the velocities are quite comparable with those of other bodies in space. The star 1830 Groombridge, for example, moves at the rate of 200 miles per second across the line of sight, and its real velocity may be much greater.

Eye observations have been made on every available occasion. The chief variation from those previously reported is the general fading of the continuous spectrum, and the consequent unmasking of the lines between *b* and D. Micrometric measures of four new lines in this region were made by Mr. Fowler on February 23 and 24. These, with the other lines observed at Kensington in the region F to C, are shown in the table which follows. The corresponding lines observed in the spectra of new stars which have previously appeared, and those in the spectra of some of the bright-line stars, are added for comparison.

Nova Aurigæ.		Nova Cygni.			Nova Andromedæ.	Nova Coronæ.	γ Argûs.	Arg.-Oeltz. 17681.	Lalande 13412.	1st Cygnus.	2nd Cygnus.	3rd Cygnus.	γ Cassiopeiæ (Sherman).	Suggested origins.
Feb. 23.	Feb. 24.	Cornu.	Vogel.	Copeland.										
656 (C)	656	661	656	656	—	656	—	—	—	—	—	—	—	H (656·2)
635	630	635	630	630	—	—	—	—	—	—	636	636	635	—
589 (D)	—	588	589	589	—	—	590	—	—	—	—	—	—	Na (589·1)
579	579	—	580	577·5	—	—	580·9	581	581	583	581	581	—	Fe (579·0)
—	570	—	—	—	—	—	—	—	—	571	570	569	—	—
566	—	563	564	—	—	—	566	—	—	—	—	564	—	C (563·5)
558	558·3	—	—	—	558	—	—	—	—	558	—	558	556	Mn (557·6)
531	531·5	531	531	—	532	—	—	—	—	—	—	—	531	—
518	517·7	518	—	—	517	—	—	—	—	—	—	517	517	C (516·5) or Mg (517·5)
500·6	500·6	500	499	502	—	501	—	—	—	—	—	—	499	Mg (500·6)
490	490·3	—	490	—	—	—	—	—	—	—	—	—	—	—
486	486·2	483	486	486	486	486	—	—	—	—	—	—	486	H (486·2)

It will be seen that all the lines of Nova Aurigæ have previously been recorded in other Novæ, or in the bright-line stars.

The complete spectrum, including the photographic region, is shown in a diagram (which was exhibited). This, and the light curve of the spectrum from F to C, were drawn by Mr. Fowler and Mr. W. J. Lockyer on February 22, and confirmed by Mr. Fowler on February 23. The 3-foot reflector and McClean spectroscope were employed in each case.

The changes which are taking place in the Nova are exactly what would be expected according to my hypothesis that new stars are produced by the collisions of meteor-swarms. The rapid fading of the star demonstrates that small bodies and not large ones are engaged, and this is further confirmed by the observed diminution in the brightness of the continuous spectrum relatively to the bright lines. If two condensed bodies were in collision, it is evident that the lines would fade first.

