THURSDAY, JANUARY 13, 1898.

## A SYSTEM OF MEDICINE.

*A System of Medicine.* By many Writers Edited by Thos. Clifford Allbutt, M.A., M.D., F.R.C.P., &c., Regius Professor of Physic in the University of Cambridge. Vol. iii. Pp. xi + 1001. Illustrations 23. Charts iv. Plate i. Vol. iv. Pp. xii + 880. Illustrations 31. Plate i. (London: Macmillan and Co., Ltd., 1897.)

THE works before us are the third and fourth volumes of Prof. Allbutt's "System of Medicine," the first and second volumes of which have been already reviewed in these columns.

Vol. iii. begins with a consideration of the General Diseases of Obscure Causation. The subject is introduced by an article on Acute Rheumatism, or Rheumatic Fever, which is contributed by Dr. Church. This article contains a mass of clinical information drawn from a rich bibliography, and supplemented by the author's own ample experience at St. Bartholomew's; as an instance of the latter, we may mention a chart of 1998 cases of rheumatic fever arranged in months according to the time of onset of the disease. Acute Rheumatism in children is dealt with by Dr. Cheadle, and forms a valuable addition to the above article. The very various manifestations of acute rheumatism in children are described, and the relative sudsidiary importance of the arthritic phenomena is emphasised. Rest and full alkaline treatment are, according to the author, the most valuable therapeutic measures in diminishing the frequency of the occurrence of cardiac inflammation.

The articles on Chronic Rheumatism, Gonorrhœal Rheumatism, and Muscular Rheumatism are from the pen of Dr. A. E. Garrod. The essay on Rheumatoid Arthritis is contributed by Dr. Kent Spender, of the Royal Mineral Water Hospital, Bath; unfortunately, before its completion he had to relinquish the task. The revision, however, fell into fortunate hands, and was undertaken by Dr. A. E. Garrod, who entirely contributes the section on treatment. Rheumatoid arthritis in children forms the subject of a special essay by Dr. Still. The monograph on Rickets is written by Dr. Cheadle, and includes a full description of the disease, an account of its pathology and treatment, and of its modifications and concurrent disorders. Mr. Bowlby contributes three succinct articles on Mollities Ossium, Acromegaly, and Hypertrophic Pulmonary Osteo-arthropathy.

All will agree that the essay on Gout could not have fallen into better hands, coming as it does from the pen of Sir William Roberts. The author expresses the views so clearly enunciated by him in the Croonian Lectures for 1892, with regard to the existence and decomposition of the so-called quadri-urates. The relative merits of the mechanical and chemical theories of the production of the symptoms of gout are carefully examined. The monograph concludes with a consideration of the general and local treatment of gout. Dr. Saunby contributes the article on Diabetes Mellitus; the late Dr. Ralfe the one on Diabetes Insipidus. This part of the volume concludes with an essay on Lardaceous Disease by Dr. Howship Dickinson.

The second division of the work is devoted to diseases of Alimentation and Excretion. Two essays on the general pathology of Digestion and Secretion introduce the subject. In the former, Drs. Ralfe and Soltau Fenwick give an account of what may perhaps not inappropriately be termed the clinical chemistry of digestion, and describe the more recent methods for the qualitative and quantitative determination of the various constituents—normal and pathological—of the digestive juices, more especially, of course, of the gastric juice. It is to be wished that the value of exact chemical examination of the gastric contents after test meals should be more recognised in this country. The general Pathology of Secretion is the subject of a short essay by Dr. Rose Bradford. The pathological modifications, both in quality and quantity, of external and internal secretions are considered. Shock and Collapse is treated in an original manner by Dr. Cobbet; Diseases of the Mouth by Dr. Wills, and Diseases of the Œsophagus by Dr. Rolleston.

The Diseases of the Stomach are treated by several authors. Among the monographs composing this subsection of the work may be mentioned the essays on Dyspepsia and Gastritis, by Dr. Lauder Brunton. These articles contain a mass of valuable clinical information, and many useful hints for the treatment of these disorders. They are written in that clear and lucid style which is characteristic of their author. Dr. Stocker contributes a short account of Sea-sickness. He divides the treatment of this most unpleasant disorder into preventive and remedial. Under the former head he advises light diet and purgation before starting. He regards the beneficial action of the bromides as most probably due to the anæsthetic action which they exert on the pharynx and larynx, and suggests that they would probably be as efficacious if given as gargles. The Editor writes an account of Mountain-Sickness. He adopts the view that the symptoms are due to the diminished oxygen tension obtaining at high altitudes. Prof. Allbutt further contributes the essays on Neuroses of the Stomach and Gastrectasis. In the former article the author gives an account of the recent researches of Pawlow upon the nervous mechanisms influencing gastric secretion. He then passes to the symptoms of the many varieties of gastric neuroses. Motor Disorders of the stomach are dealt with, and the article concludes with an account of the neuroses of the other abdominal viscera. The article on Gastrectasis comprises a discussion of the ætiology, varieties, diagnosis and treatment of this disease.

The essay on Ulcer of the Stomach is written by Dr. Dreschfield. The author first gives a brief account of the history of this affection, he then passes on to the ætiology, considering the *rôle* played in its production by sex, age, race, climate, occupation, &c. The discussion of symptomatology is very full, and includes a mention of Acetonuria and Diaceturia. The complications and sequelæ are fully considered, as is the diagnosis, prognosis and treatment. Duodenal Ulcer forms the subject of a short appendix to the above article. An able monograph on Tumours of the Stomach is from the pen of Dr. Hale White. Short accounts of Subphrenic Abscess and Diaphragmatic Hernia are given by Dr. Lee

Dickinson. A succinct essay on Abdominal Diagnosis from a Gynæcological point of view is contributed by Dr. Playfair. Enteroptosis is treated by Mr. Treves. The normal mechanism of the suspension of the various abdominal viscera is first considered, and then the displacements undergone by the viscera severally are discussed. The commonest of all these conditions, viz. movable kidney, is reserved for a future article. The author then passes on to general ptosis of the abdominal viscera or Glenard's disease. Its results and treatment are described and illustrated by three well-marked cases.

The next section of the book is devoted to diseases of the Peritoneum; it begins by an article on Acute Peritonitis, which is written by Mr. Treves. After a few pregnant general considerations the author proceeds to enumerate the chief varieties of peritonitis classified according to their cause. A table of 100 cases of peritonitis from the records of the London Hospital is given. The symptoms are next discussed, and numerous temperature charts appended. The course, termination, and prognosis of the disease are then considered, and the article closes with a clear enunciation of the lines of treatment, operative or medicinal, to be adopted. The remaining part of this section is written by Dr. Allchin. The author first directs his attention to Acute Peritonitis of Undetermined Nature. Simple Chronic Peritonitis is then dealt with, subsequently Tubercular Peritonitis, and finally New Growths of the Peritoneum. From the brief sketch given above it will be obvious that the whole subject is very thoroughly treated, and that all of interest to the physician finds very ample consideration.

The concluding division of the volumes is devoted to Diseases of the Bowels. The subject is opened by an essay from the pen of Dr. Lauder Brunton on the Physiology of Fæcal Evacuation and Constipation. The author considers fully the connections between the central nervous system and the intestines, and discusses the influence of emotions upon intestinal peristalsis. Under the head of Constipation Dr. Brunton discusses its causes and treatment, position playing an important part, relief from habitual constipation being occasionally obtained by advising the patient to defæcate in the crouching position. The essay on Diarrhœa is from the pen of the same author, and forms an admirable study of the subject. Dr. Rolleston contributes an article on Diseases of the Small Intestine, and Dr. Hale White a short monograph on Colic. The editor has done well to entrust a special article on the Diarrhœas of Children to Dr. Eustace Smith; this, for the general practitioner, most important subject, is exhaustively treated by the author, who, from the fulness of his clinical experience, handles the subject of treatment especially well. Sprue or Psilosis is well treated by Dr. Patrick Manson.

Mr. Frederick Trevers writes an account of Intestinal Obstruction; physicians will find this essay most useful for reference. It is very full, and well classified, so that the reader can easily find what he wants. The essay on Perityphlitis, or Peritonitis localised in the region of the Cæcum, is from the pen of the same author, and forms a complete clinical study of the subject. A carefully written monograph, by Dr. Hale White, upon Diseases of the Colon, and a short note on the Differential Diagnosis of Diseases of the Rectum and Anus, by Mr. Allingham, conclude the volume.

Vol. iv. opens with a section on Diseases of the Liver. This subject is introduced by four monographs of general interest on the Anatomy and Physiology of the Liver, Congestion of the Liver and Jaundice by Dr. William Hunter. The same author subsequently contributes special articles on Toxæmic Jaundice, Weil's Disease, and Acute Yellow Atrophy. Dr. Hale White writes a succinct account of Perihepatitis and Hepatic New Growths. The difficult medico-surgical subjects of Diseases of the Gall Bladder and Bile-Ducts and Cholangitis are ably handled by Mr. Mayo Robson. The great progress which has of late been made in the treatment of these affections will render Mr. Robson's article, which is quite up to date, of especial value to physicians. We find it odd, however, that no mention should be made in the bibliography of a book recently written upon this subject by Mr. Waring. The section concludes with an essay on Diseases of the Pancreas by Dr. Fitz.

The second division of the volume is devoted to Diseases of the Kidneys. Dr. Rose Bradford writes a complete essay on the General Pathology of the Renal Functions. The first part of the essay is devoted to abnormalities in the urine and their detection. The second part concerns itself more especially with the General Pathology of Renal Disease, in which are comprised a short discussion of Dropsy and Uræmia. Prof. Alexander Macalister contributes an article on Nephroptosis, or Moveable Kidney, to which is appended a rich bibliography. Dr. Howship Dickinson writes a complete essay upon Diseases of the Kidney characterised by Albuminuria. The Diseases of the Kidney which admit of surgical treatment form the subject of a comprehensive article by Mr. Henry Morris.

The third division of the volume occupies itself with the Diseases of Lymphatic and Ductless Glands, in which are included Diseases of the Thyroid Gland, the Spleen, Supra-renal Bodies, Hodgkin's Disease, and Scrofula. This section concludes with a monograph on Obesity by Sir Dyce Duckworth. The article contains a discussion of the various methods of treatment adopted in obesity, such, for instance, as Banting's, Salisbury's, Oertel's, &c., and a useful dietary adopted by the author in his own practice.

The fourth part of the book is devoted to Diseases of the Respiratory Organs, and comprises articles by Dr. Ransome on the General Pathology of Respiratory Diseases, and the Treatment of Asphyxia, and one on Physical Signs of Diseases of the Lungs and Heart by Dr. Hector Mackenzie. The volume concludes with a section on Diseases of the Nose, Pharynx, and Larynx. The articles in this last section are from the pen of nose and throat specialists, and include contributions by Sir Felix Semon, Dr. Watson Williams, Dr. Greville Macdonald, and Dr. de Haviland Hall.

The editor and his collaborators are again to be congratulated upon these further fruits of their labours. To compare one volume of the system with another would be idle. The impression of the reviewer is, however, that the present volumes, if rather less academic than their predecessors, fulfil to a remarkable degree the wants of the student and practitioner of medicine. F. W. T.

## ELECTRO-CHEMISTRY.

*The Elements of Electro-Chemistry, treated Experimentally.* By Dr. Robert Lüpke. Translated from the second, revised and enlarged edition by M. M. Pattison Muir, M.A. Pp. xv + 223. (London: H. Grevel and Co., 1897.)

THE parts of electro-chemistry dealt with in this book are the electrolysis of liquids, the theory of solutions and of osmotic pressure, and the theory of the galvanic battery. We gather from the preface that the main object of the book is to give a description of a number of experiments which illustrate the most important laws of the subject. We think that the author has been successful in this respect, and that the book will prove useful to teachers of physical chemistry. For the experiments described in this book are essentially lecture experiments; they are arranged not so much with the object of getting the greatest possible accuracy, but by means of simple apparatus to give striking illustrations of the points under discussion in the time available in a lecture. The experiments are described in sufficient detail to enable any one to repeat them without difficulty, and seem well adapted for the purpose for which they are intended. When, however, we leave the description of the experiments and come to the conclusions which the author draws from them, the book seems to us to be much less satisfactory; the statements are sometimes obscure, and occasionally erroneous. In the chapter on Faraday's laws of electrolysis the text seems to imply that the amount of salt electrolysed by a given quantity of electricity depends upon the time the electricity takes to pass through the electrolyte. The statements are on pp. 34 and 35, and occur in the definition of what the author means by the expression "electrochemical equivalent." This is quite different from the ordinary meaning of the term electrochemical equivalent of a substance. In this book the electrochemical equivalent is not, as hitherto, the number of grammes of the substance separated by the passage through the electrolyte of one unity of electricity, but the number of units of electricity required to separate the formula weight in grammes of the substance. We think that nothing but confusion can come from using the old expression in this new sense. This, however, is not the worst; for in defining this quantity the author says "the electrochemical equivalent—that is to say, the number of coulombs which causes the separation in *one second* [the italics are ours] of that fraction of the atomic weight of the metal or of the formula weight of an anion group which corresponds with a single valency." Of course the allusion to one second is quite misleading; the statement would have been equally true if one century had been substituted for one second. The point is unfortunately emphasised by the translator, who has a footnote to the effect, "the statement in the text may be put thus: the electrochemical equivalent is the number of coulombs that causes the separation of a gramme equivalent of a metal or anion group in one second." To make matters worse the following numerical example is given:

"Supposing that 20 c.c. hydrogen and 10 c.c. oxygen were obtained in an apparatus for electrolysis of water in three minutes, this is equal to the production of ·1667 c.c. explosive gas per second, and therefore the quantity of electricity was ·1667/·174; that is ·958 coulomb."

We have devoted some space to this point because it is one about which students are apt to fall into error, even when it is not suggested to them by the text-books. It is only fair, however, to say that the other chapters are much better than the one on Faraday's law. The chapter on the resistance of electrolytes is clear: it would have been more complete if it had contained an account of Mr. Whetham's experiments on the velocity of the ions. By a misprint the student, when determining the resistance of an electrolyte, is directed to adjust the resistances until the telephone sounds. In the chapters on osmotic pressure we have a clear account of the methods of preparing the semi-permeable membranes of ferrocyanide of copper. In connection with this subject we may remark that it would be interesting to have brought together all the various experiments made on the freezing and boiling points of organic solutions, so as to see how great, if any, are the divergencies from the strict accuracy of the law that substances in solution exert, as osmotic pressure, the same pressure as that which they would exert if they were to occupy as gases the same volume at the same temperature.

A large portion of the latter part of the book is taken up with the discussion of the theory of the galvanic cell; this is generally clear, and the experiments as usual are good and well described. It would be well, however, to discriminate in the theory of the potential difference between a metal and a solution of the salt of the metal between what is derivable from the theory of osmotic pressure and what is the result of further assumption. The theory shows that $\pi$ this potential difference is expressed by an equation of the form

$$\pi = -a\theta \log \omega + C$$

where $\theta$ is the absolute temperature, $a$ a constant, $\omega$ a quantity proportional to the osmotic pressure of the action in the solution, and C a quantity of which all that is known about it is that it is independent of the strength of the solution, to write the expression in the form

$$\pi = a\theta \log \frac{P}{\omega}$$

as is done in the text, is to assume that this constant is proportional to the absolute temperature, an assumption which ought to be justified by a series of experiments at different temperatures. We have no hesitation in recommending the book to teachers of physics, though we think it a somewhat dangerous book to put in the hands of a student at the commencement of his studies in electrochemistry.

## OUR BOOK SHELF.

*The Foundations of Scientific Agriculture.* By Samuel Cooke, M.A., F.I.C., F.G.S. Pp. ix + 268. (London: Longmans, 1897.)

THE author is a Professor in the College of Sciences at Poona; his book contains the matter of a short course of lectures which he has been in the habit of delivering to a mixed class of students. In the course of 260 pages he treats of meteorology, mineralogy, rocks, soil, plant morphology, Indian crops, manures, implements used in cultivation, and mensuration. There is besides a scheme of qualitative analysis, a glossary of terms, and 129

examination questions. The book is written with ability and vigour, and evidently with a keen appreciation of the special needs of India. A full discussion of any subject in the brief limits to which the author confines himself is, of course, quite impossible, but enough is done to arouse interest and inquiry, and this apparently is the author's object. One paragraph we must quote. Alluding to the present effect of Government education in India, namely the withdrawal of the educated classes from agricultural pursuits, he says: "The first great step in renovating the profession of agriculture must come from the introduction of rational systems of national education. Governments must needs rectify their educational codes so as to give greater encouragement to studies tending to the enlightenment of rural populations in regard to food production and the relation of the science of rural economy thereto, combined with systematic demonstrations of economical methods of applying science to agricultural practice." This advice is equally needed in our own country. R. W.

*The Zoological Record. Volume the Thirty-third; being Records of Zoological Literature relating chiefly to the Year* 1896. By J. A. Thomson, R. Lydekker, R. Bowdler Sharpe, G. A. Boulenger, W. A. Herdman, B. B. Woodward, A. W. Brown, D. Sharp, Florence Buchanan, R. T. Günther, and R. von Lendenfeld. Edited (for the Zoological Society of London) by David Sharp, M.A., F.R.S., F.Z.S., &c. Pp. 890. (London: Gurney and Jackson, 1897).

GREAT credit is certainly due to the zoologists for the way in which they keep up their "Record," and for the punctual manner in which the annual volume is brought out. The zoological literature of 1896, which has appeared in various works, memoirs and periodicals all over the world during that year, has been already investigated and abstracted by these diligent recorders, and the summary of it appears in the present volume, the preface of which is dated in September last, and which was actually issued to the public in November. In no other branch of science, so far as we know, has a "Record" been kept up for so long a period, or issued so nearly up to date.

Besides eighteen records relating to as many branches of zoology, the present volume contains a very useful alphabetical list of the journals and other periodicals that contain zoological papers. This is arranged according to the abbreviated titles by which the journals are quoted in the various "Records," but the full titles are also added, so that we have here a complete and most useful catalogue of zoological periodicals. We have not counted their number, but the list takes up about forty-two closely printed pages, so that if we reckon them at a thousand we shall not be much over the mark. Besides analysing the separate publications referring to his particular subject, the unfortunate recorder may, therefore, have nearly a thousand periodicals to consult, in order to collect together the fragments relating to his particular subject. So great being the field of work in zoology alone, it is difficult to over-estimate the extent of the task about to be undertaken by the Royal Society of preparing an annual record of the literature of all branches of science.

