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MUSEUMS.

Essays on Museums and other Subjects connected with Natural History. By Sir William Henry Flower, K.C.B., &c. Pp. xv + 394 (London: Macmillan and Co., Ltd., 1898.)

SIR WILLIAM FLOWER'S name is so intimately associated with the subject of museum management and organisation, that all naturalists who have been accustomed to look to him as their guide in this direction will be glad to have his writings collected into one volume for reference. The fact that the twenty essays and the four biographical notices have already been published elsewhere in no way detracts from their value, since the utterances of acknowledged leaders always possess historical interest, apart from the influence which they may have exerted upon contemporary thought.

Although the present volume deals with museums in the first place, there are altogether four sets of essays—the first treating of museums, the second of general biology, the third of anthropology, and the fourth consisting of biographical sketches of Rolleston, Owen, Huxley and Darwin. This arrangement, although upsetting the chronological order in which the various essays appeared, is very convenient for the reader and to some extent—but not wholly—compensates for the absence of an index, an omission to which we feel bound to call attention in these days of overwhelming scientific literature, when writers on scientific subjects are expected as a solemn duty to the reading public to give every facility for reference to the contents of their volumes. We are afraid, moreover, that the author himself is likely to suffer from this omission; for there is so much in his writings that one desires to remember and to quote, that unless notes are made as the pages are perused, the busy worker in science is likely to be put to endless trouble in endeavouring to find a passage which may have struck him at first reading as worthy of selection for future use. It is true that the various essays have their contents set forth at the commencement of the volume, but it is generally admitted that such tables of contents are very poor substitutes for a good index. In calling attention to this defect we are in reality paying the author the compliment of recording the opinion, which will be generally endorsed, that his writings have more than an ephemeral interest.

Of the leading ideas which run through Sir William Flower's essays on museums, the importance of such establishments as educational institutions is more than once dwelt upon and cannot be too strongly emphasised. At the present time, especially when County Council Technical Instruction Committees are wavering in their policy with respect to the endowment of museums, it is of interest to read the following passage given in an address to the Museums Association in 1893:—

"One cannot help considering how much might have been done if only a moderate portion of that large sum of money obtained a few years ago by the tax on brewers, and handed over to the County Councils to spend in promoting technical education, had been used for erecting museums, which might have taken a permanent place in the education of the country. Every subject taught, in order to make the teaching real and practical, should have its collection, and these various collections might all have been associated in the county museum under the same general management. The staff of teachers would assist in the curatorial work, and thus a well-equipped central college for technical education might have been formed in every county, sending out ramifications into the various districts in which the need of special instruction was most felt, and being also the parent of smaller branch museums of the same kind wherever they seem required" (pp. 34-35).

Some few of the counties have assisted in maintaining their local museums, but these are exceptions. In districts which are rural and agricultural, and where such institutions would be particularly valuable, little or nothing has been done. Those counties which have adopted the frittering-down policy of decentralisation have left themselves without adequate funds for the purpose. It may be doubted whether the sporadic instruction in those hardy perennial subjects of cookery, dressmaking and ambulance, which come sufficiently near the definition of technical instruction to entitle local committees to claim their share of the beer money, is ever likely to be of such lasting value to the welfare of the country as the foundation of educational museums. At any rate the present writer has no doubt on this point, whatever the attitude of County Councillors may be, and it is tolerably certain that in the present state of public opinion no auditor would be likely to challenge the expenditure of the technical instruction grant for such a purpose.

Another idea which Sir William Flower constantly urges is the importance of competent curatorship. Again and again has he insisted, during many years, upon the necessity for high scientific attainments on the part of those entrusted with the care of museums. In 1893, for example, in the same address as that from which we have already quoted, he told the museum curators then assembled that they were not, as a class, properly appreciated by the public. As to the qualifications he said:—

"Now, a curator of a museum, if he is fit for his duties, must be a man of very considerable education as well as natural ability. If he is not himself an expert in all the branches of human knowledge his museum illustrates, he must be able to understand and appreciate them sufficiently to know where and how he can supplement his own deficiencies, so as to be able to keep every department up to the proper level. His education, in fact, must be not dissimilar to that required for most of the earned professions" (p. 35).

Again, in the third essay of the present volume, based on statements made in 1891 and 1895 on the subject of local museums, he says:—

"You might as well build a church and expect it to perform the duties required of it without a minister, or a school without a schoolmaster, or a garden without a gardener, as to build a museum and not provide a competent staff to take care of it.

"It is not the objects placed in a museum that constitute its value so much as the method in which they are displayed, and the use made of them for the purpose of instruction" (p. 55).[1]

[1] In this essay Sir Wm. Flower, speaking of the desirability of preserving, as an interesting survival, the parish stocks where they are still in existence, says that he knows of only one—in the village of Dinton, near Aylesbury. The writer knows of others at Brading (Isle of Wight), and Abinger, near Dorking.

Closely connected with the high qualifications which should be possessed by curators is the question of their remuneration and the inducement which such a career offers to men of scientific training. The author's remarks on this point may appear despondent, but they are, unfortunately, only too justifiable.

"In a civilised community the necessities of life, to say nothing of luxuries (which we do not ask for), but the bare necessities of a man of education and refinement, who has to associate with his equals, and bring up his children to the life of educated and refined people, involve a certain annual expenditure, and the means afforded by any occupation for this necessary expenditure give a rough and ready test of the appreciation in which such occupation is held" (p. 35).

Judged by this standard the museum curator stands very low in public estimation. Some consolation, however, may be derived by this class of scientific workers from the consideration that their position is not very different from that of the scientific enthusiast who devotes his life to research in any branch of pure science which has no immediate market value. The consolation is confessedly a very poor one, but the person with the necessary "scientific qualifications" who accepted the munificent stipend of 50*l*. per annum (with rooms, coal and gas) as resident curator, meteorological observer and caretaker of the museum and library in a certain town—of which the only redeeming feature appears to be that it was less wealthy than another town which offered 125*l*. to its museum curator—may find his case paralleled by looking at the advertisements for science teachers which occasionally appear in these columns or elsewhere, where men having an expert knowledge of several branches of science are invited to accept appointments in technical institutes, where their duties are irksome and heavy and their responsibilities great; where their time is taken up in drudgery which crushes enthusiasm and destroys originality, and for which they are offered a stipend that many a butler in a wealthy family would look at with contempt. The position of museum curators is all of a piece with the position of other workers in pure science; and until the so-called "practical man," in whose hands the administration of the technical instruction money has been placed, has been educated off the face of this country or superseded by legislation, there is very little hope of amelioration. It is instructive to note that in 1853 Prof. Edward Forbes said of museums[1]:—

"In most cases they are unassisted by local or corporate funds, and dependent entirely upon the subscriptions of private individuals. Indeed, any attempt to favour the establishment of public museums and libraries through the application of local funds is opposed with a horrible vigour more worthy of a corporation among the Cannibal Islands than within the British Empire. The governing bodies of too many of our towns include no small proportion of advocates of unintellectual darkness."

The writer could put in evidence certain local newspapers—published in a town not thirty miles from London—where an attempt to found a public museum and library was met, only last year, in the very same spirit which Prof. Forbes described in the above paragraph nearly half a century ago. So little have we advanced in this direction in fact in the rural districts, and even in many of the provincial towns, that the remarks on local museums made by Forbes in 1853 read like the precursors of Sir William Flower's observation on the same subject in the volume under notice:—

"It so happens, however, that the value and excellence of almost every provincial museum depend upon the energy and earnestness of one, two, or three individuals, after whose death or retirement there invariably comes a period of decline and decay" (Forbes, 1853).

"Voluntary assistance is, no doubt, often valuable. There are many splendid examples of what it may do in country museums, but it can never be depended on for any long continuance. Death or removals, flagging zeal, and other causes, tell severely in the long run against this resource" (Flower, 1895).

The history of too many local museums is unfortunately comprised in these paragraphs, and the writer has vividly in mind some very pregnant remarks in this strain made by Sir William Flower at Chingford in 1895, at the opening of that excellent little local museum founded by the Essex Field Club. We can only add that every one of the seven essays on museums reprinted in the present volume deserves most careful perusal, and all who are interested in the subject will do well to study them.

The eight essays on general biology, which follow those on museums, abound with interesting topics. Although, no doubt, many readers of these columns are quite familiar with these addresses, it is refreshing to have brought before us again the views of the author on the development of the Ungulata (Royal Institution lecture, 1873), his remarks on classification and nomenclature (Address to Section D, British Association, 1878), and the two lectures on whales delivered, respectively, at the Royal Institution in 1883 and at the Royal Colonial Institute in 1895. Throughout all these biological essays runs the leading idea of evolution, of which doctrine Sir William Flower has always been a consistent and temperate advocate. The perusal of some of these essays induces feelings akin to those with which the old soldier recounts his past campaigns. The arguments with which hostile criticism had to be met in the early days may now have lost their point, but the younger reader must never forget that the great battle of evolution has been fought and won since Sir William Flower entered the field, and a calm consideration of the contents of the present volume will show that no insignificant part in this struggle has been borne by its author. In fact, one of the most prominent episodes in the history of the spread of the new doctrine beyond the circle of workers in science was the memorable address on "Recent Advances in Natural Science in relation to the Christian Faith," given at the meeting of the Church Congress at Reading in 1883, and reprinted as the ninth essay of the present volume. If the consideration of these biological essays calls forth any feeling of regret on the part of those who are now actively engaged in carrying on the work of research, it must be that their distinguished author was unable by virtue of his official duties to enter into the later controversies which have divided the school of evolutionists. Sir William Flower's essays read like very "orthodox" Darwinism; yet there are few whose opinions on such topics as heredity and

1 "The Educational Uses of Museums." (Introductory lecture, Session 1853-54; Museum of Practical Geology.)

the transmission of acquired characters, and the bearing of the teachings of Prichard, Galton and Weismann on the original theory of Darwin and Wallace would have been of greater value to the present generation of workers. On one point which has from time to time been raised in connection with the theory of evolution, viz. the rate of modification of organisms in past time, the author has recorded his view in the following terms:—

"There is no proof whatever that the laws of variation and natural selection, if such be the laws which lead to the introduction of new forms and the extinction of old ones, were ever more potent than they are at present" (p. 109).

The section on anthropology comprises five essays of which the last, "Fashion in Deformity," is familiar to our readers as one of NATURE Series. There are two presidential addresses to the anthropological section of the British Association, viz. York, 1881, and Oxford, 1894. The presidential address to the Anthropological Institute on "The Classification of the Varieties of the Human Species" was delivered in 1885, and the lecture on "The Pygmy Races of Men" at the Royal Institution in 1888. It is now familiar history that Sir William Flower was among the pioneers who in this country helped to raise anthropology to its present position among the natural sciences. It is strange that the science of man should have made less progress than that of the other subjects dealt with in these essays. The author says in the preface:—

"Upon the third subject, the main point of which is the advocacy of a more systematic study of Anthropology in this country, there has been, as it seems to me, less advance than in either of the other two; and in putting forth its claims for greater recognition I felt for a long time as one crying in the wilderness."

Among recent signs of progress the author notes with satisfaction the establishment of a professorship of anthropology in the University of Oxford, a fitting place for such a chair being that University which gave a home to the first systematically arranged anthropological collection brought together and presented by another great pioneer in this field of research, General Pitt-Rivers.

In concluding this notice we can only say that while giving expression to the widely felt regret that the author should have been compelled to withdraw temporarily from active administrative duties, it is a matter of congratulation that he has been enabled to turn his enforced leisure to such useful account as the publication of the present volume.

R. MELDOLA.

CLERK MAXWELL'S INFLUENCE ON MODERN PHYSICS.

James Clerk Maxwell and Modern Physics. By R. T. Glazebrook, F.R.S. Pp. viii + 224. The Century Science Series. (Paris and Melbourne: Cassell and Company, Ltd., 1896.)

THE sketch of Clerk Maxwell's life and work which Mr. Glazebrook has written well illustrates the immense influence which Maxwell has exerted on modern physics. Of his work it can be said, in a truer sense than of much that has been accomplished, that it lives after him. Its vitality is apparent in all kinds of ways, and in nearly every region of physical inquiry. In a certain measure the developments of his great scientific generalisation, though they do not yet lie in perspective before us in the same way, recall those of Newton's theory of gravitation. There is the same kind of power of intuition displayed in arriving at the general theory, the same kind of partial development, by the methods most ready to hand, of its consequences, and, to a certain extent at least, the same kind of presentation of the whole subject by methods which were not quite those of discovery. Now we have other workmen with tools of keener edge and finer temper, perhaps, adding here and taking away there to improve its symmetry and remedy its occasional want of logical consistency, and, what is of far more importance, extending the scope of its results, until electric wave-theory and experiment threatens to become a subject almost too great for any single investigator to intelligently follow in all its ramifications.

It is remarkable how quickly, sometimes, the natural philosophy of a science is built up, when observation and classification have been carried sufficiently far. At the right moment, when in a sense everything has been prepared, the genius arrives, and the chaotic elements spring into relation with each other and to life at his touch. Not that there is nothing really to be done; on the contrary, the task is one which only genius could accomplish. Much has been achieved by other workers, who have spent laborious lives in research; indeed, the actual toil by which the data have been collected and classified, and their relations traced, has been spread over centuries, and the actual work of those who unite all in a general theory is small in comparison. But how great the result is, is immediately made known by its fruits.