Chemical Society, February 4.—Prof. A. Crum Brown, F.R.S., President, in the chair.—The following papers were read:—Pedetic motion in relation to colloidal solutions, by W. Ramsay. The pedetic or Brownian motion of small particles depends (1) on the size of the particles, (2) on their density, and (3) on the nature of the medium in which they are suspended. If an electrolyte be added to a liquid containing such particles in a state of pedetic motion, the movement is soon arrested, owing to the particles touching one another, and cohering to form clots or clusters. If no electrolyte be present, the particles do not tend to touch each other. From microscopic observations, it is calculated that a particle with a mass of $2 \cdot 8 \times 10^{-12}$ grams moves through, approximately, its own diameter, $1 \cdot 4 \times 10^{-4}$ c.m., in a second. Such a particle has one hundred billion times the estimated mass of a water molecule; hence, if its pedetic motion be produced by bombardment from water molecules, these must exist in complex groups of considerable mass and some stability. The fact that pedesis is stopped by the addition of an electrolyte would appear to indicate that the water complices are disintegrated in the presence of ions. The effect of pedetic motion in a liquid is to cause hydrostatic pressure; such hydrostatic pressure would be less on a membrane capable of penetration by the molecular aggregates or particles than on one not so permeable. It is not unlikely that these particles obey gaseous laws in regard to pressure on the sides of the containing vessel, as microscopic observations show that the relative velocity of the particles depends on their mass and density. L. Meyer has pointed out the great discrepancies existing between measurements of the osmotic pressures of solutions and the pressures calculated on the assumption that the dissolved substances obey gaseous laws. These discrepancies may be best explained by considering that combination of the dissolved substance with the membrane walls takes place, and that, subsequently, dissociation of the compound occurs at the other side of the cell wall, as in the case of hydrogen penetrating a palladium diaphragm. The author is disposed to conclude that solution is merely subdivision and admixture, accompanied by pedetic motion, that the true osmotic pressure has never been measured, and that a continuous passage can be traced between visible particles in suspension and matter in solution.—The acid action of drawing-paper of different makes, by W. N. Hartley. An examination of numerous samples of the best drawing-papers shows that they all contain free sulphuric acid. Water in which the paper has been steeped yields a precipitate of barium sulphate, and solutions of helianthin and azolitmin painted on to the paper give the acid reaction.—The interactions occurring in flames: a correspondence between Sir G. G. Stokes and H. E. Armstrong. Sir G. Stokes considers that the facility with which steam is decomposed by glowing carbon favours the view that, at a high temperature, oxygen combines with carbon in preference to hydrogen. He considers it necessary to distinguish carefully between the changes which take place in the partial combustion of a molecule and those which are produced in neighbouring molecules as a result of the heat liberated. This latter change may be termed a thermo-chemical one, in contradistinction to a pure chemical change. In the blue base of a candle flame, where oxygen is plentiful, pure chemical change may occur. The blue part envelops for a little way the highly luminous shell in which glowing carbon is present. This carbon may owe its origin to a thermo-chemical change, the heat being derived from the pure chemical change occurring just outside it. The hydrocarbon spectrum may be due to a gas formed by a pure chemical change; this gas is generally supposed to be acetylene, but Sir G. Stokes considers that it is more probably methane. This unknown gas is a hydrocarbon, which, when burnt in the pure state, would show but feebly, if at all, the hydrocarbon spectrum. For, in order that it should show its spectrum, its molecule must be in a state of violent agitation; this might be expected to be the case if it had just been formed as the result of partial decomposition, but would not be so merely because it was going to be destroyed by union with oxygen. Dr. Armstrong, while admitting that the facts do not justify the assertion that oxygen combines with hydrogen in preference to carbon when a hydrocarbon is burnt with insufficient oxygen, is unprepared to adopt the view, advocated by Sir G. Stokes and Prof. Smithells, that the carbon is the more combustible, and thinks that the actual condition of affairs is far less simple than is expressed in the statement of either of these views. There seems to be very little opportunity in flames for simple heat changes to occur, the molecules of different kinds being so mixed up together. Thus opportunity is given for interactions to occur, the end result of which is the same as that of a simple heat change of the chief substance concerned; merely because a change occurring at one moment is reversed the next, and so escapes notice. In this way, contiguous molecules may play the part of surfaces, and that there can be little doubt that such actions are of primary importance may be inferred from the well-known fact that the extent to which the dissociation of water vapour takes place depends on the character of the surface in contact with which it is heated, and not solely on the temperature. In fine, it seems permissible to doubt whether, under the conditions present in flames, carbon is ever separated by simple heat changes. It will certainly be unwise at present to infer that the oxidation of the hydrocarbons, or the separation of carbon and also of hydrogen from them, takes place entirely in any one way.—Properties of alcoholic and other solutions of mercuric and other chlorides, by S. Skinner. The author has determined the variation in the boiling-point of alcohol produced by dissolving it in mercuric, lithium, magnesium, and calcium chlorides, as well as the variation in the boiling-point of a solution of hydrogen chloride of constant boiling-point produced by mercuric chloride. He has also studied the distribution of mercuric chloride between the two solvents, water and ether. The results indicate that mercuric chloride affords a case in which the measure of the property is a simple function of the quantity of salt present, whereas in the case of the other chlorides, the measure of the property involves some higher power.—The isomeric α-bromocinnamic acids, by S. Ruhemann. An account is given of experiments on the action of ammonia and phenylhydrazine on the α-bromocinnamic acids.