As regards the individual records in the present volume, we observe with regret that several of them are without any sort of introduction. It is obvious, as we pointed out last year, that an introduction, specifying the principal points in which an advance has been made in the particular subject, is a necessary part of a good record. Such an introduction would be read with interest by many zoologists, who do not require to go into details very deeply—and should on no account be omitted. Considerable care and time is, no doubt, involved in its preparation; but we trust that Dr. Sharp, who in this respect himself sets an excellent example as regards the Insecta, will not allow any of his "recorders" to shirk this part of their task, however unwilling he may be to add to their arduous duties.

*Annuaire pour l'An* 1898, *publié par le Bureau des Longitudes.* Pp. 613 + 147. (Paris: Gauthier-Villars et Fils.)

*Annuaire de l'Observatoire municipal de Montsouris pour l'Année* 1898. Pp. 636. (Paris: Gauthier-Villars et Fils.)

THESE two year-books of scientific information annually increase in value by the addition of new data and revision of the old. The *Annuaire* of the Bureau of Longitudes has undergone several changes. In the astronomical part the tables of mean positions of stars supposed to be variable have been omitted, the tables of the elements of minor planets have been curtailed, and in the same way the number of coordinates referring to the orbits of double stars has been diminished. The table of elements of periodic comets only observed at a single apparition has been transferred to the *Connaissance de Temps*, but comets observed at a return are retained in the volume. The chapter on tides has been rearranged and revised, and new tables inserted. M. Moureaux contributes three new charts showing the magnetic elements in France, based on direct observations; the charts are for the epoch January 1, 1896. M. Berthelot brings up to date the tables in the section on thermo-chemistry. The articles in the *Annuaire* are all interesting. MM. Lœwy and Puiseux contribute a paper on recent progress in the knowledge of the lunar surface, obtained by means of photography; M. Poincaré contributes a valuable paper on the stability of the solar system; an account of Fizeau's scientific work is given by M. Cornu; and M. Janssen describes the work done at the observatory on the summit of Mont Blanc in 1897. Finally, there is an address by MM. Janssen and Lœwy, delivered on the occasion of M. Faye's jubilee last January.

The *Annuaire* of the Municipal Observatory does not cover so wide a field as that of the Bureau des Longitudes. It contains the results of observations made, during 1896, in the departments of meteorology, chemistry, micrography, and hygiene under the control of the Municipal Council of the City of Paris. In each of these branches, and especially in the sections of chemistry and micrography, a large amount of work was done beyond the mere compilation of statistics, and the volume is thereby rendered serviceable to all who are interested in the science of public health.

*Mémoires de la Société de Physique et d'Histoire naturelle de Genève.* Tome xxxii. Seconde Partie. Pp. lxxxi + 401. (Genève: Georg et Cie. Paris: G. Fischbacher, 1896-97.)

THERE are five papers in this volume, illustrated by fourteen plates and numerous figures in the text. In a long memoir, Mlle. C. Schépiloff describes her researches on the nerves of the labyrinth or internal ear, and the functions of the brain and medulla of frogs, with a general comparison of the central nervous systems of various batrachians. A demonstration of a fundamental theorem referring to the primitive factors of prime numbers is developed by M. Ch. Cellérier. Anatomical researches on a number of plants are described by M. J. Briquet. M. P. de Loriol describes some echinoderms, and M. J. Briquet makes a contribution to a flora of Paraguay.

*Elementary Practical Physiography.* (Section I.) By John Thornton, M.A. Pp. vii + 311. (London: Longmans, Green, and Co., 1897.)

THE elementary stage of the physiography examination of the Department of Science and Art is now divided into two parts, the first part (Section One, as it is termed)

dealing with the fundamental principles of physical science, and the second with physical geography as it is generally understood. The complete syllabus thus provides the outlines of an elementary course of general science. Mr. Thornton's book has been written upon the lines of the first part of the syllabus, and therefore it is limited to brief treatment of the elementary facts and principles of physics and chemistry. A large number of experiments are included, some of them good. The illustrations are also numerous, and some of them are original.

*The Wealth and Progress of New South Wales*, 1895-96. By T. A. Coghlan. Vol. i. Ninth issue. Pp. 491. (Sydney: Government Printer, 1897.)

THE difficulty in preparing a volume of this kind is to limit the information concerning the details of local affairs, and yet make them useful both locally and to the outside world interested in the features and progress of our colonial possessions. Mr. Coghlan, the Government Statistician of New South Wales, seems to have successfully adjusted the balance of the two interests, with the result that his volume appeals to all who wish to have accurate information concerning the active life of the Colony. Moreover, there are chapters on the history of the Colony, the climate, geological structure, physical configuration, fauna, flora, forestry and fisheries, and mines and minerals. The volume will be very serviceable for reference.

## 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 Glacial Period and the Irish Fauna.

IT has been shown by the work of many observers, in Scotland, Ireland, north-western England and the Isle of Man that during the Glacial Period the basin of the Irish Sea must have been filled with an ice-sheet. It is not probable, therefore, that the interesting speculations of Dr. Scharf on the origin of the Irish fauna (NATURE, October 28, 1897), in so far as they are based upon assumptions as to the glacial conditions of the Irish Sea, will meet with much acceptance among geologists.

There is one possible mode of migration for land-animals in formerly glaciated regions which I think has been too frequently ignored by students of the subject. I refer to the probability that the ice-sheet itself may have furnished a practicable route across narrow seas. In Prof. I. C. Russell's luminous description of the Malaspina Glacier of Alaska, we read that "a broad game-trail which had evidently long been used by bears, wolves, foxes and mountain-goats," skirting the Chaix Hills, "continued across the glacier 6 or 8 miles north-eastward to the Samovar Hills." Again, Dr. Scharf himself incidentally mentions that in Northern Europe "it is a well-known fact that reindeer are in the habit of travelling considerable distances on ice."

During my recent survey of the Isle of Man I have found abundant evidence to show that during the maximum glaciation an extraneous ice-sheet swept across the highest summit (2034 feet), and also that during the closing stages of the Glacial Period this ice-sheet melted away more rapidly in the vicinity of the island than in the surrounding obliterated sea-basin. Under such conditions the island formed a nunatak accessible for any animal which could cross the ice. And I think that the general circumstances attending the close of the Glacial Period indicate that most of the land surrounding the enclosed sea-basins in our latitudes might be in a condition to support animal life before the decaying ice-lobes had disappeared from these hollows. During the earlier stages of the Glacial Period it is clear that the climate was such as to favour the accumulation of glaciers even at sea-level, and this condition persisted until ice-sheets of great thickness had covered the lowlands. This growth at length ceased; perhaps, as I have elsewhere suggested, in the east sooner than in the west, because of the greater amount of snowfall along the western periphery of the sheet.

In the northern part of the Irish Sea basin there existed a high plateau of ice, its surface probably not far, if at all, short of 3000 feet above present sea-level. An amelioration of climate set in, and progressed until, say, no permanent snow was possible at any altitude under 1000 feet. But the ice-sheet was already in possession, and by reason of its elevation would remain, throughout the greater part of its area, uninfluenced by this extent of change, or it might even still continue to grow where there was sufficient precipitation. In an ice-choked basin hemmed in by hills as is the Irish Sea, the discharge by flow alone was scarcely likely to keep pace with the surface accumulation.

Not until the climate became such that melting was in progress over the whole plateau would there be much general lowering of its surface. Under such conditions, as the elevation of the ice-sheet was equal to, or greater than, the uplands upon which it abutted, the snowfall could no longer remain permanently, even on the hilly ground. Hence, as the land emerged from its icy covering, it would remain bare, and ready to support vegetation. As on the Malaspina Glacier, even the ice itself, where covered with morainic débris, might become verdure-clad.

The melting influence of rain falling upon the ice-sheet would be distributed equally over the recipient surface, for its superfluous heat would be at once absorbed. But whatever rain fell upon the emerging land could gather and flow in comparatively warm streams, capable of exerting a considerable differential effect where they impinged upon the margin of the ice. There would thus be a general tendency for the melting mass to shrink down more quickly in the vicinity of land; and this effect would be accelerated as the lower levels were uncovered.

These are the conditions disclosed by the field evidence in the Isle of Man, and that life existed under such conditions is proved by the presence, in one of the gravel-terraces of this period, of the arctic fresh-water crustacean *Lepidurus* (*Apus*) *glacialis*, which lives now in icy pools near glaciers in Norway and Spitsbergen, along with an arctic willow, *Salix herbacea*, and a few other plants of wider range.

The Irish Elk reached the Isle of Man about this time, and I think it probable that it crossed from the mainland on the waning ice-sheet. The evidence is altogether unsatisfactory for a Post-Glacial land-connection, as Mr. P. F. Kendall has shown.

The distance between the nearest points of Ireland and Scotland is about the same as between the nearest points of the Isle of Man and Scotland, and I see no reason why certain elements of the Post-Glacial fauna of Ireland should not have been similarly introduced by the ice-bridge. At any rate, in view of the above-quoted data furnished by the Alaskan Glaciers, this appears to me to be a legitimate supposition, and one which is in keeping with the general trend of the geological evidence.

G. W. LAMPLUGH.

### The Variability of Mira Ceti.

THE notes in NATURE, December 2 and 9, are very welcome, as they show more interest in *o* Ceti than in late years, and especially as from present information there have been but few observations from this side on the recent appearance. It seems that I have seen, so far, more of the star than any one else.

The maximum of Mira, following previous ephemerides, was due October 1. But *The Companion* and Chandler have added a correction of about forty days, and given the date as November 9. This phase appears to have occurred this season November 30, which is sixty days late. But it is not at all improbable that another maximum may be observed, although the star seems now to have broken away definitely. It was a step or so brighter than a star (3·99 H.P.) last night, and is unchanged to-night except in colour. Its reddish cast to-night, judging from some past experiences, indicates a change in light, and another rise may occur.

The magnitude November 30 was 3·2, Gamma Ceti being 3·59 Harvard measurement.

It is remarkable that while there is agreement as to the light-curve of Mira for three years, the dates of maximum are as much as five weeks apart. But there still remains some doubt as to the fluctuations in 1894-95; and did not Mr. H. M. Parkhurst confirm the present writer's observations of that apparition, they would have been thrown out of court. And some doubt would attach to Mr. Parkhurst's did not an observer at Moscow, mentioned in NATURE, confirm both of us. DAVID FLANERY.

Memphis, Tenn., U.S.A., December 24, 1897.

## RECENT SEISMOLOGY.

### I.—EARTH MOVEMENTS WHICH WE FEEL.

THE circumstances which led to the recent advances in seismological science are closely connected with an earthquake-like reformation in the policy of a foreign country. The country referred to is Japan, and the story of the changes it so suddenly effected is well known.

To bring about the new conditions engineers, architects, doctors, lawyers, surveyors, literati generally, together with representatives of a variety of trades, were invited to the birth of a new *régime*.

The engineers built their bridges, but found that they were shaken down; architects were disheartened that their houses were unroofed and subjected to processes of shattering; doctors learned that seismic disturbances might be followed by nervous prostration, tetanus and erysipelas; lawyers were perhaps perplexed when their opinion was required respecting the ownership of superimposed properties; the surveyors saw that the area of a piece of ground was not necessarily a constant quantity, and that gate-posts, on which bench-marks had been placed, might change their position by hopping—in short, one and all were impressed by the mobility of their near surroundings, and were often alarmed by rude awakenings.

The result of this was that an unusually keen interest was taken in all that pertained to earthquakes, and the new-comers, one and all—by speech, writing, or by special investigation—contributed to the advancement of seismological knowledge.

Amongst the many workers stationed in Tokio we find the names of Verbeek, Wagener, Knipping, Chaplin, Mendenhall, Ewing, Gray, Perry, Ayrton, West, Alexander and Knott; whilst amongst the Japanese, no less enthusiastic than their new colleagues, we see the names of Sekiya, Omori, Hattori, and many others. Outside assistance came from Bissett and Talbot in Yokohama, Fukushi in Sapporo, and a number of other workers throughout Japan.

At this time Tokio was in reality a city of many inventions, all of which were for the purpose of obtaining trustworthy information about earthquakes; their name was legion, and it is no exaggeration to say that of seismographs, seismoscopes and seismometers, more than one worked with at least fifty different devices.

One great problem which presented itself was to suspend a mass of material so that at the time of an earthquake it should practically remain at rest. The solution was first sought for in the bob of an ordinary pendulum. It being supposed that greater stability would be attained if the lengths of the pendulums were increased, three enthusiasts, in order to obtain a support from the roof timbers of their houses, cut holes through two ceilings, and the bobs of long pendulums were even to be seen in drawing-rooms.

Inasmuch as it was found that whenever a heavy earthquake occurred these pendulums were caused to swing in some instances so violently that apparatus in their vicinity was wrecked, attempts were made to render them dead-beat and next astatic, and a series of experiments were started which it would require pages to describe.

Following ordinary pendulums came horizontal pendulums, combinations of ordinary and inverted pendulums, rolling sphere and cylinder seismographs, ball and plate seismographs, parallel motion seismographs, and such a multitude of devices—not only for recording earthquakes, but also for timing them—that about 1883 it was decided to hold a public exhibition of earthquake apparatus. This was held in Uyeno Park; it lasted three days, and people flocked in such numbers to see the exhibits, that police assistance was called in, and the sight-seers were admitted in batches of about fifty.

Although in Japan, as a whole, there are on the average two or three earthquakes per day, whilst at many stations fifty to eighty shocks may be recorded during a year, because the disturbances came at unexpected times and from unexpected quarters, the appetite of the Tokio seismologists was so far from being satisfied that a series of experiments, which extended over several years, were inaugurated on artificially produced earthquakes.

The shakings were obtained at first by the fall, from heights up to about thirty feet, of a ball approaching a ton in weight, and subsequently by the explosion of charges of dynamite and gunpowder in boreholes.

The resulting vibrations—longitudinal, transverse, and vertical—were recorded at a series of stations so arranged in electrical connection that the time of any vibration could be noted to within a small fraction of a second.

Spare time was occupied in analysing earthquake registers and the carrying out of seismic surveys. The first of these was on an area of about nine acres, the next extended over the city of Tokio, whilst the last embraced a district some 500 miles in length, extending from the capital to the northern island.

In the first of these surveys a number of similar seismographs, one of which was in a pit, were connected together in the same manner that instruments had been connected when studying the effects of artificially produced disturbances; but with the latter, although a certain number of seismometers and seismographs were employed, the records were largely dependent upon information received on post-cards respecting the time at which a disturbance had occurred, and observations respecting its duration, direction, and severity.

This work, together with investigation on the volcanic phenomena of Japan, the more or less mysterious sea waves which occasionally inundated the coast, the supposed relationship that might exist between magnetic, electric, and seismic phenomena, the effect of earthquakes upon the lower animals, for studying which Prof. Sekiya kept a pen of pheasants, and a variety of other investigations formed interesting occupations for many.

On February 22, 1880, seismic enthusiasm was brought to a head by a very severe shaking, which gave to Yokohama the appearance of a town which had been bombarded. Taking advantage of the disturbed state of mind common not only to those who were repairing their roofs and chimneys, but to the whole community, a meeting was called, and in less than sixty minutes the Seismological Society of Japan, with its rules and regulations, was established. Many paid their subscriptions before they left the hall.

One great incentive to the work was competition between rival bodies, and many a time a member of the new Society, because his seismogram of the last quake was insignificant as compared with that obtained by a neighbour, after bitter controversy returned homewards from a meeting with a sad heart. At first these differences were regarded as the results of differences in the adjustment or construction of the instruments which had been employed, and it was not before sharp battles had been fought that it was recognised that the differences were due to differences in the localities of installation.

The feeling which at this time prevailed was not unlike that which characterises many sportsmen who, in the ordinary affairs of life, are everything that is admirable, but in the excitement of the field the desire to excel exceeds all others.

After seventeen years the seismic fever has abated, and we say with the poet—

"*Haec olim meminisse juvabit.*"

Now what was the good of all this expenditure of time and money in the endeavour to trap the fleeting earth-

quake? The earthquake-hunters of Japan, no doubt, saw a little that was before them; but now, when they stand beside the elaborate seismographs of the present day, costing 50*l.* or 100*l.*, and look backward upon the days when pins were propped up in rows to act as seismoscopes, and twopence would buy a bit of string and a bob for a pendulum, I do not think that it was ever anticipated that the study of earthquakes would lead to the knowledge which we now possess.

In seismometry we have seen the gradual evolution of several types of instruments which give faithful records of the amplitude, period, duration, and the time of occurrence of all ordinary earthquakes.

For this work we are greatly indebted to Ewing and Gray, and it is fair to say that the seismometry of Japan has done much to revolutionise seismometry throughout the world. The examination of earthquake records completely changed our ideas of earthquake motion, and we learned that nearly all the formulæ which up to this time had been employed to calculate earthquake elements had been founded upon a wrong hypothesis. The fact that the period of earthquake motion increased as it died out and as it radiated, coupled with a discussion of the observations made upon the movements which had occasionally been observed in the bubbles of levels, magnetographs,

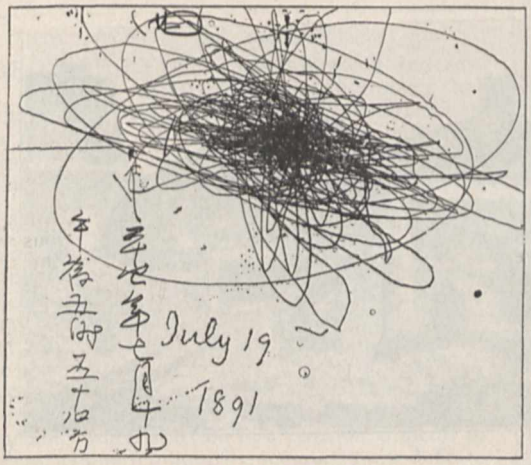


FIG. 1.—Static diagram of the earthquake of July 19, 1891, showing the complicated direction of motion common to most earthquakes. (Milne.)

and other instruments, and, above all, that now and then unfelt earthquakes had been recorded, enabled one investigator to state, fifteen years ago, that it was "not unlikely that every large earthquake might with proper instrumental appliances be recorded at any point on the land surfaces of our globe"—a prediction which of late years has been amply verified.

It was found that modified forms of seismographs might be used to record the joltings of a railway carriage, and thus to indicate defective points along a railway line. Another application of seismometry has been to measure the steadiness of a locomotive, which in part depends upon the manner in which it is balanced. On Japanese railways this has been turned to practical account, with the result that a saving of from 1 to 5 lbs. of coal per mile per locomotive has often been effected. The modern seismograph is also used to measure the elastic vibrations of bridge work, buildings, and steamships.