The present state of the science of electricity and magnetism is due to advances of this kind made by a close succession of men of genius, of whom one of the greatest is happily still with us. The natural philosophy of electricity, which may be said to have begun with Oersted and Ampère, is due in no small measure to the experimental researches and truly philosophical ideas of Faraday. The first consistent statement of it was given by Thomson, who expressed in mathematical language Faraday's ideas of lines of force, and deduced by a dynamical process the consequences of Faraday's experimental discoveries. Thomson's theory was at bottom one of action in a medium, and from it he obtained by deduction and experimental verification important discoveries of his own. Upon this quantitative philosophical discussion Maxwell to a great extent based his form of the theory, the essence of which is its dynamical character, and its explicit transference of the phenomena from the conductors and magnets and circuits to the electromagnetic field. The theory of light, though far from being the end, is the crown of the whole work.

The manner of scientific progress was traced very clearly by Comte, but the distinction between the observational and classificatory stage of a science and its natural philosophy stage, and the importance of the latter, have not been so well appreciated by other writers. It was said, as many people know, by a celebrated philosopher, that the theory of gravitation was really contained in the laws of Kepler, to whom therefore, and not to Newton, the discovery of gravitational attraction was due. The utterance was a remarkable one for a philosopher who always contended that the object of philosophy was, as no doubt it is, to find unity in diversity. It only shows that even divine philosophy does not always suffice to lift a man above national jealousy and prejudice. The law of gravitation was the one uniting principle, the unity which explained the whole range of planetary motions, brought into one view the motion of the moon and the fall of a stone, enabled the motions of the heavenly bodies to be computed, and the places of the bodies predicted for a long range of future time, and gave the keynote for those great investigations of the future and the past of the solar system, and of our own terrestrial system within it, which have been carried out since Newton's time by his followers. Some of the greatest of these researches —we may well be proud of the fact—have been carried out by scientific men of our own country, whom this age has either seen or still possesses.

Like Maxwell's electrical theory the Newtonian gravitation raised, as does every really science-making theory, questions which it did not answer. There is the further problem of the *rationale* and mechanism of gravitation, and questions of its application to close aggregates of particles, and our minds are suddenly turned from the stars in their courses to the structure of molecules and the nature of inter-molecular action. The new problems bristle with difficulties far greater than those which have been surmounted, the new standing ground attained has only disclosed steeper heights to be scaled.

So it has been in the electromagnetic theory of light. The conception of a plane wave of light as a propagation of a disturbance in which there is electric, and at the same time magnetic, intensity varying as a simple harmonic function of the time, and its minute verification by Hertz and his pupils, and by others, has opened whole vistas of problems we cannot hope to solve for many a day. There are the primary questions, whether the theory of the ether, according to which light vibrations are transmitted as waves of distortion in a medium for which the ratio of the rigidity modulus to the density is enormous, has any foundation in fact, and, if so, what is the relation of the varying electric and magnetic forces to the material vibrations; how do these electric and magnetic forces arise, and how are they maintained in the ether: in short, how does matter act upon ether and ether uopn matter. In these are involved others of perhaps a more limited or special nature, the mode of localisation of energy in fields in a steady state, and the mode of flow of energy in cases of transference. The complete solution of these would yield the secret of voltaic action, and, it might be, reduce the voltaic cell to a magneto-electric machine, and tell us in what magnetic and electric induction themselves consist.

That Mr. Glazebrook's book can be of great interest, even to those who are more or less familiar with Campbell and Garnett's life of Maxwell, we can fully testify. It is true that most of the early reminiscences given in the biographical sketch are to be found in the life; but there are personal recollections of Mr. Glazebrook's, and several other touches here and there, which give this part of the work a charm and value of its own. This is followed by one or two specimens of the verses which Maxwell from time to time threw off, sometimes in a serious mood, sometimes in a gay, but always with a grace of expression and originality (and at times a quirkiness amounting almost to caprice) of thought peculiarly his own. The specimens chosen are the inimitable parody in verse of Tyndall's Belfast Address, the verses on "Molecular Evolution," written on the same occasion, the verses addressed "To the Committee of the Cayley Portrait Fund," and the song of the Rigid Body. A few more might have been included without giving too much illustration of this side of Maxwell's versatile nature. The rapidity and ingenuity of his verse composition were extraordinary. The writer well remembers seeing on a sheet of the article "Elasticity," written by Lord Kelvin for the ninth edition of the "Encyclopædia Britannica," a copy of verses which Maxwell had jotted down before returning the proof. It began:

"Vex not my ears, ye crystal spheres,
Your harmony's insipid, O.
But play again that tuneful strain,
My parallelepiped, O."

And so on,

"Finding great fun in twenty-one
Elastic moduluses, O!"

for six or eight verses, with marvellous rhymes for the numerous, and for purposes of verse somewhat intractable, technical terms with which a mathematical discussion of the elasticity of an æolotropic solid abounds.

His letters also were very beautiful, and serve as a comforting reminder that if letter-writing is a lost art, it survives still in some men of playful fancy and lightness of touch as a natural gift. Of these only a few specimens are given by Mr. Glazebrook, and hardly more could have been included within the limits of space at his disposal.

The rest of the book consists of a sketch of Maxwell's work in Colour Vision, Molecular Theory of Gases, and Electricity. This we need not review. Suffice it to say that it is thoroughly clear and trustworthy, and will well repay perusal by the physicist already acquainted with later developments of Maxwell's work. Mr. Glazebrook has also found room for a valuable concluding sketch of the work of Hertz and his followers, which was founded on Maxwell's theory, and afforded its experimental verification.

There are one or two misprints. At p. 68, the Don referred to oddly enough turns a *watch*; and there is another, near the beginning of the foot-note on p. 131. The biographical reference to George Green, of Nottingham, on p. 158, is not quite accurate.[1]

[1] It is strange that the ninth edition of the "Encyclopædia Britannica" should contain no biography of Green. He was undoubtedly a great genius, and made an impression, not merely on mathematical physics, but on pure analysis, which will never be effaced. It has been said in jest, but with considerable truth, that applied mathematics is made up of continual applications of Green's theorem. Of this enormously powerful theorem a more lately discovered relation, which is very fundamental in the theory of functions of a complex variable, and which is generally quoted as Riemann's theorem, is only a particular case.

Green's career was certainly very remarkable: but Mr. Glazebrook is in error as to his original occupation. Up to the year 1829 he assisted his father, who was in business first as a baker in Nottingham, and afterwards as a miller in the neighbouring village of Sneinton. In that year, when Green was thirty-six years of age, his father died, and not long after Green

Mr. Glazebrook is to be congratulated on having produced an attractive and useful book. The only fault of the sketch is that it is too small for the subject, but for that the author is not responsible. And after all the time has hardly yet come for a complete appreciation of Maxwell's influence on modern science. A. GRAY.

FUNAFUTI.

The Atoll of Funafuti, Ellice Group: its Zoology, Botany, Ethnology, and General Structure, based on Collections made by Mr. Charles Hedley of the Australian Museum, Sydney, N.S.W. (*Memoirs Australian Museum, Sydney*, No. iii. Parts 1–6, 1896–1898.)

THE Pacific Ocean is divided into basins by a series of island chains and submarine ridges. The most conspicuous chain begins in Malaysia, crosses New Guinea, and, sweeping round parallel to the eastern coast of Australia, runs past New Caledonia and Lord Howe Island to New Zealand. The islands of this chain all rise from the Melanesian plateau, and they are continental both in structure and in the characters of their recent and fossil faunas. Outside this series is another, which Hedley calls the Marshall-Austral chain, including the Ellice, Phœnix, Marshall, Gilbert and Samoan archipelagoes, and perhaps represented still further to the south-east by the great Patagonian platform that projects north-westward from the coast of South America. All but one of the members of this chain are oceanic in structure and inhabitants; the exception is Samoa, where the chain crosses the line of elevation that passes from the Tonga Islands, through Samoa, and on northward towards the Sandwich Islands. In the angle between this line and that of the Austral-Marshall series is one of the deep open basins of the Pacific. A belt of apparent subsidence lies on each side of the Tonga-Sandwich line, marked amongst other points by the decreasing size of the atolls as the two belts are approached. It is the atolls that border these two belts of subsidence that offer the best chance of settling the great coral island controversy. Funafuti, as one of the easternmost of the Ellice Islands, is in as good a position for a test boring as could be selected; for it is near the depression between the Ellice Archipelago and the Tonga-Sandwich Island line, and is on the south slope of one of the deep open basins of the Pacific. The mechanical difficulties, however, proved too serious at the first attempt. But the expedition of 1896 was valuable not only from the lessons taught as to the methods of boring in coral reefs, but as it afforded the opportunity for a detailed study of the island. Captain Feild worked out the submarine contour, and the naturalists collected materials for a detailed study of the fauna and ethnology. Monographs of various types of Indo-Pacific islands are greatly to be desired before the primitive characters have been lost. We must therefore welcome the valuable monograph on Funafuti, based on the extensive and systematic collections of Mr. Hedley, which have been promptly worked out by the officials of the Sydney Museum. Six parts of the monograph have been received, amounting to 368 pages, and illustrated by twenty-two plates. Mr. Hedley contributes a general introduction, in which he clearly states the geomorphological position of the island, and describes its geological structure and its people. It is interesting to notice that, in spite of the slight depth reached by boring in 1896, Mr. Hedley infers from the general characters of the atoll that its structure supports the Darwinian theory. Mr. Hedley also contributes a series of most interesting notes to the other articles, and shows in them that he is as competent a naturalist as he is a keen collector.

The second part begins the description of the fauna with the account of the insects and Arachnida by Mr. Rainbow, of the Crustacea and Echinodermata by Mr. Whitelegge. The third part contains Mr. Waite's report on all the Vertebrates except the birds, which are described by Mr. J. North in the first part, and also some of the Alcyonaria and Enteropneusta. The accounts of these two groups are concluded in the fourth part, which also contains the report on the sponges. Mr. Hedley himself contributes the ethnological section, which forms the fifth part. The sixth section, the last we have received, contains one of the contributions of most interest at the present time—Mr. Whitelegge's account of the corals. Mr. Hedley tells us that the chief impression the coral reefs of the island made upon him was their poverty both in individuals and species. More genera and species can be collected, he tells us, in a single tide on the reefs of Queensland, New Guinea and New Caledonia than he could find at Funafuti in several weeks' search. Nevertheless, Mr. Whitelegge finds forty-seven species in Mr. Hedley's 170 specimens, and divides into distinct species corals which Mr. Hedley had especially collected to illustrate different forms of the same. But Mr. Whitelegge only adds two new species, which for corals is an unusual act of moderation.

In a series of memoirs such as this, it is of course inevitable that the standard varies. One factor that has a marked influence on the merit of the articles is the size of the group concerned. Mr. Waite's note on the indigenous mammal is a complete monograph, and its accuracy is apparently unimpeachable; but when we come to the sections on the Arthropods we find that Mr. Rainbow has to describe all the insects, including representatives of the orders Coleoptera, Hymenoptera, Lepidoptera, Diptera, Hemiptera and Orthoptera, and also that he has to describe the Arachnida. It is therefore Mr. Rainbow's misfortune, not his fault, that his determinations cannot hope for the same degree of finality as those of his colleagues who deal with smaller groups. But Mr. Rainbow's contribution is no less useful; only it must be judged as one of those preliminary descriptions which record the general constituents of a fauna, and thus sort it out ready for criticism and revision by the specialists. The specialists are few and insects are many. The specialist monographers cannot keep pace with the collectors. Hence if the work had waited until the

disposed of the business in order to obtain more leisure for his studies and researches. His entering at Gonville and Caius College in 1833 at the age of forty, and his obtaining the fourth place in the mathematical tripos of 1837, the year of Griffin, Sylvester and Gregory, are better known facts. His University career, whatever else it may have done, apparently did not tend to make his earlier work more generally known, and he died in 1841 without that scientific recognition which was his due. That came later when William Thomson (Lord Kelvin), who was the first to recognise the tremendous importance of Green's work, obtained in 1850 the republication in *Crelle's Journal* of the famous "Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism" [*Crelle* 40, 44, 47 1850, 1852, 1854)], originally published in 1828.

collection had been distributed and described by the experts, the account of the arthropod fauna would not have been available until the present interest of Funafuti had passed.

OUR BOOK SHELF.

Weather Lore. A Collection of Proverbs, Sayings and Rules concerning the Weather. By Richard Inwards, F.R.A.S. Third edition. (London: Elliot Stock, 1898.)

MR. INWARDS is to be congratulated on the fact that his industry, exhibited in the collection of quaint sayings concerning the weather, has been rewarded by the demand for a third edition of his book on weather lore. If this popularity indicates a greater taste for an acquaintance with unscientific rules to be applied for the purposes of weather prediction over long periods, than an appreciation for the forecasts made on sound principles but for shorter intervals, it would imply a retrograde movement in meteorological education; but we imagine the demand for the book arises rather from the curious information it contains, and the old-world wisdom it exhibits, than from its scientific teaching and character of guide to weather prophecy. This edition is apparently much increased in size, and some features of a distinctly scientific value have been added. We notice a frontispiece in which the typical forms of cloud are well illustrated, and the average height at which these clouds float is marked by the marginal introduction of well-known mountain summits, calculated to bring home to us a correct notion of the elevation at which these clouds circulate. Cloud study is deserving of much more attention than it generally receives, and we welcome any attempt to induce more regular examination of the forms and motions of the familiar spectacle clouds present.