Entomological Society, February 10.—Mr. Frederick DuCane Godman, F.R.S., President, in the chair.—The President nominated Lord Walsingham, F.R.S., Captain Henry John Elwes, and Dr. D. Sharp, F.R.S., Vice-Presidents for the session 1892–93.—Mr E. Meyrick exhibited a number of specimens of *Euproctis fulviceps*, Walk., taken by Mr. Barnard, showing the extraordinary variation of this Tasmanian species, all the males of which had been "sembled" by one female. The males were represented by various forms ranging from black to white, which had all been described as distinct species. Dr. Sharp, Mr. Hampson, Mr. McLachlan, Colonel Swinhoe, Mr. Elwes, Mr. Poulton, and Mr. Jacoby took part in the discussion which ensued.—Dr. Sharp exhibited samples of pins which he had tried for preventing verdigris, and stated that silver wire was the best material to use, as insects on silver pins remained intact, whilst those on gilt pins were destroyed by verdigris.—Mr. G. T. Porritt exhibited a series of specimens representing Huddersfield forms of *Polia chi*, including nearly melanic specimens, found there during the last two seasons. He said these forms had not hitherto been observed elsewhere.—Mr. Tutt exhibited a series of *Hadena pisi*, comprising specimens very grey in tint, others of an almost unicolorous red with but faint markings, and others well marked with ochreous transverse lines; three distinct forms of *Hadena dissimilis;* red and grey forms of *Panolis piniperda*, and a dark form of *Eupithecia fraxinata;* also a specimen of *Sciaphila penziana.*—The Rev. Dr. Walker exhibited specimens of *Arge titea*, *A. lachesis*, *A. psyche*, *A. thetis*, and other species of the genus from the neighbourhood of Athens; also specimens of *Argynnis phœbe*, taken in Grenada in May 1891.—Mr. W. Farren exhibited a series of specimens of *Peronea variegana* var. *cirrana*, and *P. schalleriana* var. *latifasciana*, from Scarborough; *Eupœcilia vectisana*, from Wicken Fen; and *Elachista subocellea*, from Cambridge.—Mr. G. A. J. Rothney sent for exhibition a number of species of ants collected in Australia, in May and June 1886, which had recently been named by Dr. Forel. The collection included: *Iridomyrmex purpurens*, Sm., *I. rufoniger*, Lowne, *I. gracilis*, Lowne, *I. itinerans*, Lowne, *Ectatomma metallicum*, Sm., *E. nudatum*, *E. mayri*, *Aphænogaster longiceps*, Sm., *Polyrhachis ammon*, Fab., *Myrmecia nigriventris*, Mayr, and *nigrocincta*, Sm.; and a variety of *Camponotus rubiginosus*, Mayr, from Brisbane; also a few species from Honolulu; and a species of *Monomorium*, which Dr. Forel had not yet determined.—Mr. C. O. Waterhouse read a paper entitled "Some Observations on the Mouth Organs of Diptera," which was illustrated by numerous diagrams.—Mr. E. Meyrick read a paper entitled "On the Classification of the Geometrina of the European Fauna." Mr. Hampson, Mr. Elwes, Mr. McLachlan, Colonel Swinhoe, Mr. Tutt, and Mr. Distant took part in the discussion which ensued.

Zoological Society, February 16.—Osbert Salvin, F.R.S., Vice-President, in the chair.—Mr. W. T. Blanford, F.R.S., exhibited two heads and a skin of the Yarkand Stag, lent for exhibition by Major C. S. Cumberland, by whom they had been obtained, and proposed the name of *Cervus elaphus yarkandensis* for this form.—Mr. Sclater exhibited and made remarks on some living specimens of what are commonly called Spinning or Japanese Mice.—Mr. Sclater also exhibited and made remarks on some mounted heads of Antelopes from Somali-land, belonging to Captain Swayne, R.E., amongst which was an example of the recently described Swayne's Hartebeeste (*Bubalis swaynei*).—Mr. A. Smith-Woodward exhibited and made remarks on examples of the supposed jaws and teeth of *Bothriolepis* from the Upper Devonian formation of Canada.—Mr. F. E. Beddard read a paper containing the results of his examination of the Chimpanzee "Sally" and the Orang "George," lately living in the Society's Menagerie. The author's remarks referred principally to the external characters and the muscular anatomy of these Anthropoid Apes.—A communication from Mr. A. G. Butler gave an account of a collection of Lepidoptera from Sandakan, North-East Borneo.—Mr. G. A. Boulenger gave an account of a third collection of Fishes made by Surgeon-Major A. S. G. Jayakar at Muscat, East Coast of Arabia. Amongst these was a specimen of *Histiopterus typus*, a fish described in "Fauna Japonica," but not since recognized; and an example of a new species of *Box*, proposed to be called *B. lineatus*.—A communication from Dr. W. B. Benham contained a description of three new species of Earthworms from British Colombia and South Africa. These were proposed to be called *Plutellus perrieri*, *Microchæta papillata*, and *M. belli*.—Mr. F. E. Beddard read a paper on some new species of Earthworms of the genus *Perichæta*.—A communication was read from Dr. H. Bolau, on the specimens of *Haliaëtus pelagicus* and *H. branickii*, now living in the Zoological Gardens of Hamburg. Coloured drawings of these nearly allied Sea-Eagles were exhibited.