The greatest material benefits which recent seismological investigation has conferred upon the world are those which have resulted in minimising the destruction of life and property. The builder now, rather than making a structure strong because an earthquake is strong, has before him definite measures and a clear knowledge of the character of the forces he may expect to meet. Given the dimensions and tensile strength of a body that has been overturned or shattered, we can calculate the maximum acceleration to which the same

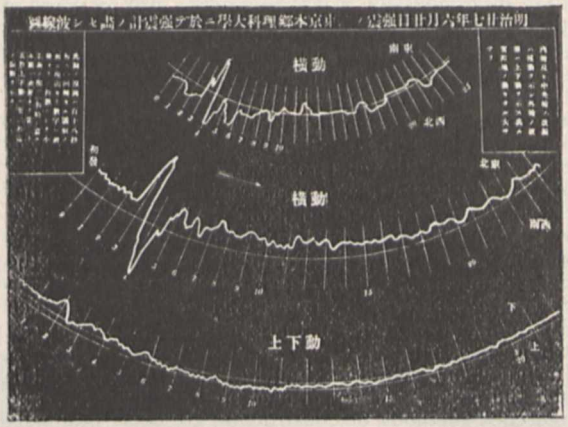


FIG. 2.—Earthquake of June 20, 1894, recorded at the Science College of the University of Japan. The upper figure is the S.E.-N.W. component; the middle, the N.E.-S.W. component showing preliminary vibrations, the shock, and concluding vibrations; and the lower, the vertical motion. The intervals are the seconds of time. (Ewing's Seismograph.)

has been subjected, and that quantity is practically identical with that derived from a seismogram.

By experience we know the maximum acceleration which may be expected in a given district or on a given

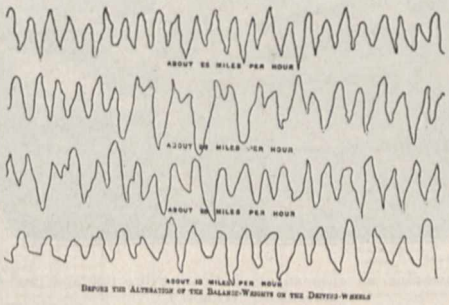


FIG. 3.—The fore and aft motion of a locomotive as balanced in England and after rebalancing in Japan, by which a safe speed has been increased from 28 to 35 miles per hour, and coal saved. (Macdonald.)

site, and we can therefore proportion a structure to meet the known conditions.

The fact that the new rules take into consideration that buildings have to withstand measurable stresses, due

to more or less horizontal displacements applied at the foundation, have been largely adopted in the building of houses and the works of engineers, is a testimony that they have been well worthy of consideration. The correctness of the new methods is found in the fact that in very many instances tall chimneys, as well as those of ordinary buildings, together with buildings themselves embodying the new principles, remain standing, whilst the old types have fallen or at least been shattered. When we remember that on June 15, 1896, Japan lost nearly 30,000 of her people by earthquakes and sea-waves, that on October 28, 1891, the loss of life was about 10,000, and the cost to restore railways and other works involved an outlay of approximately 3,000,000*l.*, that the Calcutta earthquake on June 12, 1897, is to be followed by an expenditure of 35 lahks of rupees for the restoration of public works, for the payment of which the Chief Commissioner of Assam applies for a grant from the Imperial revenue, the importance of anything which will minimise the effects of these great catastrophes can not be over-estimated.

In Japan engineers and builders are already crystallising the results of experience and experiment, and stereotyped methods of construction are being gradually

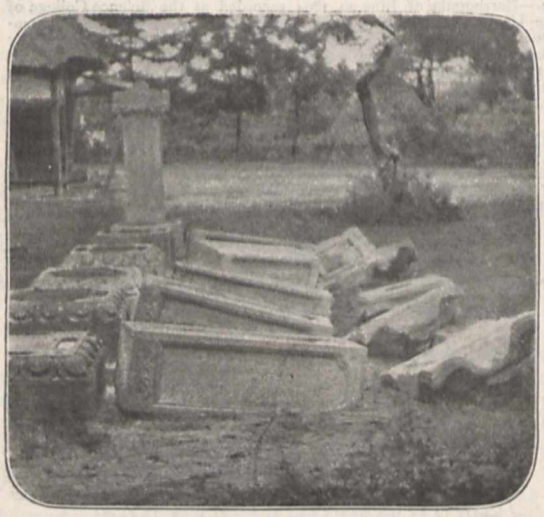

FIG. 4.—Gravestone as seismometers, indicating direction and intensity of movement. (Omori.)

abandoned, with the result that after fire, flood, or earthquake, or as other opportunities present themselves, new types of structure are growing up, which have already shown themselves to be better than the old.

Even if these results represented everything that the pioneers of the new seismology had achieved, they carry with them a feeling of satisfaction that the study of earthquakes has not been altogether unfruitful, but has led to that which is practical and simple in its application.

The experiments in which vibratory movements of the ground were produced by artificial means, whilst reproducing and affording an explanation of many phenomena observed or expected in earthquake disturbances, directed attention to others, the existence of which was for the first time rendered probable.

The velocity of propagation of wave motion evidently increased with the intensity of the initial disturbance; it was greater for vertical and normal than for transverse waves, whilst motion was propagated more rapidly to stations near an origin than between stations which were at some distance from the same.

The period of the movements increased as a disturbance died out, or as it radiated. A wave which had a slight notch upon its crest by the gradual growth of the riplet, as the motion radiated from its origin, was seen to change into a double wave. Within 50 or 100 feet of an origin, the first movement was due to a wave of compression, but beyond this distance a separation between normal and transverse movements was not observable.

The manner in which a shadow area, formed behind a cutting or hill, was invaded by movements creeping round the two ends of the obstruction was remarkable. These and many other results were confirmed and extended by actual seismograms obtained from a series of stations situated on a piece of ground less than ten acres in area. The motion on one side of this piece of ground was invariably so much greater than it was upon the other side, that it afforded an explanation of the peculiar distribution of ruin, sometimes observed in a city after a disastrous earthquake.

The fact that the side of greater motion was that, where the ground was soft, and the confirmation of this by observations in other localities, was a matter that attracted the serious attention of architects and builders. Another observation which has received many practical applications, especially in connection with the foundation of buildings, was that at a depth of 10 or 20 feet the

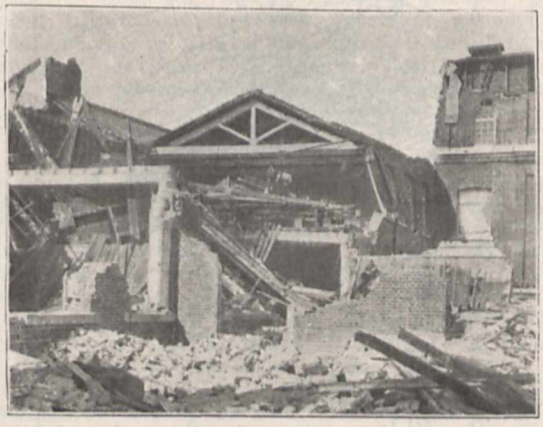

FIG. 5.—Destruction of an ordinary European structure (a cotton mill at Nagoya) by the earthquake of October 28, 1891. (Burton.)

movements of the ground were found to be less than they were upon the surface.

The seismic survey of North Japan, which has been extended to cover the whole empire, shows clearly that the volcanoes, extending for the most part along the backbone of the country, have no immediate connection with the earthquakes, nearly all of which originate along the eastern seaboard. Many of the largest of these have their home beneath water which in certain places exceeds a depth of 4000 fathoms, and it is in these sub-oceanic recesses at the base of a continental dome where a certain class of geological activities, which from time to time are announced to us by the shaking of the ground, are most pronounced.

The earthquakes of one region have been separated from those of another, whilst the land area which was sensibly shaken by each disturbance is well known.

The advantage of these registers when, for example, we seek for a connection between earthquakes and lunar attraction, or the rising of the tide upon a coast, because these influences attain a maximum in different localities at different hours, must be apparent.

Thanks to Dr. C. G. Knott, who first subjected earthquake statistics to rigid analysis, to Dr. C. Davison, who so ably emphasised and extended these methods of

investigation, and to Dr. F. Omori, our knowledge of annual, semi-annual, diurnal, and other earthquake periodicities has been placed on a more certain basis than it formerly occupied.

Without entering into the observations which have been made upon magnetic phenomena, sea waves, sound phenomena, the behaviour of lower animals, and a variety of other subjects connected in a greater or lesser degree with exhibitions of seismic force, what has been said indicates that the study of earth movements, which we feel, have not been without profit.

In Japan, at its University, there is a chair of Seismology; a bureau, which in 1895 controlled 968 observing stations; whilst the Government give liberal support to a committee of engineers and architects, whose duty it is to carry out investigations which may lead to the mitigation of earthquake effects.

Notwithstanding the opportunities which Japan offers to make such investigations, it is worthy of note that two trained men were ordered by the Government of that country to report upon the recent earthquake in Assam. This they have done, and no doubt Japan is now in a position to avoid forms of construction of which she was hitherto without experience. J. MILNE.

(*To be continued*).

## *THE AREQUIPA OBSERVATORY.*

PROF. PICKERING has conceived and carried to a successful issue many projects that require both mechanical skill and confidence in his resources. In the gradual development of these schemes, we have seen the modest row of volumes, that contained the annals of the Harvard Observatory prior to his directorate, increase to imposing proportions. We know how deftly he holds the strings that control the operations of many departments outside Harvard, and how efficiently he copes with the work that a whole army of astronomers submits to his examination. But assuredly the equipment and maintenance of the observatory at Arequipa will be remembered as one of his most successful achievements. We are apt to think of a subsidiary observatory, especially when situated in a position difficult of access, as one temporarily occupied for a definite purpose, and requiring but few instruments, mounted in buildings of slight construction. But the energy of Prof. Pickering has established in South America an observatory that a State government, having the resources of a public exchequer at its will, might look upon with satisfaction. We reproduce in Fig. 1 (p. 250) the general appearance of this astronomical station, some 8000 feet above the level of the sea, and a mere glance will show or suggest how varied must be the work of the observatory, in which all the telescopes under the different sheds are kept constantly employed through every clear night. In the illustration the observer's residence is on the extreme right. Starting from that point and taking the several buildings in order as we approach the left, we have first of all a laboratory with developing rooms attached, next a shed containing a 5-inch visual telescope, which leads on to another containing a 20-inch mirror of short focal length, figured by Dr. Common for the observation of the solar eclipse of 1889. We then pass a building containing the principal clocks and a transit instrument, and come to that containing the Bache telescope of eight inches aperture. Next to this is the 13-inch Boyden telescope under a cylindrical drum roof. To the left of this, and before we come to the buildings occupied by the assistants, is a telescope with a Voigtlander portrait lens as an objective in which are taken photographs of four hours' exposure of faint nebulous regions of considerable extent. To this list of instruments must now be added the Bruce photographic telescope, having an objective doublet of 24 inches aperture, and from Prof. Pickering's last report we learn that a transit photometer similar to that in use at Harvard has been erected. Photographs of all the bright stars from the North to the South Pole are now obtained when they cross the meridian on every clear evening, either at Cambridge or Arequipa or both.

We shall get a good idea of the use to which these instruments are put if we describe some of the illustrations that Prof. Pickering has given in the volume containing the "Miscellaneous Investigations of the Henry Draper Memorial." We have first of all a picture of the Southern Cross on which abuts a portion of Herschel's Coal-sack region, taken with the Bache telescope, exposure 127 minutes, covering an area ten degrees square. We might make this plate the excuse for discussing several points of great interest. First, should photographs represent the stars on paper as positives or negatives? Prof. Pickering, by his practice, is clearly in favour of exhibiting the stars as black dots on a white ground. In this decision he has been guided by the use of ordinary star charts, in which there has never been any question as to the most convenient method of representing stars, and to which astronomers have already accommodated themselves. With regard to the important question of the scale to be adopted, and which in this telescope gives three minutes to the millimetre, it will be admitted that it is too small for star charts, if faint stars are to be represented. Prof. Pickering says distinctly that the images are too near together to be conveniently studied. It is mainly for this reason that we do not reproduce the plate, which would have been interesting since it affords a good illustration of the difference between photographic and visual magnitudes. $\gamma$ Crucis, which has a spectrum

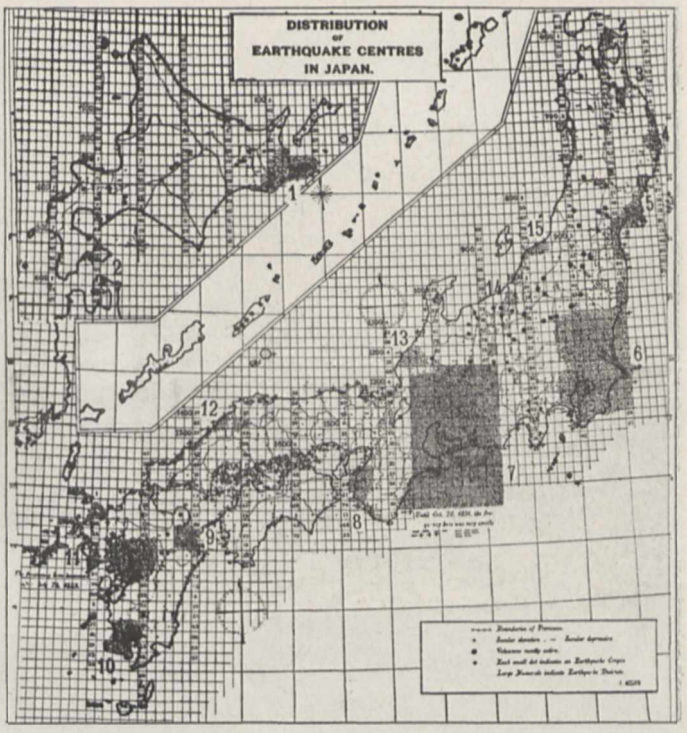


FIG. 6.—Map showing the origins of 8331 shocks recorded between 1885 and 1892 in Japan. The large dots indicate the positions of active volcanoes. The small dots indicate the origin of different earthquakes which group themselves into fifteen districts, each marked by a large numeral. (Milne.)

of the third type and is very red in colour, appears on the print much fainter than δ, while ε Crucis, also a third type spectrum star, which to the eye is so conspicuous that it is usually inserted in rough diagrams of the constellation, as for example on the Brazilian postage-stamps, is on the negative so faint, that it would not be selected as one of the principal stars.

The trifid nebula in Sagittarius, taken with the same telescope and exposure, illustrates still more completely the inadequacy of this scale for star maps, but brings out well the structure of such portions of the Milky Way as fall on the plate. This particular region is remarkable for the number of gaseous nebulæ that fall within the area covered by the plate. One-tenth of the whole number hitherto discovered in all parts of the sky are here depicted; but almost every night increases the number of these objects in our catalogues. The examination of only two plates taken with the Bruce telescope and objective prism showed that the spectra of six known nebulæ were gaseous. We pass over the photographs of the Magellanic clouds, reproduced in the volume by contact printing, and reach the nebulous region round η Argus, or as Prof. Pickering prefers to call it η Carinæ. This has been the subject of so many illustrations that its main features are well known. It serves here as an admirable object on which to test the advantages of increased scale. Three different enlargements of the original negative are given, one taken with the Boyden telescope. Prof. Pickering apparently prefers a scale of ten seconds to the millimetre at least for districts where the stars are much crowded. This size seems to him to possess the advantage of showing nearly all the stars that can be seen upon the original negative, without rendering the images inconveniently large. On a careful comparison being made between the nebulæ recorded on the plate and those given in Dreyer's catalogue one very important difference was noted. N.G.C. 3199 was observed by Herschel on four nights, and on each occasion described by him as very large and bright. There seems to be no doubt about the place of the nebulæ so described, as a curved line of stars noticed by Herschel is recognisable. But of the nebula itself there is no trace. One seems to have another instance of variability similar to Hind's nebula in Taurus. The spectra of the stars contained in this portion of the sky is also illustrated. By placing a prism in front of the objective of the Bache telescope and exposing for 140 minutes, we have, exhibited on one plate, more than 1000 spectra. Where the stars are densest the separate spectra cannot be recognised in the print, but on the original negative even these can be conveniently classified. No less than fourteen stars within this limited area, out of a total of sixty-three already catalogued, show a spectrum which consists mainly of bright lines.

The cluster known as ω Centauri is admittedly the finest in the sky. We reproduce, in Fig. 2, a reduced form of the illustration of this superb object as it depicts itself in the Boyden telescope after two hours' exposure. In one particular this picture fails to do justice to the original in the sky. The photographic images have sensible diameters amounting to, perhaps, three seconds of arc. This suggests the possibility that some stars are hidden by those nearer to us, but, as Prof. Pickering remarks, in the telescope each separate star can be distinguished, and therefore it is not probable that any star is actually occulted. The only two other clusters in the sky, which though far behind, are to some extent comparable with ω Centauri in brilliancy, are 47 Tucanæ, and the well-known cluster in Hercules, Messier 13. In each of these clusters Prof. Bailey and the staff have made attempts to count the number of stars visible, and Prof. Pickering has submitted the results to a mathematical analysis. He finds that the number of stars per square minute of arc increases in arithmetical progression as the centre is approached, and that the theoretical number derived from his formula agrees fairly well with the actual count. In the case of ω Centauri the number actually counted was 6336, while

FIG. 1.—Arequipa Station from the south-west.

theory gives 6475. The stars in the cluster 47 Tucanæ are divided into bright and faint stars. The number of each counted is 1495 and 740 respectively, while theory gives 1495 and 734. We, in the Northern Hemisphere, think Messier 13 a magnificent object, but the number of stars counted is only 723, while theory assigns one more. It says much for the admirable character of the photographs that, notwithstanding the closeness of the stars and the consequent tendency for the individual members to be obscured by the spread of the images, it should be possible to count the stars with approximate accuracy. And further, the individual stars are so distinct that variations of brilliancy are easily recognised. In this way no less than eight new variable stars have been detected in the cluster of ω Centauri, while six have also been discovered in the south following portions of the cluster 47 Tucanæ. The occurrence of a large proportion of variable stars in star clusters is a most interesting subject of inquiry. Counts have been made of the number and distribution of stars in several clusters, with the result that 400 were found in these objects. Nearly 7000 estimates were made of the brightness of the 120 variables contained in ω Centauri, and of the eighty-five variables in Messier 5.