Then the section on the average dates for the first flowering of plants and appearance of migratory birds, which is either new or has been enlarged, should lead to more accurate observation of familiar phenomena. Such sections interest us much more than the proverbs and sayings which go to make up the bulk of the book. The arrangement of these proverbs seems to be much the same as in the first edition. Of the value of these, apart from their literary character, perhaps it is as well to say nothing. We follow the author or compiler in calling these rules proverbs, but the term is scarcely a happy one. A proverb has been defined as the wisdom of many and the wit of one, but in some cases, here preserved, it is difficult to recognise either the wit or the wisdom. They may give some evidence of national customs or of local manners, and sometimes display shrewd observance on the part of the authors; but this mass of endless detail, collected by many generations of weather-wise people, may become somewhat wearisome if taken in large doses. Yet, if we understand Mr. Inwards correctly, he implies that the persevering labour and continuous observation bestowed on weather signs have resulted in securing some insight into meteorological phenomena, and he recommends us to imbibe the general spirit of these rules and adages, and try to find where similar results have followed similar indications. This would lead to the detection of a number of coincidences no doubt, but it is not easy to see how true science would be advanced thereby.

First Stage Magnetism and Electricity. (The Organised Science Series.) By R. H. Jude, M.A., D.Sc. Pp. 350 + xv. (London: W. B. Clive, 1898.)

ALTHOUGH there are several books on these subjects prepared specially to cover the syllabus of the elementary examination of the Science and Art Department, the one before us has some peculiarities which renders the treatment different in many respects. The chief difficulty which the author has attempted to overcome is the conception of electrical potential, which so often forms a stumbling-block to the beginner. This he has introduced much earlier than usual, leading appropriately up to it. In this, the first part of the book, the author has further expounded in a simple manner the conceptions of the ethereal theory, thus bringing it within reach of the beginner. The second two parts deal with magnetism and electrodynamics, the main points of treatment being the emphasis of fundamental principles, the omission of the disputed points in the theory of the voltaic cell, and, as the author states, "a liberal use of the conception of potential gradient." Numerous illustrations are inserted in the text, and a great number of examples and examination questions are added.

As a first course on magnetism and electricity the book should prove serviceable.

Problems of Nature. Researches and Discoveries of Gustav Jaeger, M.D. Selected from his published Writings. Edited and translated by Henry G. Schlichter, D.Sc. Pp. ii + 261. (London: Williams and Norgate, 1897.)

THIS small volume has been formed by collecting together a number of Jaeger's brief essays on various important subjects. They are classified under three headings as Zoological, Anthropological, and Varia. The essays are highly ambitious, and lay down the law upon matters of the deepest difficulty with commendable brevity. Thus the fourteen zoological essays range from "The Origin and Development of the First Organisms" and "The Origin of Species" to "Inheritance," "The Animal Soul," and "The Development of the Vertebrate Type," and altogether occupy eighty-three pages. The essays classed as anthropological deal chiefly with the author's pronounced views on physiological processes, infection, immunity, constitutional strength, &c.

The author is apparently a man with an active original mind and a great respect for his own opinion. Subjects of such intricacy and difficulty are not to be handled so boldly except by those who have not been able to study, or have not cared to study all that has been said about them. Allowing for the dictatorial and peremptory style of the author, much that is suggestive and interesting will be found in many of the essays, as indeed we should expect from the writings of a man who was one of the first, if not the first, to suggest the continuity of the substance of the germ cells of parent and offspring as the biological basis of heredity. A letter, written to the author by Charles Darwin in 1869, and a second in 1875, are printed, and the latter also reproduced in facsimile. Both are very characteristic in their high appreciation of the work of another.

The book is well translated and edited. The printing is good, but the few illustrations are not well executed, the representation of a nerve-cell (after Max Schultze) on p. 9 being especially bad. E. B. P.

Medical Missions in their Relation to Oxford. By Sir Henry W. Acland, Bart., K.C.B., F.R.S. Pp. 92. (London: Henry Frowde, 1898.)

THIS is an address, with a series of notes, delivered by Sir Henry Acland to the Oxford University Junior Scientific Club at the beginning of last December, with the object of showing the valuable work which can be accomplished by men with scientific knowledge acting in connection with foreign missions, either as coadjutors or as appointed religious teachers, as medical practitioners, or as health officers. The needs of India for such men are especially referred to, and it is shown that the prevention of disease, or the care of the public health among various races under different conditions of climate, life, and character, as well as the treatment of disease under the same conditions, should be an essential object of foreign missions. The establishment at Oxford of a department where the complicated subjects bearing on the public health of India can be taught is warmly advocated.

It was with the idea of securing such means of study that Sir Henry Acland resigned his office into the hands of the Regius Professor of Medicine, Prof. Burdon-Sanderson, but, unfortunately, the University is not able to carry out the scheme, and it remains for some wealthy person to grasp the great importance of the various questions involved in the public health of India, and assist the University to provide the means required.

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.*]

Protective Mimicry.

I HAVE read, with special interest, both Sir George Hampson's remarks on certain cases of pseudo-mimicry and Mr. Ed. Poulton's answer to the same (NATURE, vol. lvii. pp. 364 and 389).

Now, as I am the person that was consulted on the subject by one of Sir G. Hampson's correspondents in India, I think myself entitled, and in a way even bound, as far as possible to remove some of the misgivings that seem to have crept into Mr. Poulton's appreciation as to the true bearing of the facts under discussion.

Though he agrees, on the one hand, with Sir G. Hampson as to the fact that "this and other like cases of mimicry are quite destructive of any interpretation of resemblance based on Bates' theory," he yet maintains, on the other, that "they do not similarly affect the Müllerian theory."

But this is precisely what I contend is contradicted by the facts in question. To make this clear, I shall only use Mr. Poulton's own statements and admissions.

"The Müllerian theory," he says, "supposes that a common type of appearance among distasteful insects in the same locality acts as a common advertisement to enemies, so that the loss of life which must ensue during the time in which each generation of enemies is being educated to avoid the owners of a particular type or pattern and colouring is shared between the species instead of being borne by each independently."

The theory, thus understood, seems to Mr. Poulton to be rather exemplified and confirmed than contradicted by the facts in question, and he therefore continues: "It is probable that *Teracoli* are on the whole avoided by birds; and if this is also true of the *Abraxas*, the resemblance may well be advantageous, in spite of the difference in station, even granting that the 'good round sum' of 6000 feet is an absolute barrier to the *Teracoli* below and the *Abraxas* above. But future investigation may show that they approach much nearer than this."

First of all this reasoning, which is openly all about admitted facts, looks rather as a running away from those facts to some wished-for possibilities. Besides Mr. Poulton grants, after all, that unless both types occur in the same locality and be exposed to the same enemies, no possible training of young birds can be conceived, and consequently no advantage can be supposed to accrue.

But what are the facts? For here, of course, I do not pretend to discuss what might take place in any possible supposition, nor even to find fault with the logical slip so very common among natural selection evolutionists, which consists in so confounding the simple admission that similarity of colour exists, or even is useful, as to conclude from it that it is therefore the result of usefulness.

Now, so long as we keep to facts, whether we consider the two species of butterflies themselves or their respective enemies, the conclusion is the same, and they both require distinct climatic conditions and distinct "habitats."

Willingly or not, we must resign ourselves to see the "good round sum" of 6000 feet, or rather the difference in climatic conditions and other "surroundings" represented by this difference in elevation in our regions of Southern India remain as an insuperable barrier between the above-named species of butterflies, and to much the same extent also between their enemies.

Far from coming into contact, therefore, they are thus kept by their habits apart from one another, and put under conditions quite different from those required for the possible application of even the Müllerian theory.

Finally, both from the evidence of these and many like facts and, as Mr. Plateau has so well demonstrated, from the trifling importance of colouring in the selection of insects by their enemies, it is, to say the least, difficult to see how the facts of similarity in colour, shape, &c.—which for shortness sake we may even call "mimicry"—can be interpreted or explained by any possible theory based on simple natural selection. And I would, in conclusion, remark that I distrust all such theories not, as Mr. Poulton seems to believe, "on the ground that the evidence is not demonstrative," but because, far from offering an intelligible and possible explanation of facts, they simply stand in contradiction with them and mislead us as to their real meaning.

J. CASTETS, S.J.

St. Joseph's College, Trichinopoly, India, June 8.

I DO not propose to deal with Mr. Castets' objections to natural selection in general. They have often been met before. As to the special case under discussion, he feels that his knowledge of the distribution of the two species is exhaustive enough to give him safe warrant for the assertion that they are invariably separated by a height of 6000 feet. If this conclusion is well founded, it is an important contribution to the facts of the case under discussion. Nevertheless neither this nor the climatic differences need affect the Müllerian theory if the barrier which separates the one form from the other is crossed by the enemies of both. The *Teracolus*-like appearance of the moth is remarkable, and separates it very sharply from its allies. It occurs on an elevated district surrounded by lower country in which the *Teracolus* abounds. The approximation is sufficient to render the Müllerian theory a probable explanation in view of the immense number of similar relationships accompanying a closer approximation in other parts of the world, and considering the complete absence of any other explanation; unless, indeed, Mr. Castets intends to imply, by so constantly dwelling upon one aspect of the environment, that the *difference* in climate is responsible for the *agreement* in appearance.

Oxford, June 30. E. B. POULTON.

Epidemics among Mice.

REFERRING to a paragraph in your issue of June 23 (p. 179), relative to the discovery by Dr. Issatschenko of a new microbe pathogenic to rats, I would call attention to some articles by Prof. F. Loeffler on epidemics among mice, &c., in the *Centralblatt für Bacteriologie und Parasitenkunde*, Band xi. pp. 129–141 (February 10, 1892), and Band xii. pp. 1–17 (July 5, 1892), which will be found translated in a Blue Book entitled, "Report of the Departmental Committee appointed by the Board of Agriculture to inquire into a Plague of Field-Voles in Scotland, with Minutes of Evidence and Appendices and a copy of the Minute appointing the Committee" (1893). Translations of the above papers form Appendix vi. of this Report; and Prof. Loeffler's second paper relates his successful efforts to employ the "Bacillus typhi murium" to destroy field-voles in Thessaly.

It would be interesting to know whether the microbe discovered by Dr. Issatschenko is the same as that described by Prof. Loeffler, or a different species. W. F. KIRBY.

Chiswick, June 25.

Remarkable Hailstones.

ON Sunday, June 26, a district to the south of Manchester was visited by a thunderstorm, which was remarkable for its accompaniment of heavy hail. The storm came from the same quarter as the cool surface wind, viz, north-east, and reached its height about 2.15 p.m.

Preceded by a lull in the heavy rain, hail, accompanied by lightning, began to fall, and continued to do so for five minutes.

The most noticeable fact was the peculiar shape of the hailstones. These were conical in shape, about $\frac{1}{2}$ inch long, and $\frac{3}{8}$ broad in widest part. In longitudinal section they showed (*a*) opaque white bands; (*b*) clear, colourless bands; (*c*) semi-opaque bands, dotted with more opaque portions.

All of those examined agreed in possessing transparent portions at the *vertex* and *base*. On making a transverse section through one of the opaque bands, it was seen to consist of (*a*) narrow clear channels intersecting the surface; (*b*) opaque masses, many of an uniform size, separated by the above-mentioned clear, transparent channels.

The general appearance of this transverse section inclined one to regard the stone as built up of a number of conical spicules, with their vertices pointing towards the vertex of the stone.

This was confirmed by the fact that one of the stones, whilst melting, was squeezed between the thumb and finger, and immediately fell apart into three distinct spicules.

SAMUEL N. PLAYER.

126 Burton Road, West Didsbury, Manchester.

Dendritic Patterns caused by Evaporation.

I WAS glad to see the note (with illustrations) published in NATURE (June 23) on this subject. Among the specimens which I did not mention in my paper are two microscope slides similar to those described by Prof. G. H. Bryan. They are botanical slides from the collection in my laboratory at Bedford College, and as they were bought specimens, I was not certain that they had been mounted in glycerine jelly, although I believed it was probably the medium used. I therefore laid them aside for future work, and am now pleased to find the probability confirmed. I wished also to make further experiments on the relation of the structure to the included specimen.

I should like to point out, however, that although the medium does not contain recognisable particles in suspension, we may look upon the jelly as representing material in an extremely fine state of division, as it were, so that the principle of formation may be similar to that in the other slides described.

July 1. CATHERINE A. RAISIN.

Solar Halo of July 3.

IN case it may interest your readers, I write to say that there has been a magnificent halo round the sun, lasting almost without interruption from 4 p.m. to 6 p.m.

It varied in intensity during the time of its visibility, and also in colour. When at its best it was distinctly bluish at its outer margin, shading through yellow to red; the more decidedly green and pink tints of the rainbow seemed to be wanting. But the most conspicuous feature of the apparition was the comparative darkness of the sky within the ring. The halo appeared as if fringing a dark storm-cloud; but that this was not really the case, was evident from the sun's appearance.

All day, in fact for several days past, the sky has been exceptionally much decorated with fantastic cirrus clouds, and this afternoon, at the time of the halo, veils of cirrus concealed almost all the blue; while a lower layer of cumulus clouds drifted up from the west and gradually obscured the sun, halo and all, for a time.

I do not know if the halo formed a complete ring round the sun, as trees partly concealed my view; but I was able to trace it for fully three-quarters of its circumference.

Bradfield, Reading, July 3. CATHARINE O. STEVENS.

A Monochromatic Rainbow.