Anthropological Institute, February 9.—E. B. Brabrook, Vice-President, in the chair.—Mr. Walhouse exhibited the skull of a Dacoit leader from the Chin country on the Burmese and Chinese frontier; also a quiver and several other Chin objects sent to him by Captain E. S. Hastings.—The following papers were also read:—On the exploration of Howe Hill Barrow, Duggleby, Yorkshire, by J. R. Mortimer; and on the human remains found in Howe Hill Barrow, by Dr. J. G. Garson.

Royal Meteorological Society, February 17.—Dr. C. Theodore Williams, President, in the chair.—The following papers were read:—The untenability of an atmospheric hypothesis of epidemics, by the Hon. Rollo Russell. The author is of opinion that no kind of epidemic or plague is conveyed by the general atmosphere, but that all epidemics are caused by human conditions and communications capable of control. In this paper he investigates the manner of the propagation of influenza, and gives the dates of the outbreaks in 1890 at a large number of islands and other places in various parts of the world. Mr. Russell says that there is no definite or known atmospheric quality or movement on which the hypothesis of atmospheric conveyance can rest, and when closely approached it is found to be no more available than a phantom. Neither lower nor upper currents have ever taken a year to cross Europe from east to west, or adjusted their progress to the varying rate of human intercourse. Like other maladies of high infective capacity, influenza has spread most easily, other things being equal, in cold calm weather, when ventilation in houses and railway-cars is at a minimum, and when, perhaps, the breathing organs are most open to attack. But large and rapid communications seem to be of much more importance than mere climatic conditions. Across frozen and snow-covered countries and tropical regions it is conveyed at a speed corresponding, not with the movements of the atmosphere, but with the movements of population and merchandise. Its indifference to soil and air, apart from human habits depending on these, seems to eliminate all considerations of outside natural surroundings, and to leave only personal infectiveness, with all which this implies of subtle transmission, to account for its propagation.—The origin of influenza epidemics, by Mr. H. Harries. The author has made an investigation into the facts connected with the great eruption of Krakatão in 1883, and the atmospheric phenomena which were the direct outcome of that catastrophe. He has come to the conclusion that the dust derived from the interior of the earth may be considered the principal factor concerned in the propagation of the recent influenza epidemics, and that, as this volcanic dust invaded the lower levels of the atmosphere, so a peculiar form of sickness assailed man and beast.—Report on the phenological observations for 1891, by Mr. E. Mawley. This report differs in many respects from the previous reports on the same subject. Among other changes, the number of plants, &c., selected for observation has been greatly reduced, while the number of observers has considerably increased. The winter of 1890-91 proved in England very destructive to the root-crops, as well as to green vegetables and tender shrubs. Birds also suffered severely. In Scotland and Ireland, however, there was scarcely any severe weather until March. The flowering of wild plants was greatly retarded by cold in the spring, but during the summer the departures from the average were not so great. The harvest was late, and its ingathering much interfered with by stormy weather.—Note on a lightning discharge at Thornbury, Gloucestershire, July 22, 1891, by Dr. E. H. Cook.

EDINBURGH.