It might be thought from this short summary that Prof. Pickering is interesting himself mainly in these very interesting objects. It must be remembered, however, that they come naturally before him in the course of a complete survey of the whole heavens, and that while we have referred to only a few plates, the entire scheme had on January 1, 1895, resulted in the collection of no less than 12,777 plates taken by the Bache, and 6281 by the Boyden telescope. Such a mass of information is likely to yield many discoveries, some of which are given in this volume before us, but to which we cannot adequately refer. This is the case with the discussion of that interesting variable, Nova Normæ, which in nineteen days sprang from a magnitude below visibility to the seventh, and then gradually faded away, passing beyond the reach of the most powerful telescopes in about two years. Comparisons of its spectrum with that of Nova Auriga are given, showing the hydrogen lines bright in both stars, and each accompanied by dark lines of slightly shorter wavelength.

FIG. 2.—ω Centauri.

## ERNEST HART.

MR. ERNEST HART, editor of the *British Medical Journal*, died on January 7 at Brighton, where he was staying for the benefit of his health. He had suffered from diabetes for many years, and had been compelled to submit to amputation of the leg last September. The operation though successful only postponed the fatal termination of his illness.

Ernest Hart was born in London in 1836, and received his early education at the City of London School during the headmastership of Dr. Mortimer. At school he performed prodigies of prize-winning, and would have taken up a scholarship to Cambridge, in the same year as the late Sir John Seeley, but for the disabilities under which the Jews then lay at the older Universities. He resolved to enter the medical profession, and joined Lane's School, then attached to St. George's Hospital. He became a member of the Royal College of Surgeons in 1856, and after serving the office of Resident Medical Officer of St. Mary's Hospital, was appointed Ophthalmic Surgeon and Lecturer on Ophthalmology at that hospital. Subsequently he became Aural Surgeon also, and for some years held the office of Dean of the Medical School. He was already a valued member of the staff of the *Lancet*, then still directed by its founder, Mr. Thomas Wakley, M.P.; and though he engaged, not without considerable success, in the practice of surgery, and especially of ophthalmic surgery, his heart was in public work. Even as a student he had given evidence of his natural bent by organising a society, to which he acted as secretary, which had for its object to ameliorate the depressing and injurious conditions under which the Naval Medical Service then laboured. This movement was completely successful, as was also another in which he took an active part as one of a commission appointed by the *Lancet* to inquire into the nursing and other arrangements of the poor law infirmaries in London. The

Home Secretary was by the facts thus brought to light led to appoint a special committee, and, as a result of its report, Gathorne Hardy's Act was passed. This Act, by the establishment of the Metropolitan Asylums Board and in other ways, has worked an immense improvement in the care of the sick, infirm, and imbecile poor.

Ernest Hart's great opportunity came in 1866, when he was appointed editor of the *British Medical Journal*, then, as now, published by the British Medical Association. He threw his whole energies into the task of making the *Journal* more useful to practising members of the profession, while at the same time extending and consolidating its influence on the course of public health legislation and administration. A special Parliamentary Bills Committee was appointed. Of this he was elected chairman, and through it he did most of the work which earned him his reputation as a sanitary reformer. Among the subjects to which he gave special attention were the amendment of the Public Health Acts, the introduction of the system of notification of infectious diseases, and of the registration of plumbers; the improvement of factory legislation, and of local administration in public health matters, the abatement of the smoke-nuisance, and the desirability of replacing arm-to-arm vaccination by the use of calf lymph. On all these matters his industry in accumulating facts and his power of arranging them into a logical statement of the need for reform and the mode in which it should be carried out, were of great value in moulding professional and public opinion.

His chief claim to recognition as a man of science rests on his life-long study of the dissemination of certain infectious diseases by water specifically contaminated. His attention was early directed to the matter during the investigations of the curious outbreak of cholera at Theydon Bois in 1865, and of the more extensive epidemic in the East-end in 1866. Subsequently he gave much attention to the question of the dissemination of typhoid fever by the same vehicle, and gradually accumulated a mass of evidence drawn from the successive object-lessons provided by municipal authorities in various parts of the country, which put beyond question the fact that, whatever may be the cause of the endemicity of typhoid fever, the specific contamination of drinking water is the immediate cause of epidemics of that disease. In 1894, during a tour in India, he expounded this doctrine and its application to the conditions of Eastern life. The greater degree of importance which the Government of India is now disposed to attach to bacteriological investigations is to be attributed in no small degree to Mr. Ernest Hart's forcible advocacy.

His chief recreation in his later years was the study of Japanese art. He formed a large and choice collection. A few years ago he visited Japan, in the company of his wife, who was also his companion during his journeyings in India and Burmah, and lives to mourn his loss.

He was a man of great alertness of mind, of untiring industry, of steady perseverance, and strong convictions. These sometimes brought him into controversies in which he showed himself a hard hitter; but he was always ready to sink personal differences for the public good.

## NOTES.

A CABLEGRAM received from Ratnagiri on Saturday last, informs us that H.M.S. *Melpomene*, having on board Sir Norman Lockyer, K.C.B., F.R.S., and other members of his eclipse party, has arrived at Viziadurg. Following the scheme drawn up last year at Norway, Sir Norman Lockyer hopes to take advantage of the keen sight and trained faculties of the officers and men of the ship's company to obtain observations during the forthcoming eclipse. He has asked for volunteers, and has obtained as many as 115. Unless unforeseen circumstances arise, the records obtained by this large number of observers will assist in making the eclipse memorable in the annals of astronomy.

WE regret that by an oversight the name of a distinguished Fellow of the Royal Society was not mentioned in our note on the New Year Honours. We refer to Brigade-Surgeon Lieut.-Colonel Dr. George King, who has been promoted to be a Knight Commander of the most eminent Order of the Indian Empire (K.C.I.E.). Sir George King is renowned as an Indian botanist, and for the valuable services he has rendered in connection with the introduction and cultivation of the cinchona in India. He is Superintendent of the Royal Botanical Gardens, Calcutta, and also of the Government Cinchona Plantations, Darjeeling.

AMONG the new officers of the Legion of Honour we notice the names of M. Henri de Parville, editor of *La Nature*; Dr. G. Hayem, professor in the Faculty of Medicine of the University of Paris; Dr. Raymond, professor in the same Faculty; M. Paul Buquet, director of the Central School of Arts and Manufactures; and M. Jourdan, director of the School of Higher Commercial Studies. Among the new Chevaliers of the Legion of Honour are: M. Albert Gauthier-Villars; Prof. Grouvelle, professor of industrial physics at the Central School of Arts and Manufactures; M. Leclanché, maker of electric batteries; M. Auguste Lumière, manufacturer of photographic plates; and M. Molteni, manufacturer of projection apparatus.

AT a meeting of the managers of the Royal Institution, held on January 6, Prof. E. Ray Lankester, F.R.S., was elected Fullerian Professor of Physiology in the Royal Institution.

M. VAN TIEGHEM has been elected Vice-President of the Paris Academy of Sciences for the current year, in succession to M. Wolf, who passes to the presidential fauteuil.

THE Watt Memorial Lecture, given at Greenock on the anniversary of the great engineer's birth, will this year be delivered by Prof. Thorpe. The subject will be "James Watt and the Discovery of the Composition of Water."

THE Geological Society of London will this year award its medals and funds as follows:—The Wollaston medal to Prof. F. Zirkel; the Murchison medal and part of the fund to Mr. T. F. Jamieson; the Lyell medal and part of the fund to Dr. W. Waagen; the balance of the Wollaston fund to Mr. E. J. Garwood; the balance of the Murchison fund to Miss J. Donald; the balance of the Lyell fund to Mr. Henry Woods and Mr. W. H. Shrubsole; a part of the balance of the Barlow-Jameson fund to Mr. E. Greenly.

M. LE CHATELIER has been nominated, by the Minister of Public Instruction, to the chair of Inorganic Chemistry in the College of France.

SUBSCRIPTIONS are invited for the erection of a bronze monument in honour of the eminent German chemist, August Kekulé, who established stereo-chemistry. The scheme is receiving generous support, and there is every reason for believing that a memorial worthy of Kekulé's great reputation will be erected. Friends, admirers, and old pupils who wish to assist in this object are requested to send their contributions to Dr. J. F. Holtz, Berlin N. Müllerstrasse 170-171, or to Consul J. Zuntz, Bonn Poppelsdorfer, Allee 63.

IT is announced that the German Association of Naturalists and Medical Men will hold its annual meeting this year at Leipzig, under the presidency of Prof. Waldeyer, of Berlin.

PROF. P. FRANCOTTE, assistant professor of embryology in the Université libre de Bruxelles, has been elected corresponding member of the Royal Academy of Belgium.

A PROMISING career has been cut short by the death of Dr. Hugh Calderwood, demonstrator of anatomy in the University of Glasgow.

WE notice with regret the announcement of the death of Herr Dr. Freiherr R. v. Erlanger, assistant professor of zoology at Heidelberg.

AT the Passmore Edwards Settlement, Tavistock Place, on Monday evening, January 17, Sir George Baden-Powell will lecture on the discoveries made by his expedition to Novaya Zemlya in 1896 to observe the total eclipse of the sun. He will also indicate the main points that are to be observed in India at the total eclipse of the sun on January 22.

THE death is announced of Sir Charles Hutton Gregory, K.C.M.G. He was the son of the late Dr. Olinthus Gilbert Gregory, professor of mathematics at the Royal Military Academy, Woolwich, and was born in 1817. He was a consulting engineer to the Governments of several Colonies, and a past president of the Institution of Civil Engineers.

WE are glad to learn that the new Psychological Laboratory at University College, the opening of which has been unavoidably delayed, gets to work this term. Any students who think of joining the classes should communicate at once with Dr. W. H. R. Rivers, who has charge of the laboratory during this term.

BY the death of Mr. H. Stacy Marks, R.A., the world has not only lost an eminent artist, but also an enthusiastic observer of living nature. Mr. Marks was an ornithologist who gained his knowledge of bird-life by the contemplation of his feathered friends in their natural haunts. Communion with nature gave him an insight into organic life denied to many students of comparative anatomy, and he was able to convey the knowledge to others by means of his paintings. Our readers may remember two books—"Letters to Marco" and "Riverside Letters"—consisting of collections of letters on natural history topics, sent by Mr. George Leslie, R.A., to his late friend Mr. Marks. These letters have found many sympathetic readers among outdoor naturalists. Mr. Marks was one of those who "love nature for her own sake, untrammelled by the prepossessions that not infrequently accompany that love among the votaries of science or sport." His death will be regretted by men of science as well as by artists.

THE annual general meeting of the Royal Meteorological Society will be held on Wednesday next, January 19, at 7.45 p.m., when the report of the council will be read, the election of officers and council for the ensuing year will take place, and the president (Mr. E. Mawley) will deliver an address on "Weather Influences on Farm and Garden Crops," which will be illustrated by lantern slides.

ON Tuesday next (January 18) Prof. E. Ray Lankester, F.R.S., will begin a course of eleven lectures at the Royal Institution on "The Simplest Living Things"; on Thursday (January 20) Prof. Dewar, F.R.S., will deliver the first of a course of three lectures on "The Halogen Group of Elements"; and on Saturday (January 22) Prof. Patrick Geddes will begin a course of three lectures on "Cyprus." The Friday evening meetings of the members of the Royal Institution will be resumed on January 21, when Sir John Lubbock, Bart., M.P., will deliver a discourse on "Buds and Stipules."

DR. E. SYMES THOMPSON will lecture on "Tropical Diseases," at Gresham College, Basinghall Street, on January 18, 19, 20 and 21, at 6 p.m. The lectures are free to the public.

MR. R. H. SCOTT, F.R.S., has kindly forwarded to us a note, received at the Meteorological Office, from Mr. W. T. Balmer, on a remarkable lunar corona observed at Tenby on Friday, January 7. In addition to the ordinary yellow corona, two well-defined concentric circles showing spectrum colours were seen outside it. The phenomenon was most intense at 5.35, and faded away at 5.55; the golden corona, however, was visible until about 9 p.m. The sky was cloudless, but there was a large proportion of moisture in the air; Mr. Balmer's readings for the wet and dry bulb thermometer on the morning of Friday being 37°·5 and 39° respectively.

THE German scientific weekly, *Die Natur*, commences its forty-seventh annual volume with an article on the aims of the journal by Dr. Willi Ule, who has just assumed the editorship. Dr. Ule is well known as one of the rising geographers of Germany; he has done a good deal of practical work in physical geography and in the improvement of mathematical instruments. He desires to carry out the purpose of *Die Natur*—the diffusion of a knowledge of natural science—mainly by the direct description of natural scenes and phenomena, appealing to the educated but unscientific public. The paper under its new editor promises to become an important element in the scientific culture of the German people.

REUTER'S correspondent at Paris reports that the will of the late Dr. Thomas W. Evans leaves only an insignificant sum to the direct heirs, but that, on the other hand, a sum of nearly 20,000,000 francs is bequeathed to the deceased's native city Philadelphia, contingent on the fulfilment of certain conditions of a somewhat original character. For instance, the city of Philadelphia must construct a museum which will bear the name of the Evans Museum, and in which the medals, decorations, and other insignia of the deceased, as well as his clothes, will be carefully arranged and catalogued. The city must also erect on a public square a statue of Dr. Evans, the price of which must not be less than 1,000,000 francs nor more than 2,000,000 francs.

THE next annual meeting of the British Medical Association will be held at Edinburgh on July 26–29, under the presidency of Sir Thomas Grainger Stewart, K.C.B. An address in medicine will be delivered by Dr. T. R. Fraser, F.R.S.; one in surgery by Prof. T. Annandale; and one in psychological medicine, by Sir John Batty Tuke. The following are the sections and their presidents:—Medicine, Dr. G. W. Balfour; Surgery, Dr. John Duncan; Obstetrics and Diseases of Women, Dr. A. R. Simpson; State Medicine, Sir Henry D. Littlejohn; Psychology, Dr. T. S. Clouston; Neurology, Dr. Byrom Bramwell; Pathology, Dr. W. S. Greenfield; Pharmacology and Therapeutics, Dr. J. O. Affleck; Ophthalmology, Dr. D. Argyll Robertson; Laryngology and Otology, Dr. P. MacBride; Diseases of Children, Dr. Joseph Bell; Dermatology, Dr. W. A. Jamieson; Medicine in relation to Life Insurance, Dr. C. Muirhead; Tropical Diseases, Dr. P. Manson; Anatomy, Sir John Struthers; Physiology, Dr. W. Rutherford, F.R.S.

THE ninth International Congress of Hygiene and Demography will (says the *British Medical Journal*) be held at Madrid on April 10 to April 17. The Congress is under the patronage of His Majesty Alfonso XIII. and Her Majesty the Queen Regent, and the Spanish Minister of the Interior, Señor Sagasta, is President of the Organising Committee. The Secretary-General of the Congress is Dr. Amalio Gimeno y Cabañas, Professor of Hygiene in the University of Madrid.

The President of the Executive Committee is Prof. Julian Calleja, the Vice-President the Marquis del Busto, Professor in the Madrid Faculty of Medicine. As far as relates to hygiene, the work of the Congress will be divided among ten Sections as follows: microbiology in relation to hygiene; prophylaxis and transmissible disease; medical climatology and topography; urban hygiene; hygiene of alimentation; hygiene of infancy and of schools; hygiene of exercise and labour; military and naval hygiene; veterinary hygiene, civil and military; sanitary architecture and engineering. The part of the work relating to Demography will be divided among three sections as follows: technics of demographic statistics; statistical results in relation to demography; dynamical demography (movements of population, &c.). A British Committee, of which Sir Douglas Galton, K.C.B., is Chairman, has been formed to secure the co-operation of sanitarians in this country, and generally to promote the success of the Congress. Programmes of the subjects to be dealt with, and all other particulars, may be obtained from the Honorary Secretary to the British Committee, Dr. Paul F. Moline, 42 Walton Street, Chelsea.

A CABLEGRAM through Reuter's agency, dated January 6 at Bombay, states that plague returns for Bombay show 142 cases and 105 deaths during the preceding forty-eight hours. Later news states that on January 8-9 there were 159 cases and 126 deaths. The total mortality during the present outbreak is 406. The epidemic is now following closely the lines of the original outbreak, and ominous rumours are circulating to the effect that unless things improve by the time of the forthcoming solar eclipse, there will be a serious exodus and a general suspension of business.

THE memorial presented to the Department of Woods and Forests by the Guildford Natural History Society, asking that Wolmer Forest be reserved as a sanctuary for wild birds and other animals, has been passed on to the War Department, to which the forest, including the rights of shooting and sporting, is in lease. In doing so, Mr. Howard, Commissioner of Woods and Forests, takes the occasion to remark that he is disposed to think that the best mode of arriving at the objects which the petitioners have in view is to take advantage of the game laws and the present system of game preservation in order to protect animal life generally. He thinks that where game preservation is carried out only those creatures which are specially destructive of birds are kept down, and animal life generally flourishes better than it would be likely to do in other circumstances.

DR. E. ZINTGRAFF, whose death we have already announced, was one of the most energetic of the German pioneers to whom fell the work of exploring the interior of the Cameroons, after that territory had, in 1884, become a dependency of the German Empire. Born at Dusseldorf in 1858, Dr. Zintgraff obtained his doctor's degree at the University of Heidelberg, and gained his first experience of African exploration as member of Dr. Chavanne's expedition to the Congo (1884). A year or two later he proceeded to the Cameroons, at that time a veritable *terra incognita* in respect of all but its coast line. For the space of six years his activity was unabated, and to him belongs the honour of being the first to push his way through the belt of dense forest lying behind the Coast Settlements to the open grassy plains which occupy the interior plateau, and to reach by this route the populous regions of Adamaua in the Southern Sudan, with their enterprising population of Hausas. This successful journey to the north was not made until 1889, the previous years having been occupied by detailed explorations north of the Cameroons Mountain, and by the establishment of the Barombi Station as a base from which the ultimate advance could be made. Dr. Zintgraff subsequently did much to encourage agricultural enterprise in the Cameroons. His arduous journeys had undermined his health, and the latter years of his life were spent at Teneriffe, where he died on December 5, 1897.

THE work which the late Mr. Gardiner G. Hubbard did for the cause of science is made the subject for appreciative comment in *Science*. In 1883 Mr. Hubbard and Mr. Alexander Graham Bell founded the old series of *Science*, the first editor of which was Mr. S. H. Scudder. He was what the French language terms an *entrepreneur* of scientific ideas, inventions and discoveries—the man of affairs who pushed them into the service of mankind. He was the *entrepreneur* of oral speech for the deaf, and also of the telephone, for it was through his energy and business ability that the instrument was introduced to the world and made a practical agency of intercommunication. Having accomplished this he retired to Washington, and when the National Geographic Society was founded there, he was elected first president. The function of the National Geographic Society is the discussion of the principles of geography and the diffusion of geographical knowledge among the people. To carry out this purpose Mr. Hubbard organised the *National Geographic Magazine*. Then he organised a system of bulletins designed to discuss the elements of physiography as a compendious library for teachers in the public schools, and finally he organised in the city of Washington a system of public lectures on geography, enlisting not only the members of the Society, but many other able public men in this enterprise. In all of these agencies the working geographers of Washington most heartily co-operated, and the National Geographic Society has within very few years attained remarkable influence and efficiency.