A CURIOUS rainbow was observed here on Friday evening last. Heavy rain falling in a dark southern sky formed the lower portion of one limb of a bow, extending about 10° directly towards the zenith. The red band alone was visible, and lasted *after sunset* (which occurred at 8.40 for our horizon, and some ten minutes earlier below the Howgill Fells), for a full quarter of an hour. A. J. K. MARTYN.

Sedbergh, July 3.

CAST METAL WORK FROM BENIN.

AMONG the spoils, interesting to ethnologists, brought back from Benin by the punitive expedition under Admiral Rawson, was a large number of elaborately carved elephant's tusks, some of them of remarkable length; various smaller objects in ivory; profusely ornamented wooden panels forming doors and looking-glass frames, and hundreds of objects of great multiplicity of design cast in metal, both in the round and in high relief. The wonderful technical skill displayed in the construction of the metal objects, their lavish ornamentation, much of which is deeply undercut, and in nearly every case the high artistic excellence of the completed subject, have been a surprise and a puzzle to all students of West African ethnology. If they have now begun to recover from their surprise that work of such excellence, indicating skill born of long experience, should have come to light from among so barbarous a race, and that no whisper of its existence should have reached Europe, notwithstanding its great abundance (as attested by the numerous pieces exposed in London and provincial auction rooms, in addition to the hundreds of plaques and figures sent to the British Museum); there has, at all events, been as yet no elucidation of the mysteries—who were its manufacturers, where and when was it executed, and whence did they derive the knowledge of this art?

Although the city has been described as being, in the middle of the seventeenth century, "of greater civility than to be expected among such Barbarous People," none of the travellers who, within the past two or three hundred years, have left accounts of their visits to Benin, have described this metal work as a special feature of interest there. If the amount that has already found its way to Europe had been displayed in the king's or chiefs' houses, or in their public buildings, it could not surely have failed to attract attention and remark. The artificers and their appliances for the manufacture of works, on so large a scale, could hardly also, one would suppose, escape notice, or be passed over in silence, if observed. More than one traveller mentions seeing blacksmiths at work and turning out good workmanship, "considering the appliances they have"; but no foundry work or modellers in clay or wax are referred to.

Tusk-holders in the form of human-headed vases have certainly been alluded to; and the nearest approach to a description of the plaques is the "melted copper whereon are Ingraven their Warlike Deeds and Battels, kept with exceeding curiosity," mentioned in Ogilby's collection of African travels. Few, however, if any, of the plaques brought to Europe display warlike deeds or battle scenes. The accompanying illustrations are taken from examples lately acquired by the City of Liverpool, and described by Dr. Forbes in vol. i. No. 2 of the *Bulletin* of the Liverpool Museums—a recently established periodical, intended to make known the contents of the Derby (or Zoological) and the Mayer (or Ethnological) Museums, and the results of the investigations carried on in the laboratories attached to them.

Fig. 1 represents a small plaque, used as a lid of a box, or perhaps as a pendant, in which the king or some high personage is shown, supported by two slaves; while in Fig. 2, is illustrated one of the human-headed vases which sat on the altar in the king's principal Juju-house, supporting a carved elephant tusk. The head-dress of this figure is a network of coral strings with pendants, set off on both sides by rosettes of larger beads of a different sort. Encircling the neck as high as the lower lips are thirty-one coral ropes, forming the collar, which is the insignia of a high dignitary.

On the face may be observed his tribal marks, consisting of three raised weals over the outer corners of each eye, and of two long perpendicular lines running down the front of the forehead above each inner corner. These last probably represented ordinary tattoo marks on the brow, as they are represented by bands of iron, ingeniously let into the metal during the casting. In the same way the pupils of the eye are formed by round discs of iron. The whole figure has been very carefully chiselled over; and when it was newly finished, there is little doubt that the steel-blue tattoo lines and the glistening pupils gave to the face and eyes a very life-like appearance.

The projecting circular flange of the base has depicted on it a series of most interesting symbolic and fetish emblems. From its centre in front, the different symbols follow each other in the same order round both halves of the circumference. The central symbol is a bullock's head; then, in succession, a stone neolithic celt; an arm excised at the shoulder (with a tripod-like ornament covering the termination, and in its hand a three-pointed object); a frog; a fish, with protruding eyes, which seems to resemble more nearly than any other the curious mud-hopping *Periophthalmus koelreuteri*, so common on the brackish margins of West African rivers, or, possibly, it may be intended for—though very unlike—the electric fish (*Malapterurus*), which is a powerful fetish on different parts of the coast, because of the "quaking and trembling it produces in the arm"; then follows another bullock's head, which, with a second neolithic stone axe, completes the series.

The bullock's head, which occupies the central position among the symbols, is doubtless a fetish emblem. The

Fig. 1.

Beni have large herds of black and white cattle, as described by Burton; and bullocks form one of the chief sacrifices, human beings being the other, when the king is making "country custom" for his father and dead ancestors. The same emblem was much in evidence also in Dahomey, when, "during the customs," as Commander Forbes records, "a party carrying the fetish gear is headed by a man in a huge coat of dry grass, wearing a large bullock's head. As he passes, all the boys follow crying 'Soh, soh!' This is the representative of the god of thunder and lightning." One of these actual masks formed part of the Benin loot, and is now in the National Collection.

The next emblem to this, on each side, is the representation of an undoubted neolithic celt. These implements, which occur in the ground in many parts of Africa, are, among the Yorubas, considered to be "thunderbolts which Shango or Jakuta, the thunder god, cast down from heaven, and are venerated as sacred relics. Among the negroes in Tobago, in the West Indies, where they disinter similar neolithic axes, from time to time, in digging holes for sugar-canes, the stone is often boiled, and the water drunk to cure various kinds of ailments. The tusk-holders that have been secured for the Liverpool Museum must be of great antiquity, for they are overlaid with a very rich patina, the result of long exposure.

The little statuette (Fig. 3) is very interesting. It represents a native soldier or hunter, standing with a flint-lock in his hand. The upper part of his body is clothed in a garment ingeniously made of the two halves of a headless leopard's hide. A short pleated kilt-like garment encircles his loins. He wears a bandolier, a short sword, a hunting-knife, and a powder-flask made

Fig. 2.

of elephant tusk. The most interesting detail of this statuette is undoubtedly the flint-lock, as it serves to fix the period anterior to which this casting could not have been made, *i.e.* 1630 to 1640, the date of the invention of flint-locks.

The elaborate details on the plaques, statuettes and tusk-holders prove that whoever the artist was who designed these objects, he was, or had become, well acquainted with the religious or fetish feelings and ideas of the people, their ceremonies and customs, and with the minutest details of their various garments, ornaments and accoutrements, and was no passing visitor. His skill and patience are beyond question.

The material of which these various objects is composed is not bronze, as has been generally stated in most of the accounts of them, but a copper-lead-zinc compound, in which the proportions of the three elements vary very much. Its analysis has consequently thrown little light on the source whence the metal was obtained.

The process of manufacture was undoubtedly that known as *Cera perduta*, in which the object is first modelled in very fusible wax. The model is then overlaid with finely levigated clay, and built up to a sufficient thickness. Through an orifice, afterwards made in the clay, the wax is melted out, and the molten metal run into the vacuity. By this process each article requires a model for itself, and only one casting can be made from one mould.

FIG. 3.

As the present natives of Benin are incapable of producing, at the present day, any works approaching these plaques and statuettes, it may be that the art was brought to the West Coast Hinterland by some European trader, prisoner or resident, who, observing the skill of these people in the modelling of clay figures, such as the Fantee women fashion, may have instructed them how to do the same in wax, and how by overlaying the model with clay to finally reproduce it in metal.

It is possible, on the other hand, that their knowledge of founding was derived from purely African sources. The ancient Egyptians knew how to cast in bronze, in which there was, however, no zinc. The Benin upper classes are not negroid, their features are regular, and their skin olive-coloured. It seems not improbable, therefore, as another explanation of the presence of such high works of art in Benin, that many centuries ago the city may have been occupied by an offshoot of the same central Soudan race, with the leaven of Abyssinian or Egyptian influences among them, as now occupies Nupe, a few hundred miles further north; but that through intercourse with the debased coast tribes, they became demoralised and degenerated into their present low civilisation. The metal work discovered in the city may, therefore, be the relics of a former higher civilisation; or they may, as Commander Bacon has suggested, have been the spoils of some campaign, kept as fetishes. When, however, their full history is elucidated, an interesting and unsuspected chapter in the history of West Africa will undoubtedly be brought to light.

THE PROPOSED UNIVERSITY FOR BIRMINGHAM.

THE movement started in Birmingham fifteen years ago for the establishment of a University in the Midlands has been growing so steadily in energy and in volume that the promoters feel justified in taking definite steps for the accomplishment of their object. The first stage of operations was reached last year, when the College founded by Sir Josiah Mason in 1880 was incorporated by Act of Parliament under a new constitution, and received the new name of "Mason University College." An important step forward was taken last week, July 4, when the first public meeting in favour of the proposal to create a University was held in the Council House, under the chairmanship of the Lord Mayor of Birmingham, and was attended by Mr. Joseph Chamberlain, M.P., and an influential gathering. The proceedings must have been in the highest degree satisfactory to the promoters, for not only were some interesting speeches delivered and much enthusiasm displayed, but a very substantial proof of the earnestness with which the scheme is being taken up by the inhabitants was afforded by the announcement of promised donations to the requisite funds of about 96,000*l*. The next step will be the issue of a public appeal for further donations; and it is confidently expected that the sum of 250,000*l*., which it is estimated is necessary to complete the equipment of the College, to found new chairs, to supply additional buildings, and to provide for the administrative machinery of the University, will before long be subscribed.

The proceedings at the recent meeting included the resolution, "That in the opinion of this meeting it is essential that in the interest of the city and the Midland district generally, a University shall be forthwith established in Birmingham." Mr. G. H. Kenrick, who moved this resolution, is a manufacturer at West Bromwich, employing a large number of men; and is himself a donor of 10,000*l*. to the fund. He has for many years taken a prominent and honourable part in promoting elementary and technical education in the city; and his opinion on such a question, whether as a man of business or as a school manager, is entitled to respectful attention from his fellow citizens. After referring to the influence which the existence of the University would have upon the training and education of teachers, Mr. Kenrick went on to give his view as to the intimate relation which must be established between the University and the industries of the district; and it is to be hoped that both parties, the professors on the one hand and manufacturers on the other, will be careful to note the very sensible observations of the speaker upon this topic.

No man can now stand up and say that industry can get on very well without science. That idea has been almost given up, but a more dangerous one has arisen in its place.

Some manufacturers know quite well that their industries are dependent upon scientific knowledge; but they have got into the way of saying that they do not want people around them knowing too much, and that when they want a scientific man they can send for him. But a man of science called in on such occasions is not always able to prescribe the exact remedy for the particular disease concerning which he is consulted. This is not to be wondered at, considering that industry has done her best so long to keep science at a distance, that science has pursued her own path independently with small direct reference to the needs of industry.

Prof. Tilden seconded the resolution, and took the opportunity of pointing out that, though in the past there had been much prejudice in the minds of British manufacturers against a University training, because they had been disposed to regard it as all very well for clergymen and schoolmasters, but useless in practical affairs; nevertheless a University rightly organised and rightly conducted might be made a most practical kind of thing.

He urged upon the meeting the importance of noting what is being done in other countries, especially the United States of America and Germany, and pointed to the fact that in these countries not only are Universities numerous, but are influential and richly endowed; while the directors, managers, and even foremen in manufacturing concerns are almost entirely men who have received a complete scientific education, and have taken a degree in one of the Universities, or if not in the University in one of the polytechnics or technical schools. The polytechnics of London and the municipal technical schools in this country are institutions which have done, and are doing, good service; but there are indications that the public do not realise how different they are from their prototypes on the Continent, partly in consequence of the inferior quality of the teaching staff, and partly by reason of the fact that the instruction given in such institutions in this country is only partial, and does not demand the devotion of the whole time and energy of the student. As to the influence of the Universities in England, it was obvious that the ancient Universities, though perhaps partly alive to the question, are incapable of providing what is wanted by industry. A great opportunity is now at hand for creating a University of a new type, in which all that is best of the old and the new can be associated together; not merely a large public school, but a place for men and women, a place for study and also eminently a place for research, and a place where that predominance of examinations which unfortunately prevails so generally in most British universities would be got rid of. In constituting her University Birmingham would do well to emphasise the claims of science in its application to industry by establishing a faculty of "technics" in which "applied science" should be put on an equality, so far as honours and rewards are concerned, with the faculties of arts and of pure science. Mr. Chamberlain supported the motion in a speech which passed in review the course of events which had led up to the movement then inaugurated, and made a strong and effective appeal to local patriotism which had done so much in the past, which had made Birmingham what it was, and which he believed would now set the crown upon their educational work.

The Bishop of Hereford, in moving for the formation of a general committee, made an interesting speech which was listened to with all the more attention that the Bishop of the diocese had endeavoured to throw cold water on the scheme by pointing to the spiritual destitution of the district, and indicating his opinion that this ought to be remedied before other schemes were brought forward. The Bishop of Hereford, however, pointed out that not only was it impossible to put a stop to a great tidal movement which arose out of civic patriotism, but that the work in which they were engaged was actually more likely than any other to help the growth of that spirit in every denomination in the city which would never rest till the spiritual needs of the community were adequately supplied. The Bishop in concluding referred to Bristol and its University College, of which he is President.