Royal Society, January 18.—Prof. Chrystal, Vice-President, in the chair.—Prof. C. G. Knott read a paper on the magnetization of iron by a current passing through it. The experiments were an attempt to get some insight into the nature of circular magnetization as it exists in an iron wire carrying a current. Direct experiment seemed hopeless. Accordingly, tubes were used, in which the circular magnetization was measured by the induction current produced in a coil wound longitudinally round the wall of the tube. The circular magnetization could be produced either by an *axial current* along a copper wire threading the tube, or by a *sectional current* from end to end along the tube itself. Several tubes of different bores were used in pairs, the induction, axial or sectional, in one being balanced, by adjustment of resistances in the secondary circuits, against the induction, axial or sectional, under the influence of the same current in the other. The average magnetic force acting round the tube was calculated in accordance with the usual assumptions, and this, taken along with the observed induction, gave an average permeability. The general result was that the sectional induction accompanying a given current is greater by about 7 per cent. than it would be if the usual theory as to the relation between it and the axial current were accurate. Direct experiment appreciably showed that a current flowing through iron does not increase permeability to inductive forces acting perpendicular to the current, so that the deviation mentioned must be due to the faultiness of the theory. With greater current densities, such as exist in the circularly magnetized wire, this deviation may be even more pronounced.—A paper, written by Mr. R. W. Western, on tactics adopted by certain birds when flying in the wind, was read. In this paper an attempt was made to explain the advance of certain birds against the wind without motion of the wings.—A paper, by Dr. A. B. Griffiths, on ptomaïnes extracted from urine in certain infectious diseases, was communicated.—Prof. Tait read the second part of a paper on impact. In the series of experiments described in this part of the paper, blocks of the various substances dealt with, similar in shape to those used in the first set of experiments, but larger in size than they were, were used. The mass of the impinging body was also larger than formerly, and in some experiments the part of it which impinged upon the substance was made of a V-shape instead of flat. The paper contained a comparison of the present results with the former.—Prof. Tait also read a note on the critical isothermal of carbonic acid as given by Amagat's experiments. Throughout a considerable range of volume this isothermal is practically flat.

February 1.—The Rev. Prof. Flint, Vice-President, in the chair.—A paper by Dr. Piazzi Smyth, formerly Astronomer-Royal for Scotland, on the latest physical geography from Greenland, was read.—A paper, by Mr. R. Brodie, on the equilibrium and pressure of arches, with a practical method of ascertaining their true shape, was communicated. The method involves the use of a very simple and easily applied geometrical construction.—Prof. Tait read a note on the isothermals of mixtures of gases. In this note reference was made to a possible explanation of the flatness (indicated in Amagat's recent experiments) of the critical isothermal of carbonic acid near the critical point as due to the presence of a small quantity of air.

PARIS.

Academy of Sciences, February 22.—M. d'Abbadie in the chair.—On a geometrical interpretation of the expression of an angle with two normals infinitely close to a surface, and on its use in theories of the rolling of surfaces and gearings without friction, by M. A. Resal.—On the theory of elasticity, by M. H. Poincaré.—On the magnetic disturbance of February 13–14, by M. Mascart. It is stated that the instruments at the meteorological stations of Nice, Toulouse, Clermont, and Besançon were disturbed during the recent magnetic storm in the same manner as those at Perpignan, Lyons, Nantes, and Parc Saint-Maur. An account is also given of an aurora observed on February 14 by M. P. Lefebvre at Troyes, and M. de Roquigny-Adanson at Parc-de-Baleine.—Note on a sun-spot observed at Meudon Observatory from February 5 to February 17, by M. J. Janssen.—On the measurement of high temperatures; reply to some remarks made by M. H. le Chatelier, by M. Henri Becquerel.—Preparation of amorphous boron, by M. Henri Moissan. (See Notes.)—On an improvement of automatic arrangements for lifting water to great heights, employed in irrigation, by M. Anatole de Caligny.—Researches on ethyl monochlor-, monobrom-, and monocyanacetoacetate, by MM. A. Haller and A. Held. The monohalogen derivatives of ethyl acetoacetate react sometimes as α and sometimes as γ derivatives, and sometimes as a mixture of α and γ derivatives.—On the deformation of the earth's crust, by M. Marcel Bertrand.—Photographs of the star Nova Aurigæ, taken at the Vatican Observatory, by M. F. Denza. Two negatives were taken of the region about Nova Aurigæ on February 7. The telescope was moved slightly in declination between successive exposures, so that each of the negatives obtained showed five images of the Nova. The star on the date of observation was said to be undoubtedly of the fifth magnitude. Its image is not so clearly defined as are the images of other stars on the same plates. Careful measurements of position made with the meridian instrument of the Observatory give the values R.A. 5h. 25m. 3·4s., Decl. 30° 21′ 42″·0.—On algebraic integrals of differential equations of the first order, by M. Léon Autonne.—On maximum elastic deformation of metallic arcs, by M. Bertrand de Fontvioland.—Relation of the magnetic disturbance of February 13–14 to solar phenomena, by M. E. Marchand.—Researches on the realization of the spheroidal state in boilers, by M. A. Witz. Experiments have been made by the author to determine the duration of evaporation of water on heated metals.—On the solubility of tricalcic phosphate and hydrogen bicalcic phosphate in solutions of phosphoric acid, by M. H. Causse.—On the stereochemistry of diacetyltartaric acid; a reply to a communication by M. Le Bel, by M. Albert Colson.—Thermal study of sodium isopropylate, by M. de Forcrand.—Tartronic acid and the tartronates of sodium and potassium, by M. G. Massol. The heat of combination of tartronic (oxymalonic) acid is greater than that of malonic acid under the same conditions. This result is similar to that obtained with oxysuccinic and succinic acids.—The specific gravities of textile fibres, by M. Léo Vignon.—On the vitality of germs of microscopic organisms in fresh and salt waters, by M. A. Curtis.—On some points in the embryology of *Oniscus murarius*, Cuv., and *Porcellio scaber*, Leach, by M. S. Jourdain.—Structure of the nervous system of the larva of *Stratiomys strigosa*, by MM. F. Henneguy and A. Binet.—On nutrition during diabetes, by M. Hanriot.—Researches on the fall of the leaves of the vine and the ripening of grapes, by M. A. Muntz.—Remarks on a recent communication by M. J. Passy, as to the minimum perceptible quantity of some odours, by M. Charles Henry.