THE January number of the *National Review* has an admirable article by Mr. Gerald Arbuthnot, entitled "In Defence of the Muzzle." The temperate spirit in which it is written, and the conscientious manner in which the statistics referred to have been collected, ought to materially strengthen the hands of those who are upholding the muzzling order for dogs, in the face of the selfish and short-sighted opposition which it is receiving from a certain section of the public. In the same magazine we note also a paper by Mr. Arthur Shadwell, dealing with the recent outbreaks of typhoid fever. The writer permits himself to affirm that the medium by which the poison of typhoid fever is diffused "can hardly be anything else but water, acting directly or indirectly." The diffusion of typhoid fever is far too complicated a problem, and involves too many factors to enable water to become thus *wholly* responsible, as the writer seems to consider. Whilst contaminated water is undoubtedly an important—a very important—factor in the dissemination of this disease, there are other conditions which must be considered in this connection, and amongst such sewer-gas would seem to deserve a prominent place. Several years ago now, it was shown by an Italian investigator that the inhalation of sewer-gas markedly increased the predisposition of the subject under experiment, to suffer from the effects of typhoid poison.

IN the early days of railway engineering, little circumspection was used in laying down lines, and many tunnels were constructed which would nowadays be avoided by following the policy of evading obstacles wherever possible. An unnecessary tunnel of this kind, built fifty years ago by the North British Railway Company, and running for 3000 yards at a depth of 60 feet below the streets of Edinburgh, was afterwards discarded, another line having been constructed which carries the traffic outside the city. For a time the old tunnel remained unused, but ten years ago it was taken over by Messrs. R. and J. Paton, of Glasgow, and has since been used by them for the purpose of cultivating mushrooms. The story of this industry is briefly

told in the January number of *Pearson's Magazine*. A little consideration will show that the tunnel offers ideal conditions for the growth of mushrooms; the temperature varying but very slightly, and light being absent. The result of this combination of favourable conditions is that the Scottish Mushroom Company now practically control the market in cultivated mushrooms. The Company has eight hundred mushroom beds in the tunnel, each about 12 feet by 3 feet in size. When in full operation about one thousand bushels of spawn are used yearly. The highest output reaches five thousand pounds of mushrooms per month. The steady and constant supply has killed foreign competition in mushrooms; for it appears that, whereas ten years ago the quantity of French mushrooms consumed in Great Britain largely exceeded those of home growth, they form at present only about one-hundredth part of the total supply.

A NUMBER of remarkable instances of hallucinations connected with hemianopia, or complete blindness in one or other half of the visual field, are described by Dr. W. Harris in the course of an article in the new number of *Brain*. In one case of partial hemianopia the patient had visual hallucinations, lasting a few minutes, of folk and horses moving in a reddish atmosphere, the visions being limited to the blind field of vision. Another saw continually in his blind field a man standing at the back of his head, holding two lighted candles. A man who developed right hemianopia was troubled ten days later with hallucinations of men, flies, insects, &c. At first he recognised their unreality, but after a few days he became convinced they were real. The spectres became more frequent, and he would then hunt for t' em in cupboards and corners. Another case of hemianopia with hallucinations in the blind field, is that of a man who suddenly lost power of speech, using wrong words, and forgetting the names of things. During a subsequent attack of temporary loss of speech he suddenly noticed while reading that his sight was confused, and that the print seemed to run together. After that he noticed he could not see so well to the right, and he used to bump up against things on his right side, and had to be careful whilst crossing the road. He also has had visual hallucinations of animals and faces moving about to his right. Dr. Harris discusses the seat of production of visual hallucinations of this kind, and concludes that they cannot be elaborated in the half-vision centre in the cuneus of the brain, but in a higher visual centre—possibly the angular gyrus.

PROF. PLATEAU'S experiments on the conditions which induce insects to visit flowers have been referred to on several occasions (see p. 179). It is worth while, however, bringing the facts together. In the concluding part of his series of papers, "Comment les fleurs attirent les insectes," in the *Bull. de l'Acad. des Sciences de Belgique*, Prof. Plateau thus sums up the results at which he has arrived. In seeking for pollen or nectar, insects are guided only to a subsidiary extent by the sense of sight. They continue to visit scented flowers after the coloured parts have been almost entirely removed. When flowers of the same species vary in colour, they exhibit neither preference nor antipathy for one colour over another. Inconspicuous flowers hidden among foliage attract large numbers of insects. Artificial flowers made of paper or calico, even when brightly coloured and closely resembling real flowers, are not visited by insects; but they are when made of green leaves which have a vegetable scent. If flowers which have little or no nectar, and which are therefore habitually neglected by insects, are smeared with honey, insects are attracted in large numbers. On the other hand, if the nectary is removed from flowers habitually visited, their visits cease at once. The author has paid especial attention to entomophilous flowers, and finds that their exemption from the visits of insects is due mainly to their not providing them with honey. From all these facts M. Plateau draws the conclusion that the guiding sense to insects in visiting flowers must be chiefly the sense of smell.

WRITING in the *Revue générale des Sciences* for December 30, 1897, Dr. Louis Olivier describes the latest combination of the principles of the microphone and phonograph under the name of *microphonograph*, the invention of M. F. Dussaud, of Geneva, and which has been subsequently developed by M. George F. Jaubert and M. Berthon. A demonstration of the properties of this apparatus was given a short time ago at the house of M. and Mme. Eugène Pereire. From certain physiological facts, Dr. Laborde showed the possibility of rendering sounds audible to deaf mutes by this instrument, and his view received practical confirmation at the hands of Dr. Gellé, who experimented with signal success on a number of subjects to whom a sensation of sound was thus conveyed for the first time. It is suggested that the micro-phonograph may become an important factor in the education of deaf and dumb subjects. It will be remembered that a method of giving deaf mutes the feeling, or at all events the rhythm of music, was devised by Prof. McKendrick, and has been described in these columns (vol. lvi. p. 212). Finally, M. Berthon and M. Jaubert have employed the new apparatus in connection with the telephone and the kinematograph, the latter combination rendering it possible to reproduce scenes with all the attendant sounds of conversation and so forth. With this apparatus it is proposed to arrange life-like reproductions of a number of naval scenes at the Exhibition of 1900, under the auspices of the Compagnie générale Transatlantique.

WHERE certain salts, such as bromide of potassium and chloride of sodium, undergo changes of colour under the action of kathodic rays, after the method of Goldstein, it has been found by Profs. Elster and Geitel that they are at the same time rendered photo-electrically sensitive, inasmuch as in sunlight or broad daylight they lose any negative electric charges imparted to them more rapidly than in the dark. The same physicists, writing in *Wiedemann's Annalen* (62), now examine whether the same property is conferred on these salts when the coloration is produced by heating them in the presence of potassium or sodium vapour, after the manner described by Kreutz and Giesel. In the case of common salt, the electrometer readings representing the loss of charge in one minute in light were as follows:—For salt coloured by kathodic rays and kept in darkness a year, 214; rock-salt coloured brown to blue by potassium vapour, 73; natural violet salt, 23; chloride of sodium coloured by Berlin blue, + 1; the corresponding data in the dark being 0, − 10, − 2, − 3. With potassium bromide, nearly blackened by potassium vapour, in light, 171; the same bright blue, 101; the same coloured by Berlin blue, + 1; the results in darkness being − 4, + 2, 0 −. There is thus no doubt that the same photo-electric properties are conferred on the salts by potassium vapour as by kathodic rays; and, moreover, these properties exist more or less in the natural violet and blue varieties of such minerals as rock-salt and fluor-spar.

A DETAILED account of experiments in gliding flight is contributed by Mr. Octave Chanute to the *Journal of the Western Society of Engineers* (U.S.A.) for 1897. After trying many different types of gliding machines, some with as many as six superposed pairs of wings, Mr. Chanute seems to have chosen for his later experiments a form of apparatus with two narrow superposed aëro-curves of rectangular form. The most noteworthy feature of Mr. Chanute's investigations is his invention of a regulating mechanism by which the fore and aft equilibrium and stability is automatically maintained without any exertion or special agility on the part of the operator, and even the

action of side gusts of wind is considerably diminished. We observe that the wing surfaces are fixed above the operator's head, an arrangement quite the reverse of that adopted by Mr. Pilcher. Nevertheless both Mr. Chanute and Mr. Herring have made numerous glides with perfect safety, and the latter has achieved considerable success in "quartering," *i.e.* advancing at an angle with the wind along the side of a hill up which a current of wind is blowing. By this means Mr. Herring has succeeded in making a glide of 927 feet, the time occupied being about forty-eight seconds.

THE *Bulletin* of the Italian Geographical Society publishes a note announcing the successful starting from Tabriz of a small scientific expedition to Lake Urmia, under the direction of Prof. Paladini of Milan. It is intended to make a survey of the lake and the region immediately surrounding it.

APPLYING the principles laid down by Penck, in his "Morphologie," to the excellent and abundant data published by Forel, Dr. Wilhelm Halbfass has worked out in detail the morphometry of the Lake of Geneva: the results are to be found in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* (vol. xxxii. No. 4).

THE greater part of Nos. 9 and 10 of the present volume of the *Mittheilungen* of the Vienna Geographical Society is devoted to a learned paper, by Herr Fritz Pichler, on the Noreia of Polybius and of Castorius. Herr Pichler concludes that the town called Noreia by Castorius, near Neumarkt in Upper Styria, is an unimportant station, of which there is no trace previous to 365 A.D. The real Noreia of Polybius is the same as Virunum, near Klagenfurt, Noreia being the older name, traceable from B.C. 113 for centuries backwards.

MESSRS. SWAN SONNENSCHEIN AND CO. announce that they will shortly publish a work, entitled "The Wonderful Century: its Successes and its Failures," by Dr. Alfred R. Wallace, F.R.S. The object of the volume is to give a short descriptive sketch of all the more important mechanical inventions and scientific discoveries which are distinctive of the nineteenth century, and especially to enable those, who have lived only in the latter half of it, to realise its full significance in the history of human progress. The author maintains that our century is altogether unique; that it differs from the eighteenth or seventeenth centuries, not merely as those differed from the centuries which immediately preceded them, but that it has initiated a new era, and that it may be more properly compared with the whole preceding historical period.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*) from India, presented by Miss Vine; an Egyptian Jerboa (*Dipus ægyptius*) from North Africa, presented by Mr. H. W. Wibrow; an Indian Python (*Python molurus*) from India, presented by Mr. F. J. Allpress; three Common Squirrels (*Sciurus vulgaris*), British; two Blue-faced Honey-eaters (*Entomyza cyanotis*) from Australia, a Razorbill (*Alca torda*), two Common Widgeon (*Mareca penelope*), twelve Common Teal (*Querquedula crecca*), European, purchased.

## *OUR ASTRONOMICAL COLUMN.*

COMPANIONS TO VEGA.—One of the proofs given as to the light-gathering power of the new Yerkes telescope is that Prof. Barnard has observed a new companion to Vega, which even the Lick telescope had failed to make visible. Measures made with a temporary micrometer gave its position angle 312° and distance 53″ with respect to Vega. It is said to be much fainter than the small star discovered by Winnecke at Pulkova in 1864, whose magnitude is 14·5. In the *Astr. Journ.* (No. 414) Prof. Barnard points out that the latter companion, with position angle 288°·9 and distance 53″, is the same as that discovered by Mr. George Anderson, of the United States Naval Observatory, in 1881, but with a slightly modified position.

HARVARD COLLEGE REPORT.—In the fifty-second "Annual Report of the Astronomical Observatory of Harvard College," Prof. Pickering gives an interesting account of the work done. As regards buildings his report is similar to that from many other observatories, in that they are old and far behind observatories not only of the first rank, but even of the second class. On the other hand, however, very few can say with him "that their strongest feature is the large endowment for current expenses, which enables the large staff of forty assistants to be employed." The excellent work done at Arequipa is described in another part of NATURE (p. 249), so we will content ourselves with a brief summary of the work done in other sections of the observatory.

As before, Mr. O. C. Wendell has been engaged in the observations of variable stars, and the number of measures made is almost astounding, *e.g.* 1031 comparisons of *o* Ceti, 3296 of U Cephei, &c. Another series of interesting photometric comparisons are those made by Mr. E. R. Cram, on *β* Lyræ, the total number of measures being 2304

With the "Meridian Photometer" the total number of photometric settings has surpassed all previous records, numbering 100,052, and observations of all the stars of magnitude 7·5 and brighter, and north of − 40°, are now nearly completed. Besides star work, measures were made of Uranus, Neptune, and nearly 500 each of Ceres, Juno, and Vesta.

The work in connection with the Draper Memorial has also been remarkable, and the hydrogen lines have been shown to be bright in the spectra of many known variables, U Cassiopeiæ, R Piscium, R Canis Minoris, and many others; also new variable stars have been detected by means of bright hydrogen lines in their spectra. The Report shows that excellent results have been attained; and such, we know, is the case from notes of discoveries made at the observatory, announcements of which have appeared from time to time in these columns.

ARTHUR KAMMERMANN.—We regret to record the death of Arthur Kammermann, astronomer at the Geneva Observatory (*Astr. Nach.*, No. 3469).

Born at Bienne in 1861, he received his higher education at the Zürich Polytechnic, leaving there in 1881 with the diploma of "Fachlehrer." At Zürich he was initiated into astronomical work by M. R. Wolf, who strongly recommended him to Plantamour, at Geneva Observatory, where he became attached as assistant.

After the retirement of Dr. W. Meyer in 1883, he had the Plantamour equatorial under his charge, and undertook astronomical photography with it; with this instrument he worked until his death, and many of his observations have been published in the *Astr. Nach.* He was largely occupied with meteorological matters; and in the chronometric work of the observatory he rendered great services which benefited the watchmaking industry, so important to Geneva.

MINOR PLANETS IN 1897.—The total number of minor planets discovered in 1897 was only eight, which is considerably below the average of recent years; so that perhaps in time we shall be able to obtain a complete list of them. The latest discoveries were those of Charlois at Nice: DL on November 23, DM, DN, DO on December 18.

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WE have received from Mr. Arthur Mee a copy of his "Amateur Observer's Card Almanac." The calendar brings together in a handy form the principal phenomena for each day in the year, and it will be found useful to hang upon the walls of the observatory for reference.

PROF. G. M. SEARLE, professor of mathematics and astronomy in the Catholic University of America, has been appointed by the Pope to succeed the late Father Denza as director of the Vatican Observatory.

*Science* states that money has been granted by the Trustees of Amherst College for the purchase of a new telescope to replace the old instrument in use at present, and the bequest of 18,000 dollars for the purchase of a site for a new observatory will be expended as soon as the various plans for a new position have been carefully considered.

## EARLY MAN IN SCOTLAND.[1]

### II.

ONE may now inquire into the reason why cinerary urns, with their contained ashes, and short cists, enclosing bodies which had been buried in a bent or stooping attitude, should be associated with the men of the Bronze Age. The first and most important is the presence of objects made of bronze. In the 144 localities under analysis in which interments ascribed to the Bronze Age have been examined, bronze articles were found in thirty-four directly associated with the interments. In four of these the bronze was along with objects made of gold. In seven other interments of the same character gold ornaments without bronze were present. The men of this period were, therefore, workers in gold also; and as it has been, and indeed still can be, mined in Scotland, it is not unlikely that the ornaments had been wrought from native metal. Additional proof that the burials in short cists, and after cremation in cinerary urns, both belonged to the same period, and were practised by the same people, is furnished by the presence of articles of bronze and gold in both groups of interment.

But, in addition to metallic objects, the graves sometimes contained other implements and ornaments. In many localities articles made of flint, stone, or bone, and jet beads were associated with bronze. In others flints in the form of chips, knives, arrow-heads, and spear-heads; stone implements in the form of whetstones and hammers; bone and jet ornaments and bone pins have been found in short cists, and some of these articles also in cremation interments, unaccompanied by bronze.

Attention has been called by Dr. Joseph Anderson to the character of the bronze objects usually associated with these burials ("Scotland in Pagan Times"). For the most part they have been thin blades, leaf-like or triangular in form, and either with or without a tang for the attachment of a handle. From their shape they might have been used as spear-heads, daggers, or knives. Not unfrequently the surfaces of the blade were ornamented with a punctated or incised pattern. Sometimes bronze pins, rings and bracelets have been obtained from these interments. It should, however, be stated that the bronze articles and ornaments of gold found in association with the burials are of a more simple character, and present less variety in form, purpose and decoration than those which have been got in hoards, in various parts of Scotland. It would seem, therefore, as if the people of this period, even if they were in possession of such finished and beautifully decorated swords, bucklers, axes and bronze vessels as have been got in the hoards just referred to, did not deposit them in the graves of their deceased friends and relatives. It may be, however, that the simpler articles found in the interments represent a period in the Bronze Age earlier than that in which the art of making the more elaborate articles had been acquired, when perhaps the custom of depositing grave goods had been more or less departed from.

Cinerary urns are not the only utensils formed of baked clay to which the term urn has been applied, and archæologists recognise by the names of "incense cups," "food vessels" and "drinking cups," three other varieties.

The examples of so-called Incense cups are not numerous in Scotland; they were associated with cremation interments, and have usually been contained in cinerary urns; they are the smallest of all the varieties of urn, and are, as a rule, from 2 to 3 inches high and about 3 inches wide. In one specimen from Genoch, Ayrshire, the cup possessed a movable lid. Not unfrequently the outer surface was patterned with horizontal, vertical, and zig-zag arrangements of lines. In a few cases the sides were perforated, as if to allow the escape of fumes; and it is probably from this character, as well as from their small size, which fitted them for being easily carried in the hand, that they have been termed incense cups. The burning of incense would, however, imply, on the part of the people of the Bronze Age, the possession of fragrant gums and resins such as are not indigenous to Britain, and which the ancient Caledonians were not at all likely to be in a position to procure. In most instances the contents of these cups were not preserved by the finders. An example which was discovered in 1857 at Craig Dhu, North Queensferry, covered by a larger urn, and about the size of a teacup, was filled with calcined human bones; the specimen from Genoch, found a number of years ago by Dr. James Macdonald, of Ayr, contained the burned bones and ashes of a child in its fifth or sixth year. Of the conflicting theories as to the purpose to which these cups were applied, the view that, like the large urns with which they were associated, they were cinerary, and were intended for the reception of the ashes of an infant or young child, seems the most probable.