At one time it seemed probable that the Birmingham project would take the shape of a federation of colleges among which Bristol would be included. That idea seems now to be abandoned. But the success of movements of this kind seems to be dependent chiefly upon financial support; and if Birmingham brings her scheme to completion it may be hoped that this will serve as a stimulus to other cities to follow her example, so that at some future, not far distant, time, not only will London have a University worthy of her great position, but every large centre of population will be occupied by a seat of learning at once the guide and helper of local industry and a focus of the light and culture of the world.

THE NATIONAL MUSEUM OF NATURAL HISTORY.

THE imminent retirement of Sir William Flower after his long and extremely efficient service as Director of the Natural History Museum, is an event of very serious importance to the progress of natural science in England. At one time the national collection, like any little country museum, was a jumble of curiosities and antiquities, the stray result of capricious generosity. As knowledge grew, the various departments became specialised, and in the middle Victorian period, thanks to the prescience of Owen, and the active interest of the Prince Consort, a prodigious dichotomy was effected. The collections relating to what are called by a well-known if illogical term, the Natural Sciences, were separated from the sculptures of Assyria and Greece, from the papyri and coins, the remains of the arts and manufactures of earlier civilisations, and were lodged in the magnificent palace in South Kensington. They were placed under the care of a small army of specialists—zoological, botanical, geological and mineralogical—and these were directed by a single controlling general, directly responsible to the nation through the Trustees and the Treasury. The great abilities of Owen, and the coordinating genius of Sir William Flower, rapidly made the British Museum of Natural History an institution of world-wide importance. Scientific men from provincial England, from Scotland and Ireland, from the Colonies and from other nations, came to regard it more and more as the greatest of centres for the elaboration of all knowledge in natural science depending on the presence, classification, and display of material specimens. As the reputation of the Museum has grown, so also has grown the work done and to be done in it. Collectors from all parts of the world lavish on it or offer to it for sale the best of their specimens; naturalists bequeath to its care their treasured collections from a thousand sources, and so material for scientific work accumulates. The members of the staff become specialists of extraordinary knowledge; many of them, junior and senior, are experts of European reputation in their own departments. Among all the activities of our great nation, the scientific activity of the Natural History Museum takes a great and increasingly great place.

It is obvious that as this organism grows in activity and specialisation, the position of its Director becomes more arduous and important. The Director of the Natural History Museum should be the leader of the natural sciences in the Empire. He has the opportunity of influencing both society and the Legislature by personal contact and intercourse. He should be the channel through which the scientific workers of the nation make known their needs and aspirations. He should have attainments of the widest possible description, and scientific sympathies that are wider than possible attainments. Not only is such a man advisable for the general advancement of science—he is necessary for the particular post. An almost inevitable association with specialisation is limitation of outlook, and as the various members of the staff of the museum become more efficient in their own departments, they require more and more the assistance of a controlling and coordinating chief. Precisely as they become more distinguished in their own branches of exact knowledge, it becomes more necessary that an officer in whose wide powers they have the fullest confidence, and for the dignity and responsibility of whose post they have the highest respect, should be at their head.

There is no possible mode by which the election of a person with these high qualifications may always be secured, but at least it is certain that he should be sought for in the widest field. Britain and the Colonies, the whole Empire should be passed in review before choice is made of one to hold this arduous, dignified and supreme post. We need not doubt that the Trustees will rise to the level of their responsibilities, and we are glad to know that the President of the Royal Society is numbered among them.

NOTES.

In honour of the centenary of the establishment of the Physical and Agricultural Society at Königsberg, Dr. Walter Simon has given the Society the sum of four thousand marks to be offered as a prize for a work on the subject of plant or animal electricity, presenting either fundamentally new aspects, or dealing with the physical cause of organic electricity, or its importance upon life in general, or upon certain functions. The competition is open to every one. The works presented may be printed or written in German, French, English, or Italian, and must be sent in before December 31, 1900. Works which are published before the end of next September will not be admitted to the competition, as the intention is to give the prize for works which are comparatively recent at the time of the award. Should no work of sufficient merit be presented the prize may be withheld, or two prizes of five hundred marks each may be awarded. The Committee appointed to make the award consists of Profs. W. Pfeffer, B. Frank, W. Kühne, E. Hering, and L. Hermann, with power to add to their number. Further information concerning the prize may be obtained from the President, or the Secretary, of the Physikalisch-ökonomischen Gesellschaft, Königsberg.

The fourteenth annual general meeting of the Marine Biological Association was held on June 28; Prof. E. Ray Lankester, F.R.S., President, being in the chair. The Report of the Council dealt largely with the work done at the Plymouth Laboratory during the year. Reference was made to Mr. Garstang's investigations of the habits and migrations of the mackerel, to Mr. Holt's researches on the reproduction and development of fishes living in the neighbourhood of Plymouth, and their distribution at different ages, as well as to the experiments with floating bottles for determining the surface drift in the English Channel, and to the systematic investigation of the dredging and trawling grounds between the Eddystone and Start Point. Twenty-two naturalists and eight students were reported as having worked at the Laboratory since the last annual meeting, in addition to the members of the regular staff. The following were elected members of Council for the year:—President, Prof. E. Ray Lankester; Hon. Treasurer, J. A. Travers; Secretary, E. J. Allen. Council: F. E. Beddard, Prof. Jeffrey Bell, G. C. Bourne, Sir John Evans, G. H. Fowler, S. F. Harmer, Prof. Herdman, Prof. Hickson, J. J. Lister, Sir John Murray, P. L. Sclater, D. H. Scott, Prof. C. Stewart, Prof. W. F. R. Weldon.

On June 30 the Senate of the Dublin University conferred the honorary degree of Sc.D. on Mr. R. H. Scott, Secretary to the Meteorological Council. In a humorous Latin speech the Public Orator referred to the fact that many people believed the recipient to be not only the interpreter, but also the author of the weather. Last year the French Government conferred on Mr. Scott the Order of Officer of the Legion of Honour, in recognition of valuable services rendered during many years to the French Marine, by the transmission of timely notices of impending bad weather.

Mr. John Milne, writing from Shide, Isle of Wight, says:—At 6h. 48m. 37s. p.m. on June 29, preliminary tremors with a duration of nine minutes heralded the commencement of a large earthquake. The movements extended over three hours. The maximum change in inclination of the surface of the ground was between nine and ten seconds of arc. From an open diagram the period of the E.W. movements which were the most pronounced was thirteen seconds. Assuming a velocity of 2·5 km. per sec., then the length of the earth-waves would be about 32 km., and their height about 30 cm. Records were obtained at Kew, Laibach, and probably at all observing stations in the world.

The annual general meeting of the Society of Chemical Industry will be held in Nottingham on July 13-15.

The latest *Verhandlungen* of the Berlin Geographical Society (1898, Nos. 5 and 6) contain the addresses delivered at the special meeting held at the end of May to celebrate the seventieth anniversary of the foundation of the Society. The medals presented at the meeting were as follows:—The Humboldt medal to Dr. Nansen; the Karl Ritter medal to Dr. E. von Drygalski, for his work in Greenland and the monograph upon it; the gold Nachtigal medal to Dr. G. Schweinfurth, for his explorations in Africa; and the silver Nachtigal medal to Captain Ramsay, for his geodetic and cartographic work in German East Africa. Prof. W. M. Davis, Prof. G. K. Gilbert, M. A. de Lapparent, and Prof. Mohn were elected honorary members; and the following were elected corresponding members of the Society:—Dr. Sven Hedin, Lieut. Johansen, W. Obrutschew, Dr. Fritz Sarasin, Dr. Paul Sarasin, Captain Sverdrup, and Dr. Eduard Freiherr von Toll.

For several years the Royal Geographical Society, latterly in co-operation with the Royal Society, has been making strenuous efforts to influence the Government to equip an expedition for the exploration of the Antarctic, the greatest unknown area on the face of the earth. It will be within the recollection of our readers that at an enthusiastic meeting held at the Royal Society last February, at which Dr. Nansen and Prof. Neumayer, besides many distinguished British men of science, were present, the great value of the results to be derived from an Antarctic expedition was clearly explained. Previous to this, in October last, the President of the Royal Geographical Society wrote to the Prime Minister urging that an Antarctic expedition should be undertaken either by Her Majesty's Government or with the aid and sanction of the State. The President pointed out in strong terms that it was the duty of England to undertake the further exploration of the greatest unknown region of the globe, and so complete the work done by Ross fifty years ago. The reply received at the time was sympathetic and gave reason to hope that the final reply, which was to be sent at a later date, would be favourable. The final reply has just been received from Lord Salisbury, and in it "his lordship expresses his regret that he is unable, under existing circumstances, to hold out any hope of Her Majesty's Government embarking upon an undertaking of such magnitude." Moreover, it is stated in the reply that at the recent conference of Premiers held at Melbourne in March last, it was resolved that the Australasian Colonies should take no joint action in the matter of Antarctic exploration. In these circumstances, the Council of the Royal Geographical Society have decided to endeavour to obtain the funds for an expedition to be sent out under the Society's auspices. They have authorised the President to take steps to obtain subscriptions to the amount of not less than 50,000*l.*, and the Society itself will contribute 5000*l.* It is much to be regretted that the Government has been unable to give practical support to the enterprise, both in the interests of science and from the point of view of our national credit, but it will be still more lamentable if the expedition has to be abandoned altogether on account of want of funds. The amount required to equip and despatch the expedition is not excessive, and we trust it will soon be raised, so that the Antarctic area may be efficiently surveyed from many scientific aspects.

THE proposed removal of the Museum of Practical Geology from Jermyn Street to South Kensington, recommended by the Committee of the House of Commons on the Museums of the Science and Art Department, has met with adverse criticism from geologists and others. A circular inviting signatures to a memorial to the President and Council of the Geological Society, setting forth the reasons against the transference of the Museum to South Kensington, was recently sent to all Fellows of the Society resident in Great Britain and Ireland. The memorial pointed out that the Museum at present occupies a convenient central position, easy of access for engineers, architects, and others who make use of its collections, in proximity to most of the learned societies, and adjoining the offices of the Geological Survey. The Council of the Geological Society was therefore asked "to impress upon Her Majesty's Government that the suggested discontinuance of occupation and removal of the collections would seriously impede the progress of science, especially on its economic side." The memorial has been signed by about five hundred Fellows of the Society and was presented to the Council, a resolution passed at the recent meeting of the South-Eastern Union of Scientific Societies, and having the same object, being considered at the same time. Though the Council did not see their way to comply with the request of the memorial, they expressed the opinion that the question of the removal required more consideration than it appeared to have received. The memorial and the facts of the case were then brought to the notice of Lord Salisbury, who has promised to give attention to the whole question. There the matter at present stands, but it is to be hoped that no final decision will be arrived at until it has been given most careful consideration and more evidence taken with reference to it than has yet been laid before the Select Committee, in whose report the removal of the collections is suggested.

IT has already been announced that the Society of Arts' Albert Medal for this year has been awarded to his Excellency Dr. Robert Bunsen, the veteran professor of chemistry at the University of Heidelberg. At the annual meeting of the Society held on Wednesday of last week, the work of this eminent investigator was referred to by the Council in the following words:—Amongst the numerous and important scientific discoveries which have rendered the name of Bunsen famous wherever science is valued, perhaps the most striking is the one in which he was associated with his distinguished colleague, Prof. Kirchhoff, viz. spectrum analysis, a discovery which has shed a new and unexpected light on the composition of terrestrial matter, and has enabled us to obtain a distinct knowledge of the chemical composition of sun and stars. The contributions which Bunsen has made in the application of chemistry and physics to the arts and manufactures are of the utmost value, and their importance may be measured by two out of many instances. The Bunsen battery was, until the introduction of the dynamo, the cheapest source of electricity; the Bunsen gas-burner, by which a non-luminous, smokeless, but highly heated flame is obtained, is now not only indispensable in all laboratory work, but is used for heating purposes in thousands of houses and manufactories, and for illumination, by the incandescent system, in millions of lamps. Beyond these Bunsen's contributions to the sciences of chemistry and physics have been of the highest importance; but, perhaps, the greatest benefit which he has conferred through a long life devoted to the advancement of science, has been the influence which he has exerted as a teacher.

THE Paris correspondent of the *Chemist and Druggist* makes the following announcement:—"The gift of 2,000,000 francs (80,000*l.*), made by Baroness Hirsch some time ago to the Pasteur Institute, or rather about two-thirds of it, is to be devoted to building and fitting up a large model biological institute in the rue Dutot, Paris, opposite the Pasteur Institute. The interest of the balance of the money will be devoted to working expenses, though additional money will be required for the latter purpose. The ground on which the new building is to be erected was left as a legacy to the Pasteur Institute by another lady a few years ago. The plans for the Biological Institute have been drawn up by the directors and professors of the parent establishment with the aid of their architect. A hospital will be attached to it, where patients attacked by maladies to which Dr. Roux gives special attention will be treated. M. Duclaux will be the director of the new institute, in addition to that bearing Pasteur's name, while the laboratories of biological chemistry will be under the care of M. Gabriel Bertrand. It is hoped to have the building ready by 1900, and most likely the lectures, &c., connected with biology will in due course be transferred to the rue Dutot from the Sorbonne."

IT has been agreed by the Executive Committee that ladies attending the fourth International Congress of Zoology at Cambridge in the company of a member may become Associates on the payment of 10*s.* This payment will entitle them to attend the general and sectional meetings, and the receptions held during the meeting of the Congress at Cambridge.