BERLIN.

Physical Society, January 29.—Prof. Schwalbe, President, in the chair.—Prof. Lampe gave an account of the life and work of the late Prof. L. Kronecker; and Dr. Budde an address in honour of the late Astronomer-Royal, Prof. Airy.—Prof. König described experiments, made chiefly in collaboration with Dr. Ritter, on the luminosity of spectral colours under very widely different intensities of illumination. Special attention was directed to the curves of luminosity under very feeble illumination, a condition under which only the outermost red of the spectrum is visible.

Meteorological Society, February 2.—Dr. Vettin, President, in the chair.—Dr. Arendt spoke on the relationship of the electrical phenomena of the atmosphere to terrestrial magnetism. Neither the aurora nor the sudden discharges during thunderstorms have exhibited any regularity in their relationship to variations of terrestrial magnetism. The speaker's observations at the magnetic observatory of Potsdam, extending over a whole year, have shown that sudden luminosities in the sky, which differ from ordinary sheet-lighting, but are certainly due to electrical discharges, and are most prevalent in winter, are always accompanied by changes of terrestrial magnetism. In connection with the above, Prof. Spoerer pointed out that the solar activity had undergone a sudden reversal in April 1891, in so far as since 1883 the southern hemisphere had been more active than the northern, in the ratio of 15 and 18 to 10, whereas since April the activity had markedly increased in the northern hemisphere, so that it had exceeded that of the southern in the ratio of 34 to 10.—Dr. Assmann gave a preliminary short account of some observations made in a captive balloon in January last during a dead calm and the lowest temperature of the winter. The balloon ascended slowly at 1 o'clock, and was slowly pulled down at 5 p.m.; and since it was found that the self-registering apparatus was in perfect working order, it was again allowed to ascend, and remained up until 11 p.m. During the whole afternoon the cable hung perfectly vertical, so that the balloon reached its full elevation of 750 metres. In the evening a slight south-easterly wind blew aloft, although the calm was continuous below. The temperature at midday at the earth's surface was −12° C.; a few metres above the surface it rose 0°·6, and was then constant up to a height of 250 metres, and as far as the fine mist extended. At greater elevations it rose rapidly, and at an elevation of 750 metres stood at −4°. That this considerable elevation of temperature at the higher altitude was not due to solar radiation was shown by the fact that in the evening the temperature at an elevation of 700 metres was as much as 12° above that at the earth's surface. The data as to humidity and barometric pressure were less trustworthy.

Physiological Society, February 5.—Prof. du Bois Reymond, President, in the chair.—Dr. René du Bois Reymond gave an account of his researches with chloroform purified by crystallization at −100°, and compared its action with that of ordinary chloroform and of the mother liquor from the crystals. Experimenting on frogs and rabbits, he found their action was practically identical.—Prof. H. Munk made a short communication on the function of the superior laryngeal nerve, on extirpation of the thyroid gland, and on a centrally blind monkey.

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