Numerous examples of the variety of urn termed "food vessel" have been found in Scotland, and "drinking cups" although not quite so numerous, are fairly represented. In the 144 localities under analysis, the bowl-shaped food urns were found in thirty-one, drinking cups in twenty-five, and in seven instances the size and form of the urn is not stated with sufficient precision. With a few exceptions, in which the character of the burial had not been fully described, the urns were contained in short cists, in which also the skeleton of an unburnt body in the bent or contracted position was lying. In several instances it is stated that the urn, either food or drinking vessel, contained black dust, or earth, or greasy matter, but burnt bones are never said to constitute their contents. Not unfrequently, although this is not an invariable rule, the urn was placed in proximity to the head and raised hands of the skeleton.

These varieties of urn are by no means invariably present in short cists. In twenty-five localities where this kind of grave was seen, there is no record of either form of urn being present. It is obvious therefore that, though associated with so many inhumation interments, they were not regarded as necessary accompaniments, and they obviously discharged in the minds of the people of the time a different function from that of cinerary urns. The term food-urns applied to the bowl-shaped variety is probably appropriate, as indicating that edible substances were placed in them, in the belief that food should be provided for the use of the corpse. It is questionable, however, if the taller variety were drinking cups, as the unglazed clay would not fit them for the retention of liquids for any length of time. The presence of food urns in cists, along with, in some instances, implements and weapons, would point to the belief, in the minds of those practising this form of interment, in a resurrection of the body, and a restoration to the wants and habits of the previous life. It may be that placing the body in the crouching position, lying on one side, was regarded as the attitude best fitted, when the proper time came, to enable it to spring into the erect position and assume an active state of existence. The practice of cremation, however, to an almost equal extent as inhumation, by people of the same period, shows that they may not all have shared in the belief in a corporeal resurrection. But it should not be forgotten that, even in many cremation interments, blades and other objects made of bronze have been found along with the burnt bones and cinerary urns, as if for use in a future life.

The association of bronze objects, both with short cists and cinerary urns, establishes these forms of interment as practised at a time when bronze was the characteristic metal used in many purposes of life. The crouching attitude of the dead body, the contracted grave, and the varieties of urns already described, are therefore to be regarded as equally characteristic of this period, even if bronze is not found in a particular instance associated with the interment, and this view is generally held by archæologists in Scotland.

In a preceding paragraph implements and weapons made of stone, flint and bone were referred to as having been sometimes associated with bronze, and also of similar objects having been found in graves, in which, though obviously of the same class and period, no article made of metal was observed. Such an association proves that there was no sharp line of demarcation between the employment of the more simple substances used by Neolithic man in the manufacture of implements and weapons, and the use of bronze for similar purposes. The two periods undoubtedly overlapped. It has been customary to regard this overlapping as if bronze-using man had continued for a period to employ the same substances in making useful articles as did his Neolithic predecessors; that time was required before the more costly bronze, imported from foreign sources, replaced the native material, and that consequently both groups of objects became associated in the same grave.

Additional light is thrown on the mixture in the same interment of objects representing different stages of culture by a collection of goods from the grave of an aboriginal Australian, buried about fifty years ago, recently brought under my notice by Dr. R. Broom. Along with the skeleton were found a clay pipe, an iron spoon, the remains of a rusted pannikin, the handle of a pocket-knife, and a large piece of flint. The handle

[1] A discourse delivered at the Royal Institution, London, by Sir William Turner, F.R.S. (Continued from page 237.)

of the knife, with its steel back, had doubtless been used along with the flint for the purpose of obtaining fire, as in Neolithic times a similar office was discharged by flint and a nodule of pyrites. These accompaniments of the Australian interments show that men in a lower grade of culture and intellectual power utilise, as opportunity offers, objects representing a much higher civilisation. It is possible, therefore, that some of the mixed interments ascribed to the Bronze Age may be the graves of Neolithic men who, in conjunction with articles of their own manufacture, had employed the material introduced by a bronze-using race, with whom they had been brought in contact, and whose usages they had more or less imitated.

That the inhabitants of prehistoric Scotland were not a homogeneous people, but exhibited different types in their physical configuration, so as to justify the conclusion that they were not all of the same race, has long been accepted by archæologists. The first observer who made a definite statement, based on anatomical data, was the late Sir Daniel Wilson, in his well-known "Prehistoric Annals of Scotland." Whilst admitting that the material at his disposal was scanty, he thought that he was justified in stating that the primitive race in Scotland possessed an elongated dolichocephalic head, which he termed boat-shaped, or kumbecephalic. This race, he said, was succeeded by a people with shorter and wider skulls, which possessed brachycephalic proportions. Further, he considered that both these races preceded the intrusion of the Celtæ into Scotland. But the evidence is by no means satisfactory that the interments from which Wilson obtained the long kumbecephalic skulls were of an older date than those which yielded the brachycephalic specimens. So far, therefore, as rests upon these data, one cannot consider it as proved that a long-headed race preceded a broad-headed race in Scotland, and that both were antecedent to the Celtæ.

Evidence from other quarters must be looked for, especially from the extensive researches of Thurnam, Greenwell, Rolleston and other archæologists into prehistoric interments in England; and by the study of the material which has accumulated in Scotland since the publication of Sir Daniel Wilson's "Prehistoric Annals."

The remains of prehistoric man in England subsequent to the Palæolithic Age have for the most part been found in mounds and tumuli, some of which were very elongated in form, others more rounded, so that they have been divided into the two groups of Long and Round barrows. There is a consensus of opinion that the long barrows were constructed by a race which inhabited England prior to the construction of the round barrows. The long barrows are indeed the most ancient sepulchral monuments in South Britain; obviously they were erected before the use of bronze or other metal became known to the people. They belonged, therefore, to the Neolithic Age, as is testified by the implements and weapons found in them being formed of stone, flint, bone and horn, and by the absence of metals. They are not widely distributed in England, but are found especially in a few counties in the north, as Yorkshire and Westmorland, and in the western counties in the south. The builders of these barrows in their interments practised both inhumation and cremation, but the burnt bones were never found in urns.

The study of the human remains obtained from the English long barrows by Drs. Thurnam and Rolleston proves that the crania were distinctly dolichocephalic, and that the height was greater than the breadth. Those measured by Dr. Thurnam gave a mean length-breadth index 71·4, whilst Dr. Rolleston's series were 72·6.

The round barrows were constructed by a bronze-using people. The crania obtained in them were, as a rule, brachycephalic. Of twenty-five skulls measured by Dr. Thurnam seventeen had the length-breadth index 80 and upwards, and in six of these the index was 85 and upwards. Only four were dolichocephalic, whilst in three the index ranged from 77 to 79. In the brachycephalic skulls the height was less than the breadth.

As similar physical conditions prevailed both in England and Scotland during the Polished Stone and Bronze periods, there is a strong presumption that the two races had, in succession to each other, migrated from South to North Britain. Unfortunately very few skulls have been preserved which can with certainty be ascribed to Neolithic man in Scotland, but those that have been examined from Papa Westray, the cairn of Get and Oban, are dolichocephalic, and doubtless of the same race as the builders of the English long barrows.

Seventeen skulls from interments belonging to the Bronze period have been examined by the author. The mean length-breadth index of twelve was 81·4, and the highest index was 88·6. In each skull the height was less than the breadth. In the other five specimens the mean index was 74; the majority, therefore, were brachycephalic. In only one specimen was the jaw prognathic; the nose was almost always long and narrow; the upper border of the orbit was, as a rule, thickened, and the height of the orbit was materially less than the width. The capacity of the cranium in three men ranged from 1380 to 1555 c.c.; the mean being 1462 c.c. In stature the Bronze men were somewhat taller than Neolithic men. The thigh bones of the Bronze Age skeletons gave a mean platymeric index 75·1, materially below the average of 81 8 obtained by Dr. Hepburn from measurements of the femora of modern Scots.[1] The tibiæ of the same skeletons gave a mean platyknemic index 68·3; intermediate, therefore, between their Neolithic predecessors and the present inhabitants of Britain. Many of the tibiæ also possessed a retroverted direction of the head of the bone; but the plane of the condylar articular surfaces was not thereby affected, so that the backward direction of the head exercised no adverse influence on the assumption of the erect attitude.

Whilst in England the Bronze Age round barrows are numerous and the burials in short cists are comparatively rare, in Scotland the opposite prevails. Whilst part of Dr. Thurnam's aphorism, viz. "long barrows, long skulls," applies to both countries, the remaining part, "short barrows, short skulls," should be modified in Scotland to "short cists, short or round skulls."

The presence of dolichocephalic skulls in the interments of the Bronze Age shows that the Neolithic people had commingled with the brachycephalic race. Similarly the Bronze men, though subject to successive invasions by Romans, Angles, and Scandinavians, have persisted as a constituent element of the people of Great Britain. The author has found a strong brachycephalic admixture in the crania of modern Scots, in Fife, the Lothians, Peebles, and as far north as Shetland. In 116 specimens measured, 29, *i.e.* one-quarter, had a length-breadth index 80 and upwards, and in five of these the index was more than 85.

The question has been much discussed whether the people of the Polished Stone Age were descended from the men of the Ruder Stone Age, or were separated from them by a distinct interval of time. The latter view has been supported by Prof. Boyd Dawkins, who contends that there is a great zoological break between the fauna of the Palæolithic, Pleistocene period and that of the Neolithic Age, and that the two periods are separated from each other by a revolution in climate, geography and animal life.[2]

Undoubtedly many large characteristic mammals of the Palæolithic fauna had entirely disappeared from Britain and western Europe, but some nine or ten species, as the otter, wolf, wild cat, wild boar, stag, roe, urus and horse, were continued into the Neolithic period; at which time the dog, small ox, pig, goat, and perhaps the sheep, as is shown by their osseous remains, were also naturalised in Britain. The continuity of our island with the continent by intermediate land, which existed during Palæolithic times, also became severed, and a genial temperate climate replaced more or less arctic conditions.

Man, however, possesses a power of accommodation, and of adapting himself to changes in his environment, such as is not possessed by a mere animal. The locus of an animal is regulated by the climate and the nature of the food, so that a change of climate, which would destroy the special food on which an animal lives, would lead to the extinction of the animal in that locality. Man, on the other hand, is omnivorous, and can sustain himself alike on the flesh of seals, whales and bears in the Arctic circle, and on the fruits which ripen under a tropical sun. Man can produce fire to cook his food and to protect himself from cold, and can also manufacture clothing when necessary. Palæolithic man has left evidence that he had the capability to improve, for the cave men were undoubtedly in advance of the men who made the flint implements found in the river drifts. The capacity of the few crania of Palæolithic man which have been preserved is quite equal to, and in some cases superior to that of modern savages. So far as regards the implements which he manufactured and

[1] *Journal of Anat. and Phys.*, October 1896, vol. xxxi.

[2] "Cave Hunting, and *Journal* of Anthropological Institute," vol. xxiii., February 1894.

employed, Neolithic man showed no material advance over the Palæolithic cave dweller.

The association of the bones of domestic mammals, which were not present in Palæolithic strata, along with the remains of Neolithic man, proves that additional species had been introduced into Western Europe at a particular period, probably by another race which had migrated northward and westward; but it by no means follows that Palæolithic man had of necessity disappeared prior to this migration, and that when Neolithic man reached Western Europe he found it, as regards his own species, a desolate solitude. How then did Neolithic man with his associated animals find his way into Britain?

Was it whilst the land remained, which connected Britain with the continent in interglacial times, and along which Palæolithic man had travelled, or was it at some subsequent period after the formation of intermediate arms of the sea? If the latter, then the further question arises, How was the transit effected? Neolithic man, so far as is known, had no other means of conveyance by water than was afforded by a canoe dug out of the stem of a tree. Although such rude boats might in calm weather serve as the means of transporting a few individuals at one time across a river or narrow strait from one shore to the other, they can scarcely be regarded as fitted for an extensive migration of people; still less as a means of conveying their pigs, dogs, goats and oxen. Hence one is led to the hypothesis that, after the sea had submerged the intermediate land of interglacial times, there had been a subsequent elevation so that Britain again became a part of the continent of Europe. If one may use the expression, a "Neolithic land bridge" was produced, continental relations and climate were for a time re-established, and a free immigration of Neolithic man with his domestic animals became possible. This may have been at the period when an abundant forest growth in Scotland succeeded the elevation of what is now called the 100-foot terrace. There is no evidence of the presence of Neolithic man in Scotland until about that period. Before this island with its surrounding and protecting "silver streak" settled down to the present distribution of land and water, there are ample data, as is shown by the three sea beaches at different levels seen so distinctly on the coast of Scotland, that frequent oscillations changed the relative positions of land and sea to each other.

From the consideration of what may be called the biological data, the conclusion seems not to be justified, that because climatic changes had led to a disappearance of certain characteristic Palæolithic mammals, but by no means of all, therefore Palæolithic man had vanished along with them. When Neolithic man reached Western Europe, he in all likelihood found his Palæolithic predecessor settled there, and a greater or less degree of fusion took place between them. Hence, as the present inhabitants of Britain may claim the men both of the Neolithic and Bronze Ages as their ancestors, it is possible that as Neolithic man migrated northward into Scotland he may have carried with him a strain of Palæolithic blood. W. T.

## *PROGRESS OF TECHNICAL EDUCATION.*

A REVIEW of the progress of technical education in the United Kingdom during the year 1896-97 is given in the tenth annual report of the National Association for the Promotion of Technical and Secondary Education. A general idea of the present position of the technical education movement may be obtained from the subjoined extracts from the report just issued.

### *Technical Education in England.*

It is pleasing to be able to record that, in the year 1896-97, the total amount of money available under the Local Taxation (Customs and Excise) Act, 1890, and distributed to the local authorities, was larger than in any previous year, and that a further advance has been made as regards its utilisation for educational purposes.

Of the 49 County Councils in England 41 are now giving all and eight are giving part of their grants to educational purposes, while of the 61 County Borough Councils 55 are devoting all and six are devoting part of the fund in a like manner. In the county borough of Preston a noteworthy advance has been made. In this locality a new technical institute, erected by the Harris Trustees at a cost of about 20,000*l.*, has recently been opened, and the County Borough Council, by voting a sum of 500*l.* in aid of technical education in the borough, have now retired from that position of isolation which they had hitherto occupied. At the present time, therefore, all the County and County Borough Councils in England are utilising the provisions of the Technical Instruction Acts.

In considering the amount of money devoted one way and another, it may be stated that, of the total of 807,000*l.* now available in England alone, no less a sum than 740,000*l.* is being spent upon education. It is worthy of note that London's share of the fund now reaches 185,000*l.*, of which a sum of 150,000*l.* is being utilised for educational purposes, a growth of 30,000*l.* as compared with last year's vote. Therefore, looking at the position as a whole, it is clear that education continues to receive financial support of an extending character.

In last year's report particulars were given respecting local authorities contributing funds to education in the form of *rate aid*. The information then published went to show that there were at least 137 localities providing a total sum of 34,000*l.* in this manner. To these figures must now be added a further 23 authorities raising 5000*l.*, thus making an aggregate number of 160 local authorities levying rates, or voting lump sums from the rate-fund, to the extent of 39,000*l.*

The extent to which local authorities and responsible committees in England have built, or are building, or are about to build, technical schools is shown by the fact that the number of such schools thus initiated now reaches 161, of which 146 involve a capital expenditure of 1,730,000*l.* This sum is *exclusive* of about 500,000*l.* absorbed by the establishment of polytechnic institutions in London. It is worthy of notice that in Burslem, Chesterfield, Dewsbury, Keighley, Plymouth, Rochdale, Southport and Walsall the necessary funds for building purposes were provided entirely by voluntary contributions, and that in Lancaster, Northwich, St. Helens, Sandbach and Winsford sites and technical schools have been presented to the local authorities by private individuals; it may be estimated that, with the exception of Lancaster and Sandbach, concerning which complete information is not available, the financial provision which has thus been made in eleven localities represents a total of 137,000*l.* Of the aggregate number of technical schools mentioned above, 100 are already at work, 26 new schools, situate in 13 different counties, having been opened during the past year; the localities in which the largest of these new schools are to be found and the amounts spent upon the buildings are—Leicester (40,000*l.*), Preston (20,000*l.*), Darlington (16,000*l.*), Oldham and West Hartlepool (15,000*l.* each), Darwen (14,000*l.*), Swindon (13,000*l.*), and Handsworth and Northwich (10,000*l.* each). There remain, therefore, 61 technical schools which, according to the latest information, are still incomplete; but it must be understood that this number includes localities where technical schools have been transferred to the local authorities and where new schools are also being built.

In Bradford the technical college, upon which has been spent no less than 155,000*l.* (50,000*l.* for buildings and 105,000*l.* for maintenance), mainly provided by private munificence, now receives an annual grant of 2875*l.* from the Corporation; in Huddersfield, the Governing Body of the technical college have recently decided to proceed with considerable extensions to the present buildings at an expenditure, including the cost of furnishing, of 12,000*l.*; in Keighley, the mechanics' institution was founded in 1825, a new building, costing nearly 20,000*l.*, was erected by public subscription in 1870, and an additional wing was built, at an outlay of 11,000*l.*, in 1887. Hitherto there has been but one instance of a local authority divesting themselves of their powers of direct control, namely that of Burnley, where the County Borough Council, having established a technical school at a cost of 4000*l.*, transferred the management of the same to the Committee of the local mechanics' institution, the Committee receiving an annual grant of 1000*l.* from the Council.

During the year ended March 31, 1896, the expenditure, excluding capital outlay, upon agricultural education by thirty-six County Councils in England reached a total sum of 58,349*l.*

According to the latest annual report of the Board of Agriculture, the amount of money applied to this branch of technical education by the County Councils of England (including Monmouthshire, but excluding Derbyshire, the Soke of Peterborough and the Southern Division of Buckinghamshire) during the year 1896-97 was estimated to be 78,000*l.*, which sum includes capital expenditure.

*Progress in Wales.*

The whole of the sum of 38,000*l.* available under the Local Taxation (Customs and Excise) Act, 1890, is devoted to the purposes of intermediate and technical education, together with an estimated sum of 20,000*l.* raised by rate under the Technical Instruction Acts, 1889 and 1891. In addition to these sums, an amount of over 17,000*l.* is raised under the provisions of the Welsh Intermediate Education Act, 1889, which sum is met by a contribution from the Treasury not exceeding the amount payable out of the county rate, and based upon the efficiency of the schools aided by the local authorities. The total sum which is annually appropriated to intermediate and technical education in Wales is, therefore, about 92,000*l.*

In Cardiff, by an agreement between the Corporation and the University College of South Wales and Monmouthshire, the entire responsibility of providing technical instruction is placed upon the college, in consideration of a large annual grant, together with all fees and grants earned by, or on behalf of, the students. The work of the college in this connection comprises the maintenance of a large number of evening science and art and technical classes, a women's technical department, and a higher technical department, and the establishment of scholarships and studentships.