THE septic treatment of sewage, to which reference was made in NATURE of November 4, 1897, has so far received the sanction of the Local Government Board, that they have authorised the borrowing of the money required for extending the experimental tanks at Exeter. The Board, however, do not yet seem to be satisfied that this system is capable of producing a thoroughly satisfactory effluent, as it has been required that the minimum area of land usually allowed shall be provided for the completion of the purification. From an article in *The Engineer* of June 17 it appears, however, that this system has been in successful operation in this country for several years, and that for an original outlay of 300*l.* and an annual cost of 50*l.* the sewage from the town of Winsford, in the Salt District, containing 12,000 inhabitants, has been sufficiently purified to flow into the river Weaver without causing any pollution. Under all the existing systems that are in operation, one of the chief difficulties is the disposal of the sludge which is left in the settling tanks, but under the septic treatment this difficulty disappears. The process at Winsford is simplicity itself. The works were constructed about twenty years ago, and have been in continuous operation ever since. They consist of a series of tanks containing about seven feet of ashes and clinkers, through which the sewage flows. Each set of tanks is used for a week, and then allowed a rest. The sludge settles in the first tank, and, owing to the action of the microbes, the residue, when taken out and placed on the banks, cannot be distinguished from ordinary soil. The quantity is so small that, although none has been removed, there is no accumulation at the present time. The water in the river Weaver, into which the effluent flows, has from time to time been analysed, but no traces of pollution have been detected, and there is no discoloration.

THE Deutsche Seewarte, in connection with the Danish Meteorological Institute, has issued daily synoptic weather charts for the North Atlantic Ocean and adjacent continents, for a year ending November 1893. These charts give a complete representation of the state of the weather existing at 8h. a.m. each day, and clearly show the movements of the low-pressure areas and the positions of the barometric maxima, compiled from all available data from land and sea. Synoptic charts for the above district have now been regularly issued (including those for the same district, issued by our own Meteorological Office for 1882-3) since the latter part of 1873, and contain the most necessary materials for elucidating weather changes and for improving weather predictions. The charts are accompanied by a separate *Quarterly Weather Review* explaining the various conditions, and illustrated by charts relating specially to each period during which any particular system was maintained, and clearly exhibiting the tracks of the various storms or low-pressure areas from west to east, or north-east. Great credit is due to the German and Danish Institutes for the persistency with which this most important work is carried on, as, although some copies are sold, there must be a considerable expense thrown upon them, both as regards the production of the charts and their subsequent discussion; but the value of the work to meteorological science is beyond question.

THE Director of the Madrid Observatory, Sr. M. Merino, has published the results of the meteorological observations made there during thirty-five years (1860-94). The tables, which have been very carefully prepared and arranged by Sr. F. Cos, show *inter alia* the monthly and yearly values of all the principal elements and the daily means for each five years. This long and laborious work is the continuation of that published in 1893, which contained the results of thirty years' observations. The absolute maximum temperatures of the various years range from 98°·6 to 111°·7, and the absolute minima from 25°·5 to 9°·5. The average yearly rainfall amounts to 16·5 inches, but the quantity varies very considerably in different years.

THE study of the mathematical theory of electricity would appear to be becoming popular in Japan, to judge from the *Kiji* of the Tōkyō Mathematico-Physical Society. In two numbers now before us (vol. viii. parts 1, 2) we find no less than three papers on this subject: one by H. Nagaoka, on the strain of an iron ring by magnetisation; one by E. Sakai, on the distribution of electricity on two excentric cylinders; and finally an essay by Dr. S. Kimura, on the magnetisation by induction of a rotating sphere or spheroid under a solenoidal distribution of magnetic force.

"THE disruptive discharge in air and liquid dielectrics' forms the subject of a dissertation by Mr. T. W. Edmondson, of the University of New York (*Physical Review*, vi. 2). From experiments with different sized spheres immersed in different liquids, Mr. Edmondson finds that the curves representing the relation between the potential difference and the sparking distance are in general approximately hyperbolas becoming practically straight lines for spark-lengths of over 3 mm. While a smaller difference of potential is necessary to produce a discharge through a given distance for large spheres than for small ones when the spheres are close together, for longer distances the dielectric is electrically stronger for large than for small spheres. Mr. Edmondson gives a table of the dielectric strengths of various substances; those for air, obtained with spheres, being considerably higher than that obtained by Macfarlane for planes. Both electrostatic and alternating discharges are considered.

A USEFUL summary of the present state of knowledge of the properties of Becquerel rays, in relation to Röntgen rays, is given by Mr. Oscar M. Stewart in the April number of the *Physical Review*. With reference to these radiations from various chemical substances, it is concluded: "As these rays can be reflected, refracted and polarised, there can be no reasonable doubt that they are transverse ether waves. Interference alone is left to be established to confirm this, but owing to the extreme feebleness and short wave-length it is doubtful whether it can be shown. . . . These rays, like X-rays, are not homogeneous. They have all the properties that X-rays possess, such as photographic action, exciting fluorescence, making gas conductors, and exciting thermo-luminescence. . . . The similarity in the behaviour of the X-rays and Becquerel rays certainly presents a strong argument in favour of the theory that X-rays are short transverse ether waves." In connection with this subject, it should be mentioned that the articles which have appeared on the subject of the discharge of electrified bodies by X-rays are briefly reviewed by Mr. Clement D. Child in Nos. xxiii. and xxix. of the *Physical Review* (1897), and supplemented with some results of his own upon the effect on the rate of discharge produced by a variation in the density of the air surrounding the electrified body.

PAPERS on miscellaneous results of recent work of the Division of Entomology of the U.S. Department of Agriculture appear in *Bulletin* No. 10 (new series). The articles are of interest to economic entomologists, and of importance to agriculturists and fruit-growers. Among the general notes is one on a lead-boring insect. Examination of a lead tank which had leaked showed that the metal had been pierced with holes by the larvæ of some species of beetle of the genus Lyctus. This is the third case which has come under Dr. L. O. Howard's notice of insects which bore into lead. In one case a Cossus larva bored its way through a large leaden bullet, which was embedded in an oak tree in which the larva was living; and in another, a coleopterous larva bored its way through a piece of lead piping.

AN important memoir, containing the results of a detailed craniological investigation, has just been published in the *Transactions* of the Wagner Free Institute of Science of Philadelphia (vol. v.). The memoir is the last of the late Dr. Harrison Allen's many contributions to the knowledge of organic forms and their modifications, and entitled "A Study of Hawaiian Skulls." The concluding remarks express clearly the scope of the contents; they are as follows:—"In the study just completed I have described a new graphic method of collating measurements. I have endeavoured to establish the proposition that the difference between the crania called here the 'cave and the coast crania' are not due to race but to methods of living, and in some degree to differences of mental strength in individuals. The cave series represents the dominating and superior type, and the coast series the weak and conquered type. I have suggested that some of the contrasts that obtain in the proportions of the face of the crania after European contact may be traced to the impress made upon the individual by the action of the exanthematous diseases. I remain of the opinion that the interest attached to the study of the human skull is not confined to attempting to limit race, but to the study of the effects of nutritive and even morbid-processes upon the skull form." Dr. D. J. Brinton prefixes a short appreciative note to the memoir, and points out that the conclusion as to the influence of methods of living in producing differences between crania is most important.

"A CATALOGUE of Earthquakes on the Pacific Coast, 1769 to 1897," by Dr. E. S. Holden, forms No. 1087 of "Smithsonian Miscellaneous Collections," vol. xxxvii. In compiling this catalogue, Dr. Holden had in view the determination of the general facts as to distribution of earthquake shocks, as to topographic areas, as to time, intensity, &c., and also the characteristics of particular shocks. The result is a history of earthquakes on the Pacific Coast, the disturbances being arranged chronologically and briefly discussed in an introduction. As many of the earthquakes of California are very local phenomena, which depend upon local causes for their production, no very definite conclusions can be found with reference to them. An arrangement of the shocks according to seasons shows that for California, Oregon, and Washington at large, shocks occur with about equal frequency in the wet and in the dry seasons. The records indicate, however, that in San Francisco and San José shocks are more frequent in the rainy season than in the dry. Dr. Holden suggests that, in any future study of California earthquakes, special regions ought to be selected for examination, with the object of determining the origin of the local shocks. The data he has obtained seem to indicate that the greater number of California earthquakes have been the result of faulting in underlying strata, rather than due to volcanic causes directly. With regard to damage to life and property caused by the earthquakes recorded, it is concluded that the earthquakes of a whole century in California have been less destructive than the tornadoes or floods of a single year in other parts of the States.

WE have received the Summary Report of the Geological Survey of Canada for 1897, by Dr. George M. Dawson, Director, and it is interesting to note that there is a great and increasing demand for the Survey publications. It is, of course, not surprising to learn that the report on the Yukon district is practically exhausted, and that the text and maps will be revised and reprinted. Gold mining was first attempted in the Yukon region in 1880, and in 1887 Dr. Dawson conducted an exploration of it; his forecast of the mining prospects has been amply verified by the recent discoveries in the Klondike district. The work of the Survey has so increased that there is great need of new, fireproof, and more spacious quarters; but at present the economic and scientific value of the collections and records does not appear to be fully appreciated by the Canadian Parliament. A quotation is made from an article in NATURE, written by a geologist who attended the meeting of the British Association in Toronto, and this pointed out how well the work of the Survey is appreciated by the people for whom it is primarily intended. The results of experimental borings carried out by the Survey in Northern Alberta in search of mineral oils are duly recorded. There are useful notes on the occurrence of corundum, and of observations on it by Mr. W. F. Ferrier. Coal, peat-bogs, building-stones and various metals come in for a share of attention, as well as the soils and agricultural prospects. Various analyses and assays have been made. The purely scientific aspects of geology are by no means neglected, and we have accounts of the igneous origin of fundamental gneiss, and of various formations of all ages up to the glacial drifts and recent accumulations. Reports on the palæontologica work are furnished by Mr. Whiteaves. During the year nineteen new maps were published; so it is evident that the Survey is prosecuted with vigour and enthusiasm, and we only hope that Dr. Dawson's desire for a more appropriate establishment may be granted.

THE seventeenth annual Report of the United States Geological Survey, recording in full the work done under the direction of Mr. C. D. Walcott during the period 1895-96, has lately reached us. It is divided into three parts, which are published in two bulky and two smaller volumes, and together these comprise lxviii and 2998 pages of letter-press. The information, as usual, is of the most varied character. There is the general report of the Director; an account of magnetic declination in the United States, by Henry Gannett; further contributions to the geology of the Sierra Nevada, by H. W. Turner; a geological reconnaissance in North-western Oregon, by J. S. Diller; and a discussion of the faunal relations of the Eocene and Upper Cretaceous on the Pacific Coast, by T. W. Stanton. In addition there are reports on the coal and lignite of Alaska, on the Uintaite or Gilsonite (a variety of asphalt) in Utah; on the brick-clays of Rhode Island; on the gold-quartz veins of Nevada city; on the geology of Silver Cliff and the Rosita Hills of Colorado; on the Tennessee phosphates; and on various underground and artesian waters. The mineral statistics are full and elaborate, and it is interesting to note that Fuller's earth has been discovered in Florida, Georgia, Virginia, and South Dakota. The illustrations are many, and include figures of Eocene and Upper Cretaceous Mollusca, maps, sections, pictorial views, and plates showing structure of ores, eruptive and metamorphic rocks.

THE following important additions to our knowledge of the flora of the American continent and of Australia have reached us:—Contribution No. 3 to the coastal and plain flora of Yucatan, by D. C. F. Millspaugh, from the Field Columbian Museum, Chicago; Contributions from the Gray Herbarium of Harvard University (No. 13), by Mr. B. L. Robinson, comprising a revision of the North American and Mexican species of *Mimosa* (67 species), and of the North American species of *Neptunia*; five instalments of Contributions to the flora of Queensland, by Mr. F. M. Bailey (these, not being numbered, are difficult of reference).

TOURISTS who are contemplating a visit to the north of Ireland should procure a copy of the Official Guide to the Belfast and Northern Counties Railway, Giant's Causeway, and Antrim Coast. The volume is a handy and exceptionally interesting guide-book, containing, in addition to the usual information, a section upon scenery and geology in County Antrim, by Prof. G. A. J. Cole, botanical notes by Mr. R. Lloyd Praeger, notes on the antiquarian remains of Antrim, by Mr. W. Gray, and numerous reproductions of photographs.

THE initiation ceremonies of natives of Australia have in recent years received the attention of a number of anthropologists. The latest paper upon the subject deals with the initiation ceremonies of the Arunta tribe, Central Australia, and is by Prof. Baldwin Spencer and Mr. F. J. Gillen. (*Proceedings* of the Royal Society of Victoria, vol. x., issued May 1898). It may be recalled that an account of the Engwurra ceremony as performed by the Arunta tribe appeared in NATURE a year ago (vol. lvi., p. 136). The Engwurra is not passed through until probably the native has reached the age of at least twenty-five or even thirty; but this final and impressive ceremony is preceded by others, beginning at about the age of ten or twelve, through which practically every Australian native has to pass before he is admitted to the secrets of the tribe and regarded as a fully-developed member of it. It need hardly be pointed out that authentic records, such as are given in the present paper, of ceremonial rites of aboriginal tribes are of increasing scientific value, even though the significance of the rites is not understood. Among other subjects of papers in the volume of *Proceedings* referred to above are :—Entropy meters, a method of determining the specific heat of a liquid ; the geology of Coimaidai, with appendices on the marsupial bones of the Coimaidai limestone and the graptolites of the district ; the structure of an Australian land leech (*Philæmonpunge*, n.s.) ; and a catalogue of the marine shells of Victoria.

IN the current number of the *Berichte*, J. H. Aberson describes a very interesting substance, which appears to be a new isomeride of malic acid. This compound occurs in many species of Crassulaceæ, and has the composition, molecular weight and chemical composition of malic acid, $C_4H_6O_5$, but differs from this very markedly in its behaviour when heated. Ordinary malic acid under these circumstances yields water and fumaric acid or maleic anydride, whereas the new isomeride is converted into a volatile double anhydride or malide, $C_8H_8O_8$, formed from two molecules of the acid, small quantities of fumaric and maleic acids and other products being also formed. The new acid is, moreover, more strongly dextro-rotatory than ordinary malic acid, and yields salts which differ from the malates in several important particulars. The author considers that the new compound is geometrically isomeric with ordinary dextro-malic acid, but that in it the free rotation of the two carbon atoms has in some way been arrested, so that the atoms and groups attached to these are not in that "most favoured" position, by the aid of which Wislicenus has been able to formulate so clearly the production of fumaric and maleic acids from the ordinary acid. It has not, however, been hitherto found possible to convert the new acid into the better-known modification, although the author promises to describe at an early date a method for its synthetical production. If this new form of the acid really has the configuration assigned to it, further research will no doubt reveal the corresponding lævo-rotatory and inactive (racemic) acids, the number of isomeric malic acids being thus brought up to six.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♂) from India, presented by the Lady Tichborne ; a Pig-tailed Monkey (*Macacus nemestrinus*, ♀) from Java, presented by Mr. J. Ratillon ; two Rhesus Monkeys (*Macacus rhesus*, ♂ ♀), a Bonnet Monkey (*Macacus sinicus*, ♀) from India, presented by the Parks Committee, Tynemouth ; a Lioness (*Felis leo*) from Somaliland, presented by Mr. Henry S. H. Cavendish ; a Mouflon (*Ovis musimon*, ♂) from Corsica, presented by Mr. H. Brinsley Brooke ; a Jackal Buzzard (*Buteo jacal*) from South Africa, presented by Mr. J. E. Matcham ; a Royal Python (*Python regius*) from West Africa, presented by Mr. W. G. Woodrow ; a Chimpanzee (*Anthropopithecus troglodytes*, ♀) from West Africa, a Brush Turkey (*Talegalla lathami*) from Australia,, a Glaucous Macaw (*Anadorhynchus glaucus*) from Paraguay, a Yellow-crowned Penguin (*Eudyptes antipodum*), a Thick-billed Penguin (*Eudyptes pachyrhynchus*) from New Zealand ; six Argentine Tortoises (*Testudo argentina*) from Patagonia, a Nilotic Trionyx (*Trionyx triunguis*) from North Africa, a White-throated Monitor (*Varanus albigularis*) from South Africa, four Wagler's Terrapins (*Hydraspis wagleri*) from Brazil, deposited ; a Lesser Koodoo (*Strepsiceros imberbis*, ♂), a Beisa Antelope (*Oryx beisa*, ♂), two Hagenbeck's Jackals (*Canis hagenbecki*) from Somaliland, three Japanese Teal (*Querquedula formosa*, ♂ ♀ ♀) from North-east Asia, two Black-winged Pea-fowl (*Pavo nigripennis*) from Cochin China, a Rufous Rat Kangaroo (*Æpyrymnus rufescens*, ♂) from New South Wales, purchased ; two Bennett's Wallabies (*Macropus bennetti*, ♂ ♀), a Brush-tailed Kangaroo (*Petrogale penicillata*, ♀), a Japanese Deer (*Cervus sika*, ♀), born in the Gardens, five Upland Geese (*Chloephaga magellanica*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET PERRINE (JUNE 14).—The following is a continuation of the ephemeris from last week. The comet is rapidly decreasing its northern declination and becoming brighter.

1898.	R.A. (app.) h. m. s.	Decl. (app.) ° ′	log *r*.	log Δ	Br.
July 7	5 44 14	+48 16·7			
8	49 48	47 28·6			
9	55 18	46 38·4	9·8958	0·1744	4·02
10	6 0 45	45 45·8			
11	6 9	44 51·0			
12	11 30	43 53·9			
13	6 16 49	+42 54·5	9·8435	0·1585	5·51

LATITUDE VARIATION IN A RIGID EARTH.—In an article contributed to the *Physical Review* (vol. vi. No. 3), Prof. Henry Crew discusses the movements of the earth's axis in terms of elementary dynamics, and calls attention to the "beautiful, but much neglected, top which Maxwell first spun at Edinburgh some forty years ago." Besides giving an excellent illustration of the top itself, Prof. Crew adds also an account of the adjustments that are necessary for its accurate working, and describes the various phenomena which it will illustrate, such as nutation and precession, statical stability and dynamical instability conferred by rotation, variation of latitude, and effect of polar ice-caps. In the mathematical treatment above referred to, Prof. Crew recalls the fine illustration employed by Maxwell, that the motion of the earth is practically that of a circular hoop rolling, but not slipping, on a stick of circular cross section, the word "practically" being used as the earth, in sections parallel to the equator, is not circular but elliptical. The theory here expounded shows that this hoop does represent the motion of a freely rotating rigid solid fixed at its centre of mass. Prof. Davidson's extensive and accurate series of observations (*Astr. Journal*, No. 323) receive here due attention.

CONFERENCE OF ASTRONOMERS AT HARVARD.—In consequence of the great success of the conference of the astronomers held last year at the Yerkes Observatory, it is proposed to hold a second meeting this year, and further to continue them annually. As the American Association for the Advancement of Science will meet in Boston on August 22, on the occasion of the fiftieth anniversary of its foundation, it has been decided to hold the conference at the Harvard College Observatory on August 18, 19 and 20. The circular, which we have received from Prof. E. C. Pickering, tells us that the proposed plan will enable visiting astronomers to attend this meeting, and those who are members of the Association can avail themselves of the special rates which have been obtained from hotels and railroads. Those who intend to go are requested to send in their names, and titles of papers if they intend to read any. Besides showing the work of the various departments of the observatory, excursions will be planned to various neighbouring scientific institutions, including the Blue Hill Meteorological Observatory, the Massachusetts Institute of Technology, the laboratories of Harvard College, &c.

A FINE COLLECTION OF METEORITES.—There has just been published a most interesting and valuable catalogue and guide to the collection of meteorites in the Paris Natural History Museum. Prof. Stanislas Meunier, who occupies the chair of Geology, tells us in his preface that in 1861 they only possessed 64 meteorites, and the first published catalogue comprised 86 falls. In 1864 the number rose to 160, and in 1889 the list consisted of 367 distinct meteorites. Since that date the museum has obtained possession of numerous new additions, and the present catalogue deals with 463 distinct falls. The catalogue itself is very well arranged. We have first a list of the different types which up to the present are known and exhibited in the museum, sections of which are copiously illustrated ; we next come to the arrangement of the individual meteorites, followed by an excellent bibliographical index. The final list is arranged chronologically, and gives the date and locality of fall, type, weight, and other interesting data.

THE AMERICAN ASSOCIATION.

THE preliminary programme of the fiftieth meeting of the American Association for the Advancement of Science, to be held at Boston August 22–27, has just been issued by the local committee.

Some changes have been made in the officers of the Association by death and resignation. The revised list is:—President: Frederick W. Putnam. Vice-Presidents: Section A (Mathematics and Astronomy): Edward E. Barnard. Section B (Physics): Frank P. Whitman. Section C (Chemistry): Edgar F. Smith. Section D (Mechanical Science and Engineering): Mortimer E. Cooley. Section E (Geology and Geography): Horace L. Fairchild. Section F (Zoology): Alpheus S. Packard. Section G (Botany): W. G. Farlow. Section H (Anthropology): James M. Cattell. Section I (Social and Economic Science): Archibald Blue. Permanent Secretary: Leland D. Howard. General Secretary: James McMahon, to fill vacancy caused by the death of David S. Kellicott. Secretary of the Council: Frederick Bedell.

The meetings will be held at the Massachusetts Institute of Technology, the Harvard University Medical School, and the Boston Society of Natural History. Association headquarters will be at the Rogers Building of the Institute of Technology (named after Prof. Wm. B. Rogers, last president of the Society of American Geologists and Naturalists, from which the American Association was organised fifty years ago). The hotel headquarters will be at the Copley Square Hotel.

The general programme begins with the meeting of the Council on August 20. The first general session of the Association will be held on Monday, August 22, at 10 a.m., at Huntington Hall in the Rogers Building. The retiring president, Prof. Wolcott Gibbs, will introduce the president-elect, Prof. F. W. Putnam, of Harvard University. Addresses of welcome will be delivered by Governor Roger Wolcott, of Massachusetts; Mayor Josiah Quincy, of Boston; and President James M. Crafts, of the Massachusetts Institute of Technology. President Putnam will reply. The several sections will then commence their sittings.

The addresses of the several vice-presidents will be given on Monday afternoon as follows:—

At half-past two o'clock: Vice-President Whitman, before the section of physics, "On the Perception of Light and Colour"; Vice-President Cattell, before section of anthropology, on "The Advance of Psychology"; Vice-President Farlow, before section of botany, on "The Conception of Species as affected by Recent Investigations on Fungi."

At half-past three o'clock: Vice-President Barnard, before section of mathematics and astronomy, on "Development of Astronomical Photography"; Vice-President Blue, before section of social and economic science, on "The Historic Method in Economics"; Vice-President Packard, before section of zoology, on "A Half-century of Evolution with Special Reference to the Effects of Geological Changes on Animal Life."

At half-past four o'clock: Vice-President Smith, before section of chemistry (subject to be announced); Vice-President Fairchild, before section of geology and geography, on "Glacial Geology in America"; Vice-President Cooley, before section of mechanical science and engineering (subject to be announced).

The address of the retiring president, Prof. Wolcott Gibbs, on Monday evening, will be "On some Points in Theoretical Chemistry," after which will be a reception to the Association and invited guests.

The meetings of the several sections for the reading of papers will be held on Tuesday and Thursday, morning and afternoon; and some sections will also hold meetings at Cambridge on Friday. Sections F and H will meet on Tuesday evening at the Harvard Medical School, when Dr. Thomas Dwight will lecture on "Variations in Human Bones."

Wednesday will be "Salem Day," and will be devoted to an excursion to Salem, where the museum of the Association is located. On the return, in the evening, lectures will be given in Huntington Hall on the Boston Park System and the Metropolitan Water Supply and Sewerage System.

Friday, Cambridge Day, will be spent at Harvard University, and an address will be made in the evening at Sanders Theatre by President Charles W. Eliot.

The general closing session will be held on Saturday morning at 10 o'clock; and the concluding meetings and adjournment of the sections in the evening.

Besides the excursions to Salem and Cambridge, an excursion will be made on Tuesday afternoon, under the auspices of the American Forestry Association, to Middlesex Fells; on Thursday afternoon to the Arnold Arboretum and the Blue Hill Meteorological Observatory; and on Saturday a choice between (*a*) Wellesley College, (*b*) Concord and Lexington.

On the following Monday, August 29, excursions will start to the following places:—White Mountains, Plymouth, Provincetown (ocean excursion to Cape Cod), Wood's Holl (the Marine Biological Laboratory and the United States Fish Commission), Newport, Clinton (the new Metropolitan Water Supply), Lawrence Experiment Station (of special interest to chemists, biologists and students of public hygiene).

The foreign guests at the Boston meeting will be entertained by the City of Boston. The officers of the committee on foreign invitations are Dr. Henry P. Bowditch, chairman; Mr. A. Lawrence Rotch, secretary.

The local secretary for the Boston meeting is Prof. H. W. Tyler, of the Massachusetts Institute of Technology, to whom all correspondence should be addressed.

Meetings of affiliated societies will begin on August 18, including American Forestry Association, Geological Society of America, American Chemical Society, Society for the Promotion of Agricultural Science, Association of Economic Entomologists, Botanical Club of the Association, American Mathematical Society, Society for the Promotion of Engineering Education, American Folk-Lore Society, National Geographic Society, Botanical Society of America, and conference of Astronomers and Physicists.

FOLK-MEDICINE IN ANCIENT INDIA.

"THE most primitive witchcraft," says Sir Alfred Lyall, "looks very like medicine in the embryonic state." This is pre-eminently the case in ancient India, where it is not difficult to trace the history of medical science—such as we find it in scientific works on medicine, like the *Charaka* or *Susruta*—back to its early beginnings in the charms and witchcraft practices of the *Atharva-veda*, the most ancient compendium of sorcery.

In India, as elsewhere, the general doctrine of disease prevails that all abnormal and morbid states of body and mind are caused by *demons*, who are conceived either as attacking the body from without, or as temporarily entering the body of man. The consequence is that primitive medicine consists chiefly in chasing away or exorcising these hostile spirits. This is done, in the first instance, by *charms*. The spirit of disease is addressed with coaxing words and implored to leave the body of the patient, or fierce imprecations are pronounced against him, to frighten him away. But these charms, powerful as they are (in fact, there is nothing more powerful to the primitive mind than the human *word*, the solemn blessing or curse), are yet not the only resource of the ancient physicians or magicians.