*Expenditure on Technical Education in Scotland.*

Of the total amount of 39,000*l.* distributed to local authorities under the Local Taxation (Customs and Excise) Act, 1890, an estimated sum of 28,000*l.* is devoted to technical and secondary education. This, with the addition of an amount of 60,000*l.* available under the provisions of Section 2 of the Education and Local Taxation Account (Scotland) Act, 1892, makes the total sum devoted to technical and secondary education in Scotland 88,000*l.*, excluding those sums which are applied to technical education by six School Boards out of the school fund under the Technical Schools (Scotland) Act, 1887.

*The Position of Ireland.*

The year 1897 has been one of disappointment to those interested in technical education in Ireland. In February a large and representative deputation, organised by the Technical Education Association for Ireland, waited upon the Lord-Lieutenant. His Excellency, who was much impressed by the influential character of the deputation, and the arguments which they advanced, announced that it was the intention of the Government to introduce a Bill in the coming session which would deal with agricultural instruction, and promised to use his influence with his colleagues to introduce a Bill dealing with technical education at the earliest possible opportunity.

This promise was fulfilled, for not only was a Bill introduced to create a Board of Agriculture and Industries for Ireland, but provision was made in the Budget for an endowment of technical education. But the hopes, which the action of the Government raised, were doomed to disappointment. The Agriculture and Industries (Ireland) Bill, being unfavourably received by the Irish Members of Parliament owing to its financial clauses, was withdrawn; an announcement was made by the First Lord of the Treasury that as an alternative policy a Local Government Bill would be introduced during the following session, and the provision made in the Budget for technical education was otherwise appropriated.

At the end of November a still larger and more representative deputation, organised by the Dublin Chamber of Commerce, and representing all the Chambers of Commerce, the principal municipalities, and the leading agricultural and industrial organisations of Ireland, waited on the Chief Secretary for Ireland and pressed upon the Government the need of establishing a Board of Agriculture and Industries during the forthcoming session. The strongest representations were made as to the urgency of the matter. But the Chief Secretary, though admitting the urgency, informed the deputation that the Government were pledged to the Local Government Bill, and that it would not be fair to buoy up those interested in the movement with the hope that there was any reasonable prospect that the Government would be able to deal with two first-class Irish measures in the one session. The encouraging feature about the situation is that public opinion is thoroughly aroused upon this question, and there is, therefore, no fear that the matter will be allowed to drop.

Early in the year the Lord-Lieutenant appointed a Commission to "inquire and report with a view to determining how far, and in what form, manual and practical instruction should be included in the educational system of primary schools under the Board of National Education in Ireland." The Commission have held sittings in the principal Irish towns, as well as in England and in Scotland, and have sent experts to report upon the position of manual and practical instruction in connection with elementary education in Germany and France. It is expected that their report will be submitted to the Lord-Lieutenant sufficiently early in the year to allow the Government to make provision in the estimates to carry out the recommendations of the Commission.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

PROF. G. KRAUSE, of Halle, has been appointed ordinary professor of botany to the University of Würzburg, in the place of the late Prof. J. Sachs.

AMONG the measures to be laid before the Prussian Diet during the session opened on Tuesday is one on the vexed subject of disciplinary procedure against University Lecturers. In the Speech from the Throne this is alluded to as a "legislative regulation of the circumstances concerning the position of University lecturers."

THE Duchess of Fife opened the new Municipal Technical School at Brighton on Saturday last. The Duke of Fife, replying on behalf of the Duchess to a vote of thanks passed to her Royal Highness, remarked that in establishing the school Brighton had placed itself in line with all the great centres of population in the country, and showed itself alive to the great educational necessity of the day.

SPEAKING at the annual dinner of the Yorkshire College, Leeds, on Friday last, Lord Londonderry said that England was only slowly waking up to the fact that a technical, as distinguished from a commercial or literary, education was becoming more and more essential every day. A great deal had been done by the Yorkshire College, which had to deal with a county vast in its dimensions, and containing within its limits every variety of trade industries. The College had come to the assistance of all these industries. It had rendered valuable assistance to dyeing and weaving as well as to the application of art to the textile industries, and thanks to the grant by the Clothworkers' Company of 50,000*l.* for the establishment of this department, no less than 2500*l.* a year was expended to make the College the first weaving and dyeing school in the country. Many more such institutions as the Yorkshire College are needed before technical education is sufficiently provided for the needs and requirements of the country.

TEACHERS of science and science classes in higher-grade and public elementary schools, held a meeting on Friday last in the rooms of the Society of Arts. Mr. C. J. Addiscott, President of the National Union of Teachers, occupied the chair; and in his opening address he remarked that what is needed at the present time is a sound, workable system of technical instruction, based upon science and art teaching, which itself must be based upon a solid foundation of primary instruction. He discredited the idea that our primary system should be so moulded that it should lead necessarily to a secondary system, believing that the needs of the class with which they had to deal were outside what he conceived to be secondary education, and that the satisfaction of those needs would be found in the development of the primary system through the higher-grade Board school or organised science school on to the technical institute. The main factor for successful progress in this direction must be a central authority, which should be sympathetic, which should know the needs and the difficulties of each class at each stage of the journey. A number of resolutions were passed, one of them being opposed to the recent action of the Science and Art Department in giving instructions to inspectors to report any case where 25 per cent. of the first year students leave the schools at the end of the year, or more than that percentage of the second year students leave at the end of the second year, in order that the department might consider whether such schools should continue to be recognised as schools of science.

THE Association of Directors and Organising Secretaries for Technical and Secondary Education met on Friday last at the Guildhall, Westminster. Mr. C. H. Bothamley (Somerset) was

elected chairman, Mr. Hewitt (Liverpool) vice-chairman, Mr. J. H. Nicholas (Essex) secretary, and Mr. Turner (Staffordshire) treasurer. The places of the three remaining meetings for 1898 were fixed to take place at Birmingham, Sheffield, and London. In the course of an address, the chairman remarked that the Association had repeatedly expressed its acceptance of the recommendations of the Royal Commission on Secondary Education and had expressed the opinion that they formed a satisfactory basis for legislation. Latterly they had heard a great deal about the essential importance of constituting a central authority for education before anything else was done in the matter. The constitution of an efficient central authority could properly be brought about by the reorganisation of those Government departments that dealt at present with educational matters, a reorganisation along the lines of the Royal Commission's report. They found it to be inconvenient in practice in many ways to have two entirely separate departments, one of which they were brought into contact with in connection with evening continuation schools, and the other more and more frequently in dealing with secondary schools. They wanted to see these two departments merged more or less completely into one, with their functions properly defined, and capable of dealing with secondary education as a whole, as well as with the purely scientific and technical part of it. The other part of the central authority—the educational council—was a body to which the scholastic profession naturally attached great importance. The Association thought that one of the great needs of the present time was a system of schools corresponding fairly closely with the higher primary schools of France—schools which should be a real top to the elementary education. He concluded by moving—"This Association considers that legislation on the lines of the report of the Royal Commission on Secondary Education is very urgently needed at the present time." Mr. Turner seconded, and, after a short discussion, the resolution was adopted.

## SCIENTIFIC SERIALS.

*American Journal of Mathematics*, vol. xx. No. 1, January.—"The motion of a solid in infinite liquid under no force," by Prof. Greenhill, examines the elliptic function expression of all the dynamical quantities involved, and explores the analytical field by working out completely the simplest pseudo-elliptical cases to serve as landmarks, utilising the analysis which the author has developed in his paper on "Pseudo-Elliptic Integrals and their dynamical applications," in the *Proceedings* of the London Mathematical Society (vol. xxv.) and carrying out his work on the lines of his papers on the "Dynamics of a Top" and on the "Associated Motion of a Top and of a Body under no Forces" in vols. xxvi. and xxvii. (*Proc. L.M.S.*). Reference is made to the sketch of the theory in Thomson and Tait's "Natural Philosophy," and to a complete solution in the case of a solid of revolution in Kirchhoff's *Vorlesungen über Math. Physik*, ix.; and to the "Motion of a Solid in a Liquid," by Dr. T. Craig.—"Surfaces of Rotation with constant measure of curvature and their representation on the Hyperbolic (Cayley's) Plane," by G. F. Metzler. Minding (Crelle, vols. 19, 20) shows that it is easy to obtain the formulæ which express the relations between the sides and angles of a triangle of which the sides are geodesic lines on a surface of rotation with constant measure of curvature. Mr. Metzler shows that the same method holds for the formula expressing the area of the triangle (*i.e.* in the ordinary spherical formulæ put $a - \sqrt{1}$ for $a$, the radius of the sphere).—"Sur les Méthodes, d'approximations successives dans la théorie des Equations différentielles," par E. Picard, is a note, taken by the editors of the *Journal* from M. Darboux's "Théorie des Surfaces (à la fin du tome iv.).—M. Darboux is the mathematician whose likeness accompanies this number.

*Bollettino della Società Sismologica Italiana*, vol. iii., 1897, Nos 5, 6.—The microseismographs of the Institute of Physics of the Royal University of Padua, by G. Pacher. A reprint of a paper giving a full account of the Vicentini microseismographs, already noticed in NATURE.—The Latian earthquake of May 8, 1897, by G. Agamennone. A note on a series of slight shocks felt in the neighbourhood of Rome.—The Royal Geodynamic Observatory of Catania, by A. Riccò.—Notices of earthquakes recorded in Italy (April 27–May 14, 1897), by G. Agamennone, the most important being the series of Latian earthquakes of May 8, and an earthquake of distant, but unknown, origin on May 1.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Society**, December 9, 1897.—"On Methods of making Magnets independent of Changes of Temperature; and some Experiments upon Abnormal or Negative Temperature Coefficients in Magnets." By J. Reginald Ashworth, B.Sc.

The object of this paper was to find what kinds of iron or steel are least liable to changes of magnetic intensity of a cyclic nature under moderate fluctuations of temperature, such as take place in the atmosphere from one season to another. The subject is of importance for the sake of improving magnetic instruments, but apart from its practical consequences the investigation points to some interesting theoretic consequences.

In general the effect of alternately heating and cooling a magnet is to cause a large loss of magnetic intensity, which is only in part recovered; ultimately a cyclic state is established in which the changes may be expressed by a formula which in conformity with custom is here written $I_{t'} = I_t (1 - \alpha t' - t)$, I standing for the magnetic intensity, $t$ and $t'$ for the cold and hot temperatures.

Hitherto $\alpha$, the temperature coefficient of the magnet, has been found to be positive; that is to say, the effect of a rise of temperature is to diminish, and a fall of temperature to increase the magnetic intensity. A negative coefficient must be understood, therefore, to represent a rise and fall of magnetic intensity with rise and fall of temperature, and this abnormal effect has now for the first time been observed to be general in certain cases.

In the first place the influence of chemical composition was sought in determining the behaviour of a magnet under changes of temperature, and steel alloys severally of manganese, tungsten, cobalt, and nickel were tested, as well as a series of cast irons of different blends of pig irons. The results obtained show that the influence of chemical constituents is subordinate to that of physical condition, annealing or hardening. Thus a kind of nickel steel, the same as Dr. Hopkinson found to yield such remarkable thermo-magnetic results, exhibited in the glass-hard state a small increase of magnetic intensity with increase of temperature and decrease with fall of temperature. When annealed the converse effect took place, and these effects could be changed repeatedly by changing from hard to soft and soft to hard. Again cast iron, in the condition received from the foundry, has a very large magnetic variation for a given range of temperature, but when hardened by heating and rapidly chilling the variation becomes exceedingly small, the coefficient now being about $\frac{1}{15}$th its former amount. As hardened cast-iron magnets have also a very high permanent magnetic intensity, and are very little influenced by shocks and blows, it will be seen that they have exceptionally valuable qualities.

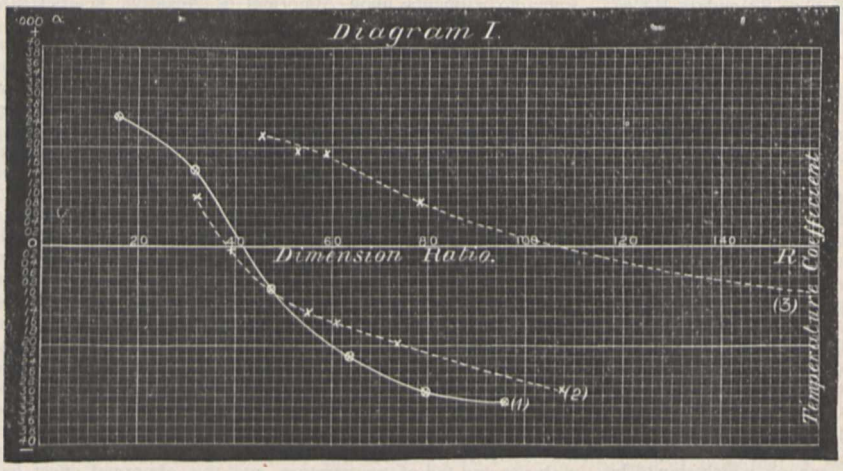
However, the most interesting results were obtained from some steel music wires which happened to be put to the test. These wires in the normal condition and when the cyclic state is established, after experiencing the usual permanent magnetic loss, exhibit a negative coefficient, the higher and lower intensities now corresponding to higher and lower temperatures, and they are thus quite exceptional. But, in contrast with the similar behaviour of the nickel steel alloys just mentioned, the negative coefficient is destroyed and a positive coefficient established if the wire be raised to a bright red heat and cooled either very slowly, as in the process for annealing, or rapidly as for hardening. If heated, however, to about a dull red and quenched, the coefficient can then be rendered just zero.

In order to gain some insight into the cause of this abnormal negative coefficient, the wire was dissolved in nitric acid and at different stages of dissolution tested. This led to the important relation, which was afterwards fully established in every possible way by a series of laborious experiments, that the longer and thinner the wire the more negative is its coefficient; and so much does the coefficient depend on the ratio of length to diameter, or dimension ratio, that by suitably altering the dimension ratio the sign of the coefficient may be changed; and for some particular dimension ratio, for a given kind of steel wire, the coefficient may be made zero, and the magnet is then independent of temperature changes.

The diagram exhibits these changes graphically. Curve (1) represents the variation of the coefficient from positive to negative for steel music wire of diameter 0·187 centimetre, and of

lengths 3, 6, 9, 12, 15 and 18 centimetres corresponding to dimension ratios 16, 32, 48, 64, 80 and 96.

Curves (2) and (3) represent similar changes in different steel wires, where the dimension ratio was varied by altering the diameter of the wire and keeping the length constant.




An almost identical curve to No. 1 is obtained by plotting against the dimension ratio the percentage permanent magnetic loss each piece suffers due to the process of alternate heatings and coolings; and as this is, without doubt, dependent on the self-demagnetising force in the magnet, it is evident the coefficient is also a function of the demagnetising force, and is principally varied by this, at least for a given range of dimension ratios.

The ultimate cause determining the abnormal negative coefficient in steel music wires of large dimension ratios is not yet completely made out, but experiments now in progress seem to indicate that it is the effect of the drawing in the process of manufacture.

"A Note on some further Determinations of the Dielectric Constants of Organic Bodies and Electrolytes at very Low Temperatures." By Prof. James Dewar, F.R.S., and Prof. J. A. Fleming, F.R.S.

December 16, 1897.—"Memoir on the Integration of Partial Differential Equations of the Second Order in Three Independent Variables, when an Intermediary Integral does not exist in general." By A. R. Forsyth, F.R.S, Sadlerian Professor in the University of Cambridge.

The memoir discusses the theory of partial differential equations of the second order in one dependent and three independent variables; and the method adopted is seen, without difficulty, to be applicable to equations which involve more than three independent variables and which can be of order higher than the second.

In order to solve a given equation, a system of subsidiary equations is constructed; and the system is made up of two parts. One of these parts is a set of simultaneous partial differential equations in two independent variables and a number of dependent variables, this number being one more than the number of the equations. An integral equivalent of this part accordingly contains an undetermined quantity. The other of the parts is a set of equations in a single independent variable; it appears that the set of equations in the second part can be consistently satisfied by a determination of the unknown quantity emerging from the first part.

The first of the three sections, into which the paper is divided, deals with the general theory, and indicates a method whereby subsidiary equations for an equation $F = 0$ of any degree in the derivatives of the second order can be constructed. If integrable combinations of the subsidiary system are not obtainable, an extension of the method shows how equations of higher order (when obtainable) can be deduced and associated with the given equation.

The second of the three sections deals with those equations of which the characteristic invariant is resolvable; and some examples are given, alike of equations for which the integration of the initial subsidiary system is possible, and of equations for which the extended method must be used.

The third of the three sections deals with those equations of which the characteristic invariant is irresolvable. Of such equations the most interesting examples are the potential equation and other equations in mathematical physics; and the theory is applied to some of these equations in detail, leading to some new solutions.

"On the Occlusion of Hydrogen and Oxygen by Palladium." By Ludwig Mond, Ph.D., F.R.S., William Ramsay, Ph.D., F.R.S., and John Shields, D Sc., Ph.D.

Palladium black prepared in the same way as platinum black contains 1·65 per cent. of oxygen, which cannot be removed *in vacuo* at a dull red heat. On heating in an atmosphere of oxygen the amount absorbed up to a red heat was about one and a half times as much as corresponds with the formula $Pd_2O$, and this also could not be extracted at a dull red heat *in vacuo*.

A comparative study of the occlusion of hydrogen by palladium black, sponge and foil was made; and, after taking into consideration some observations made by Graham and Dewar, it was found that no matter whether the palladium exists as black, sponge, foil, wire, or compact metal, or whether it is charged by direct exposure to hydrogen gas (the proper conditions being observed, as explained), or charged electrolytically, the amount of hydrogen occluded in each case is approximately the same, the atomic ratio palladium : hydrogen varying between 1·37 and 1·47.

The bulk of the hydrogen occluded by palladium black and sponge can be pumped off again at the ordinary temperature *in vacuo*.

The heats evolved per gram of hydrogen and oxygen occluded by palladium black are + 46·4 K (4640 *g*-cal) and + 11·2 K (1120 *g*-cal) respectively, the latter value being in harmony with the view that the absorption of oxygen is a true phenomenon of oxidation.

With respect to the supposed formation of a definite chemical compound on the occlusion of hydrogen, it is shown that Troost and Hautefeuille's deduction that $Pd_2H$ is formed is not warranted. If any hydride is produced at all, it probably contains at least as much hydrogen as that required by the formula $Pd_3H_2$ first suggested by Dewar.

It is also shown that the heats of occlusion of hydrogen in platinum and palladium black are not in favour of the view which has sometimes been put forward, that the heat of occlusion of a gas represents the heat of condensation or liquefaction of the gas in the capillary pores of the absorbing substance.

**Linnean Society**, December 16, 1897.—Frank Crisp, Treasurer and Vice-President, in the chair.—Mr. W. Carruthers, F.R.S., exhibited and made remarks upon a fungus, *Rosellinia ligniaria*, which had been found to attack living ash trees, eventually causing the death of the tree. Additional observations were made by Mr. George Murray and Prof. Farmer.—Mr. Edward Step exhibited two specimens of a Hermit Crab, *Eupagurus Prideauxi*, from Portscatho, Cornwall. Both were found naked and in rock-cavities, and special interest attached to the fact that, in the absence of the well-known molluscan shell which the species affects, each specimen was incrusted at precisely the same regions of its exterior by "acorn-shells."—The Rev. T. R. Stebbing gave an account of the habits of this and other species of the genus *Eupagurus*, directing special attention to the work of Aurivillius; and Prof. Howes remarked that it was on record that in the absence of a shell the bowl of a clay-pipe did not come amiss to these animals, and that they will readily utilise broken test-tubes.—Mr. H. M. Bernard read a paper on the affinities of the Madreporarian genus *Alveopora*. The question discussed was one of much interest, owing to the claim advanced by Dana, that *Alveopora* is a survival of the great Palæozoic family *Favositidæ*. This claim was rejected by

Milne-Edwards and Haime, but nevertheless was founded on close similarity of structure. Other important characters in common were now indicated, viz. the similarity of the earliest growth-stages and of the method of budding. These were described, and it was urged that there was now no reason to doubt the relationship between *Alveopora* and *Favosites* other than that which arose from the immense interval of time which had elapsed since *Favosites* flourished and from the scarcity of intermediate forms. One only had been described, viz. the genus *Koninckia* from the Cretaceous. Mr. Bernard then discussed the relationship of *Alveopora* with the recent *Poritidæ*, in which family it is usually classed. The author contended that *Alveopora* and *Poritidæ* stand about as far apart as possible in the madreporarian system, and with regard to the evolutionary stages of the madreporarian skeleton he concluded that the original columniform polyp must be considered to have had the lower portion of its body clothed with a stiff secretion which formed a cup into which the upper flexible portion could be invaginated This epithecal cup was the primitive madreporarian skeleton. Within this cup—mainly by infoldings, at first simple, but soon increasing in complexity—a new internal skeleton had been developed which had largely superseded the primitive epithecal skeleton. This internal skeleton, he thought, was as much a product of the epitheca as the apodematous systems of Arthropods are products of the chitinous cuticle. A discussion followed, in which the Chairman and others took part.—Messrs. H. and J. Groves communicated a paper on some *Characeæ* collected by Mr. T. B. Blow in the West Indies, one of which appeared to be new to science. Specimens of the plants described were exhibited.

PARIS.

**Academy of Sciences**, January 3.—M. A. Wolf in the chair.—M. Van Tieghem was elected Vice-President for the year 1898.—M. Chatin, the outgoing President, announced the changes in the Members and Correspondents during the year 1897.—General method for determining fundamental stars and latitude, by M. Lœwy. A further developement of the method announced at the previous meeting.—Histogenetic influence of an anterior form, with respect to the regeneration of Descemet's membrane, by M. L. Ranvier. It is known that the introduction of a single crystal into a solution has a considerable effect in causing crystallisation, and the present observations tend to show that an analogous phenomenon may take place in organic tissues. Observations were made upon the growth of the membrane of Descemet and its endothelium in the cornea of a rabbit, after partial destruction by incision and by a needle. In the latter case, where the corneal layers attacked by the needle have given an irregular surface, the endothelium, instead of forming a simple cellular layer, appears in the form of small masses, in which several layers of cells can be seen. The definition of endothelium thus requires considerable modification.—On the determination of the first terms of flexure of a meridian instrument. Application to the meridian circle at the Observatory of Paris, by MM. W. Ebert and J. Perchot.—On the conformable representation of one surface upon another, by M. G. Souslow.—On the velocity of propagation of a movement in a medium at rest, by M. P. Vieille. A description of experiments upon the velocity of the wave produced by exploding varying charges of powder and fulminating mercury in a steel tube. The figures obtained show that as the initial condensations increase, the mean velocities of propagation on a length of four metres also increase from values about the velocity of sound up to four times that speed.—On a new method of interferential spectroscopy, by MM. A. Perot and Ch. Fabry. The interferential spectroscope is composed of two plates of plane glass with silvered faces opposed, the distance and orientation of which can be exactly regulated. The rings produced are observed at an infinite distance, the system being lighted by a slightly converging bundle of rays. With this apparatus M. Michelson's statement that the green ray of thallium is double has been verified.—On the mechanism of the discharge of conductors struck by the X-rays, by M. G. Sagnac. The surface of a metal, M, struck by the X-rays emits new rays termed secondary rays of the metal M. Each element of volume of gas adjacent to the metallic conductor is rendered capable of conducting electricity, both by the incident X-rays and by the secondary rays.—On a simple method for directly transforming typographical plates and other objects in feeble relief into photographs, by M. Adrien Guébhard.—On the isocyanic ethers and the heat of formation of liquid isocyanic acid, by M. Paul Lemoult. The heats of formation were determined of the isocyanates of methyl and ethyl by the method of the calorimetric bomb.—On a new cyclic ketone methylcylohexonone, by M. A. Béhal. This ketone is one of those obtained from wood oil. Oxidation with potassium permanganate gave only acetic and levulic acids. The benzoyl derivative and oxime were prepared.—Preliminary note on the origin of the subrenal capsules of lophobranchial fishes, by M. Huot. The subrenal capsules have been usually regarded as arising from the epithelium of the cœlom, but the study of the development of these organs in the embryos of *Syngnatus Dumerilii*, leads to the conclusion that they arise from two sunk diverticula each of which is a bud from the posterior portion of a Wolf's canal.—On the origin of the setigerous bulbs and the nephridia in Annelids, by M. Aug. Michel. In the caudal regeneration of the Annelids, the setigerous bulbs are ectodermic and the setigerous sacs are mesodermic; the nephridia are of a neutral origin, ectomesodermic.

AMSTERDAM.

**Royal Academy of Sciences**, November 27, 1897.—Prof. van de Sande Bakhuyzen in the chair.—Prof. van der Waals gave an approximate rule for the course of the plaitpoint-curve of a mixture. The curve constructed according to the rule given will correspond very closely with the actual plaitpoint-curve in the case of all those mixtures, which present the circumstance that a maximum or a minimum tension occurs, if the components have a certain ratio to each other, as is the case with mixtures of $N_2O$ and $C_2H_6$. The curve for the said mixtures, according to Kuenen's observations, is explained in all its details by this rule.—Prof. Moll on an inquiry by Mr. Van Wisselingh into the nucleolus of *Spirogyra*. The principal results of this inquiry are: (1) besides the usual form of karyokenesis *Spirogyra crassa*, Kütz, has also a second form, in which no nuclear segments are produced; (2) in the division with segmentation ten out of the twelve segments originate in the nucleus itself, while two originate in the nucleolus; (3) in the case of nuclear division with segmentation the nucleolar segments have each a resistant thread, by which they are distinguished from the rest. The resistant threads divide longitudinally, like the segments themselves, and the two halves contribute in the daughter nucleus towards the formation of the new nucleolus. In the case of nuclear division without segmentation the nucleolus also produces two resistant threads, which in the division behave in exactly the same way as in karyokenesis with segmentation.—Mr. Eykman on the influence of the seasons on combustion of nutritive matter in man. The speaker communicated the results of a comparative inquiry into the respiratory exchange of gases in winter and in summer. With the nine persons, upon whom he experimented, the speaker found the average consumption of oxygen, when they were in a state of bodily rest, to be no smaller in summer than in winter, and concludes, also, on the ground of previous investigations made by him in India, that in man there exists no appreciable chemical regulation of heat.—Prof. V. A. Julius presented on behalf of Mr. N. G. van Huffel a short paper on magnetic hysteresis in a long soft iron bar. Round the middle of the bar was a primary coil; a secondary coil could be placed at various distances from the primary one. At a certain moment, varying from 1/3 to 2 seconds after the primary circuit was closed, the secondary one was for $\frac{1}{100}$ second brought in contact with a ballistic galvanometer. It appeared that the rate of change of induction reached a maximum at a certain distance from the middle of the bar, and that the maximum displaced itself with the increase of the time from the middle towards the ends of the bar.—Prof. van Bemmelen communicated on behalf of Mr. Schreinemakers the results of an inquiry into the equilibrium in systems of three components, in which two and three liquid phases occur.—Prof. Kamerlingh Onnes presented on behalf of Dr. W. van Bemmelen a paper, entitled "a provisional notice of new acquisitions of older observations of magnetic variation, among others by Parmentier in 1529, Cavendish in 1587, and by French navigators in the Pacific about the year 1700."—Prof. van der Waals presented (*a*) on behalf of Prof. Dibbits a paper by Dr. A. Smits, on an instrument for keeping the tension above a boiling liquid constant. The space in which the space is to be kept constant, is connected with a U-shaped barometer. When the pressure decreases, the mercury rises in the shorter limb and, in consequence of this, a galvanic circuit is closed, through which a blowing-apparatus is put in action; when the pressure increases, a sucking-apparatus is put in action by another galvanic circuit. When the oscilla-

tions of the mercury are small, the tension can be kept constant within very narrow limits. (*b*) On behalf of Prof. W. Kapteyn a paper on certain definite integrals. According to Cauchy the sum of the residues of a function which is meromorphic within a certain space, may be represented by an integral along the circumference of the space as well as by the sum of the coefficients of the first negative powers of the coefficients of this function in the proximity of the poles. The author applies this principle to a function consisting of the product of $l\left(\frac{1-z}{1+z}\right)^m$ with a function, which is meromorphic within the circumference of a circle described out of the origin with the unit for radius.

## DIARY OF SOCIETIES.

*THURSDAY*, JANUARY 13.

MATHEMATICAL SOCIETY, at 8.—Note on a Property of Pfaffians: H. F. Baker.—On the Stationary Motion of a System of Equal Elastic Spheres of Finite Diameter (continuation): S. H. Burbury, F.R.S.—On Discontinuous Fluid Motion: B. Hopkinson.—On the Intersections of Two Conics of a given Type, and on the Intersections of Two Cubics: H. M. Taylor.—On the Continuous Group defined by any given Group of Finite Order: Prof. W. Burnside, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presentation of Premiums.—Inaugural Address of the President, Joseph W. Swan, F.R.S.

*FRIDAY*, JANUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 8.—The Ternary System Lac. 7215 = *h* 4935: R. T. A. Innes.—The Double Star ζ Böotis = Σ 1865: S. W. Burnham.—The Orbit of OΣ 400: S. W. Burnham.—Note on the Result concerning Diffraction Phenomena recently criticised by Mr. Newall: F. L. O. Wadsworth.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mechanical Draught: R. Gordon Mackay.

MALACOLOGICAL SOCIETY, at 8.—Note on the Reno-pericardial Pore of *Ampullaria urceus*: R. H. Burne.—On some Points in the Anatomy of *Sepia officinalis*: R. H. Burne.—On an Example of *Acanthoteuthis Férussacii* from the Lithographic Stone of Solenhofen, Bavaria, exhibiting the Buccal Membrane: G. C. Crick.—Descriptions of Four New Species of Land Shells from New Guinea, North Borneo, and Aldabra Island: E. A. Smith.—On the New Land Shells of the Island of Lombock: E. A. Smith.—Description of Two New Species of *Clausilia* from Che-kiang Province, China: Mrs. Kenyon.

*MONDAY*, JANUARY 17.

SOCIETY OF ARTS, at 4.30.—My Recent Journey from the Nile to Souakim: Frederic Villiers.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journeys in the East Coast Provinces of Siam: H. Warington Smyth.

VICTORIA INSTITUTE, at 4.30.—The Glacial Epoch: Prof. E. Hull, F.R.S.

*TUESDAY*, JANUARY 18.

ROYAL INSTITUTION, at 3.—The Simplest Living Things: Prof. E. Ray Lankester, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be further discussed: The Machinery used in the Manufacture of Cordite: E. W. Anderson.

ZOOLOGICAL SOCIETY, at 8.30.—On the Vascular System of the Chiroptera: Dr. N. H. Alcock.—On the General Anatomy of the *Holocephali*: L. W. Byrne.—On the Development of the Hyobranchial Skeleton of the Midwife-Toad (*Alytes obstetricans*): Dr. W. G. Ridewood.

ROYAL STATISTICAL SOCIETY, at 5.30

ROYAL VICTORIA HALL, at 8.30.—Through the New Gold Fields of Alaska to Bering Strait.

*WEDNESDAY*, JANUARY 19.

SOCIETY OF ARTS at 8.—The Projection of Luminous Objects in Space: Eric Stuart Bruce.

GEOLOGICAL SOCIETY, at 8.—On some Gravels of the Bagshot District: H. W. Monckton.—On the Occurrence of Chloritoid in Kincardineshire: George Barrow.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Ordinary Meeting.—At 7.45.—Annual General Meeting.—Address by the President (E. Mawley) on Weather Influences on Farm and Garden Crops.

ROYAL MICROSCOPICAL SOCIETY, at 8.—President will read his Annual Address.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.—Address by the President, R. Trimen, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.—Notes on the Action of Cyanogen on Gold: James Park.—Mexican Methods of Mining: S. B. Newall.—On the Successful Treatment of Tailings by the Direct Filling Process on the Witwaterstrand: F. Cardell Pengilly.

*THURSDAY*, JANUARY 20.

ROYAL SOCIETY, at 4.30.—The Relations between Marine Animal and Vegetable Life: H. M. Vernon.—(1) The Homogeneity of Helium; (2) Fergusonite, an Endothermic Mineral: Prof. W. Ramsay, F.R.S., and Morris W. Travers.—On the Modifications of the Spectra of Iron and other Substances radiating in a Strong Magnetic Field: T. Preston.

ROYAL INSTITUTION, at 3.—The Halogen Group of Elements: Prof. Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—Recreations of an Indian Official: Right Hon. Sir Mountstuart Elphinstone Grant Duff, G.C.S.I., C.I.E., F.R.S.

LINNEAN SOCIETY, at 8.—On the Larval Hyobranchial Skeleton of the Anurous Batrachians, with special reference to the Axial Parts: Dr. W. G. Ridewood.—On the "Abdominal Pore" in the Myxinidæ: R. H. Burne.

CHEMICAL SOCIETY at 8.—Ballot for the Election of Foreign Members.—The Action of Caustic Alkalies on Amides: Dr. Julius B. Cohen and Edward Brittain.—The Formation of Monomethylaniline from Dimethylaniline: Dr. Julius B. Cohen and H. T. Calvert.—Note on the Aluminium-Mercury Couple: Dr. Julius B. Cohen and H. T. Calvert.—Action of Chloroform and Alkaline Hydroxides on the Nitro-benzoic Acids: W. J. Elliott.—Researches on the Terpenes. II. On the Oxidation of Fenchene: J. Addyman Gardner and G. B. Cockburn.—The Preparation of Pure Iodine: Dr. Bevan Lean and W. H. Whatmough.

*FRIDAY*, JANUARY 21.

ROYAL INSTITUTION, at 9.—Buds and Stipules: Sir John Lubbock, Bart., M.P.

PHYSICAL SOCIETY, at 5.—On Electric Signalling without Conducting Wires: Prof. O. Lodge, F.R.S.—A Tesla Oscillator will be exhibited by Prof. S. P. Thompson, F.R.S.

## BOOKS AND SERIALS RECEIVED.

BOOKS.—Practical Ethics: Prof. H. Sidgwick (Sonnenschein).—Ordinary Differential Equations: Dr. J. M. Page (Macmillan).—Euclid's Elements of Geometry, Books 1 and 2: C. Smith and Dr. S. Bryant (Macmillan).—Practical Toxicology for Physicians and Students: Dr. P. Kobert, translated and edited by Dr. L. H. Friedburg (New York, Jenkins).—Psalms of the West, 3rd edition (Longmans).—The Tears of the Heliades, or Amber as a Gem: W. A. Buffum, 3rd edition (Low).—A Trip to Venus: J. Munro (Jarrold).—Tabellarische Übersicht der Mineralien: P. Groth. Vierte Vollständig neu Bearbeitete Auflage (Braunschweig, Vieweg).—Third Annual General Report upon the Mineral Industry of the United Kingdom, 1896: Dr. C. le Neve Foster (Eyre).—A Treatise on Chemistry; Roscoe and Shorlemmer. Vol. 2. The Metals, new edition (Macmillan).—Geometry for Beginners: Prof. Minchin (Oxford, Clarendon Press).—From Tonkin to India; Prince Henri d'Orléans, translated (Methuen).—Seventeenth Annual Report of the U.S. Geological Survey, Parts 1 and 2 (Washington).—University College, Sheffield, Calendar for the Session 1897-98 (Sheffield).—The Cyclist's Pocket-Book (Constable).—General Report on the Operations of the Survey of India Department, 1895-96 (Calcutta).

SERIALS.—Scribner's Magazine, January (Low).—Among British Birds in their Nesting Haunts: O. A. J. Lee, Part 8 (Edinburgh, Douglas).—Geographical Journal, January (Stanford).—Observatory, January (Taylor).—Records of the Australian Museum, Vol. iii. No. 3 (Sydney).—The Atoll of Funafuti, Part 5 (Sydney).—Brain, Part 79 (Macmillan).—An Illustrated Manual of British Birds, new edition, January (Gurney).—Bulletin from the Laboratory of Natural History of the State University of Iowa, December (Iowa).—Mind, January (Williams).—Bulletin of the American Mathematical Society, December (New York, Macmillan).—Revue de l'Université de Bruxelles, January-February (Bruxelles).—Knowledge, January (High Holborn).—Records of the Geological Survey of India, Vol. xxx. Part 4 (Calcutta).—Atlantic Monthly, January (Gay).—History of Mankind: F. Ratzel, translated, Part 23 (Macmillan).—Notes from the Leyden Museum, July and October (Leiden, Brill).—Journal of the Asiatic Society of Bengal, Vol. lxvi. Part 2, Nos. 2 and 3 (Calcutta).—Strand Magazine, January (Newnes).—Pearson's Magazine, January (Pearson).—Zeitschrift für Physikalische Chemie, xxiv. Band, 4 Heft (Leipzig).—American Journal of Science, January (New Haven).—American Naturalist, December (Philadelphia).

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