From the earliest times people had become aware of the curative power of certain substances in nature, especially of herbs. This knowledge was first gained by experience, and, after it had once been obtained, people began to ascribe similar curative power to plants, as well as to animal and mineral substances for various other reasons. Analogy or association of ideas serves to explain not only many of the practices of primitive medicine, but also accounts in many cases for the belief in the curative power of certain substances. The principle that *similia similibus curantur* prevails throughout the whole range of folk-medicine. Thus dropsy is cured by water. A spear-amulet is used to cure colic, which is supposed to be caused by the spear of the god Rudra. The *colour* of a substance is of no small importance in determining its use as a medicine. Thus turmeric is used to cure jaundice. Red, the colour of life-blood and health, is the natural colour of many amulets used to secure long life and health. A black plant is recommended for the cure of white leprosy. But even the *name* of a substance was frequently a reason for ascribing to it healing power. One of the most powerful medicinal or magical plants is called in Sanskrit *apāmārga* (*Achyronthes aspera*), and it owes its supposed power essentially to its etymological connection with the verb "apamarj," meaning "to wipe away," and in Hindu charms the plant is constantly implored to wipe away disease, to wipe out demons and wizards, to wipe off sins and evils of all kinds.

To wipe a disease away, is a very common and a very natural means of getting rid of it. This seems to be the meaning also of that ancient method of curing disease by *the laying on of hands*, which is already mentioned in the *Rig-veda*, though it is also possible that it was intended to press the disease down by means of the hands, in order to make it go out of the body. Some of the charms used with the laying on of hands point to still another explanation. As the priest had to *touch* the person for whom he was offering prayers and sacrifices, so it was thought that the imprecations could only have effect on a person if there was an actual connection between the medicine-man and the patient. There is a striking similarity between this ancient Hindu custom and the modern practices of faith-healing, in which, after all, prayer has merely been substituted for the ancient charms.

The two chief resources of folk-medicine, then, are charms and magic rites, the principal object of the latter being to bring the body into contact with some supposed curative substance. These substances are frequently applied in the shape of amulets or talismans.

The most ancient collection of charms is that found in the *Atharva-veda*, an excellent translation of which, with extracts from the ritual books, has just been published by Prof. Bloomfield in the "Sacred Books of the East" (vol. xlii., 1897). In the medical charms of the Atharva-veda the diseases are always personified. It is only our way of speaking when we say that diseases are supposed to be *caused* by demons. As a matter of fact the diseases themselves are addressed as personal and demoniacal beings. Thus *Fever*—"the king of diseases," as it is called in the "Susruta," the great work on Hindu medicine—is addressed as a demon who makes men sallow and inflames them like a searing fire. He is implored to leave the body, threatened with destruction if he does not leave it, and yet at the same time worshipped as a superhuman being. "Having made obeisance to the Fever, I cast him down below." This is a very characteristic way of dealing with evil spirits, which we find among all primitive people. The healing power, too, is addressed as a supernatural being, and invoked to destroy the demon of disease. Thus the plant Kushtha (*Costus speciosus*), which was always considered by the Hindus as one of the most potent remedies against fever, leprosy, and other diseases, is addressed with such words as: "O plant of unremitting potency, drive thou away the Fever that is spotted, covered with spots, like reddish sediment." In some of the charms against fever, we meet with vivid descriptions of all the symptoms of malarial fever. We read in one charm: "When thou, being cold, and then again deliriously hot, accompanied by cough, didst cause the sufferer to shake, then, O Fever, thy missiles are terrible: from these surely exempt us!" And the Kushtha plant is again implored: "Destroy the Fever that returns on each third day, the one that intermits each third day, the one that continues without intermission, and the autumnal one; destroy the cold Fever, the hot, him that comes in summer, and him that arrives in the rainy season!"

The frequency of fever during the rainy season probably accounts for the belief that lightning is the cause of fever, as well as of headache and cough. A very symbolical cure of fever consists in making the patient drink gruel made of roasted grain, the dregs of the gruel being afterwards poured from a copper vessel over the head of the patient into fire, which must be taken from a forest-fire. A forest-fire is supposed to have originated from lightning, and that the cure of a disease is effected by that which causes it, is an almost universal belief. Both the roasted grain and the copper vessel are symbolical of the heat of fever. Here we have the rudiments of homœopathy. Another magic rite is intended as a remedy against cold fever. By means of a blue and a red thread a frog is tied to the couch on which the patient reclines, and a charm is recited in which the fever is invoked to enter into the frog. The frog represents the cold element, and the cold fever is expected to pass into the cold frog. A very similar charm is met with in Bohemia, where the peasants, in order to cure chills of fever, catch a green frog, sew it into a bag, and hang it around the neck of the patient.

The cure of a disease by making it enter into some animal, is one of the most general devices of medical witchcraft both in India and elsewhere. According to Jewish law, a living bird is "let loose into the open field with the contagion of leprosy." Jaundice is cured, in parts of Germany, by making it pass into a lizard. In ancient India, jaundice was cured by seating the patient on a couch beneath which yellow birds were tied. The yellow disease was expected to settle on the yellow birds.

The principle of curing a disease by something similar to its cause or symptoms is also apparent in the cure of excessive discharges by means of water. Dropsy—the disease sent by *Varuna*, the god of the sea and of the waters—is naturally cured best by the use of water. A very simple cure of dropsy consists in sprinkling water over the patient's head by means of twenty-one (*three times seven*) tufts of sacred grass (*Poa cynosuroides*), together with reeds taken from the thatch of a house. The water sprinkled on the body is supposed to cure the water in the body.

But there must have been many other reasons, too, which pointed to *water* as a great healing power. To the present day the Hindus look upon rivers as divine beings, or as the abode of spirits. And we may credit even the ancient Hindus with a certain knowledge of medicinal springs. Nor is it surprising that in a tropical climate the rain waters were hailed as "divine physicians." And it may be that actual experience of the beneficent influence of water on health suggested the eulogy found in a Vedic charm: "The waters verily are healing, the waters chase away disease, the waters cure all diseases."

That dropsy is ascribed to Varuna, one of the great gods of the Hindu pantheon, is quite exceptional. For, as a rule, diseases are caused by godlings rather than by gods. More especially, all such diseases as mania, fits, epilepsy, convulsions, &c., are ascribed to possession by Rakshas (devils) and Pisāchas (goblins). Even in the scientific works on medicine, *e.g.* in the "Charaka-samhitā," assaults of evil spirits and possession by demons are enumerated among the causes of disease. In the *Atharva-veda* we find a special class of charms, the so-called "driving-out charms," which are considered as most effective remedies against possession.

But the most powerful enemy and destroyer of all devils is the *Fire*. "Slayer of fiends" is one of the most common epithets of Agni, the god of fire. Hence we find that Fire is invoked in charms against mania to free from madness him who has "been robbed of sense by the devils." Sacrifices to the god of fire, burning of fragrant substances, and fumigation are among the principal rites against possession by demons.

Besides the Rakshas and Pisāchas (devils and goblins) whose special province it is to cause all kinds of mischief, we find in ancient India also the world-wide belief in *incubi* and *succubi*, who pay nocturnal visits to mortal men and women. These are the Apsaras and Gandharvas of Hindu mythology, who correspond to the elves and nightmares of Teutonic belief. They are really godlings of nature. Rivers and trees are their natural abodes, which they only leave in order to allure mortals and injure them by unnatural intercourse. To drive these spirits away the fragrant plant *ajasringi* "goat's horn" (*Odina pinnata*) is used, and certain charms are pronounced. According to Teutonic belief also fragrant herbs (*e.g. Origanum antirrhinum*, *Hypericum perforatum*, and especially thyme) are excellent means for frightening away devils and witches, as well as nymphs and elves.

That the spirits of trees and waters are occasionally identified with the spirits of disease, may to some extent account for the healing power ascribed to water and trees. In fact, the far-spread custom of transferring diseases to trees seems to have originated from a desire of infecting the *spirit* of a tree with a disease which may have been caused by the same or an allied spirit. Amulets as a protection against diseases, hostile sorcery, evil eye, and other calamities are frequently taken from trees. Thus, an amulet consisting of splinters from ten kinds of holy trees was considered by the ancient Hindus as a potent remedy against hereditary disease, and also against possession by demons. Nine kinds of wood are used for a similar purpose in German folk-medicine.

As these malevolent spirits are the sworn enemies of mankind, it is only natural that they should be most anxious to injure the new-born infant, and even the embryo. Numerous, therefore, are the charms and rites concerned with the protection of mother and child against the attacks of evil spirits. Hence the custom of keeping a fire or a light burning in the lying-in room—a custom found among tribes of the Malay Peninsula, prescribed in the sacred books of the Parsis, and still practised in Germany, as it was in ancient Rome. In ancient India, the rule was to keep a fire burning near the door of the lying-in room, in which mustard-seeds and rice-chaff were sacrificed every morning and evening for ten days. Visitors, too, were requested to throw mustard-seeds and rice-chaff into the fire before entering the room.

The chapter of children's diseases is as large in medical witchcraft as in modern medical science, and in the Hindu charms we find numerous names of demons to whom the various diseases of children are ascribed. One of these demons is called the "Dog-demon," and is said to represent epilepsy (though the barking dog would remind us rather of whooping-cough). When a boy was attacked by the dog-demon he was first covered with a net, and a gong was beaten, or a bell rung. Then the boy was brought into a gambling hall—not, however, by the door, but by an opening made in the roof; the hall was sprinkled with water, the dice cast, the boy laid on his back on the dice, and a mixture of curds and salt poured over him, while again a gong was beaten. To drive evil demons away by means of loud noises, such as the beating of a gong, was a device frequently resorted to in ancient Hindu rites, and bells and drums are still used in India as scarers of demons. Interesting is the practice of bringing the child into the hall through an opening in the roof—that is, *not by the door*. To enter a house by any other opening but the door seems to be a means of escaping the demons who are haunting the threshold. Thus, according to a German superstition, it is conducive to the health of a child to lift it out of the window when it is taken to church to be baptised.

Of course, the ancient Hindus knew that some maladies and derangements of the human body were not caused by any mysterious power; they knew that wounds were inflicted by weapons—they knew something about the effects of poison, and had an idea that certain diseases were caused by animals, such as *worms*. But in ancient India, as well as in German folk-medicine, the term "worms" includes all kinds of reptiles, and snakes and worms are not kept very distinct. Moreover, all kinds of diseases were ascribed to worms. And both worms and snakes are actually considered as a kind of demoniacal beings. The imprecations against worms are, therefore, not much different from the charms against the demons. Thus we read in a charm against worms in children: "Slay the worms in this boy, O Indra, lord of treasures! Slain are all the evil powers by my fierce imprecation. Him that moves about in the eyes, that moves about in the nose, that gets to the middle of the teeth, that worm do we crush." This fierce imprecation is accompanied by a rite symbolical of the destruction of worms in the patient. An oblation of black lentils, mixed with roasted worms and with ghee, is offered in the fire. Then the sick child is placed on its mother's lap, and, with the bottom of a pestle heated in the fire and greased with butter, the palate of the child is warmed by thrice pressing upon it. Then a mixture of the leaves of a horse-radish tree and butter is applied, and twenty-one (*three times seven*) dried roots of *Andropogon muricatus* are given to the child upon whom water is poured.

The words of the charm leave no doubt that not only intestinal diseases, but also pains of the head, the eyes, &c., are ascribed to worms. Thus, German folk-medicine knows of a "finger-worm" as the causer of whitlow (*Panaricium*), and even spasm in the stomach is ascribed to a worm, the so-called "heart-worm" (*Herzwurm*). As the Hindu charm mentions a worm "that gets to the middle of the teeth," so worms are believed to be the cause of toothache almost in every part of the world. "If a worm eat the teeth," says one of the prescriptions in an English "Leech Book," "take holly rind over a year old and root of carline-thistle, boil in hot water, hold in the mouth as hot as thou hottest may." In Madagascar the sufferer from toothache is said to be "poorly through the worm."[1] In a French charm against toothache it is said: "Si c'est une goutte de sang, elle tombera, si c'est un ver, il mourra." In Germany a sufferer from toothache will go to a pear-tree, walk three times round it, and say: "Pear-tree, I complain to thee, three worms sting me, the one is grey, the other is blue, the third is red—I wish they were all three dead." A young Hindu friend of mine (now a student at Oxford) tells me how he remembers the witch coming to his father's house (in Calcutta) to cure persons suffering from toothache, and how after some hocus-pocus she would point to some cotton threads she held in her hand, saying: "Look, here are the worms which I have taken out from your teeth."

In the Buddhist scriptures we read of an extremely clever physician, Jīvaka, who performed many marvellous cures. Once upon a time, we are told, there lived in the capital of Magadha a rich merchant who had been suffering for seven years from a disease in the head. Many renowned physicians came to see him, received much money, and went away without effecting a cure. At last the physicians agreed that the merchant must die; some said on the fifth day, others on the seventh day. Now Jīvaka, the physician in ordinary to the King of Magadha, was sent for, and he promised to cure the merchant if he would give him a good fee. "All that I possess shall be yours, doctor, and I will be your slave," said the merchant. "Well, my good householder, will you be able to lie down on one side for seven months?" asked the doctor. The merchant said he would. Would he be able to lie down on the other side for seven months, and on his back for another seven months? The patient thought he would be able to do so. Upon this the doctor ordered him to lie down, tied him fast to his bed, cut through the skin of the head, drew apart the flesh on each side of the incision, pulled *two worms* out of the wound, and, showing them to the people, said: "See, sirs, these two worms, a small one and a big one. The doctors who said that the patient would die on the fifth day had seen the big worm, those who said he would die on the seventh day had seen the small worm." Then he stitched up the skin of the head, and anointed it with salve. But after seven days the merchant said he could not lie down any longer on one side. Jīvaka ordered him to lie down on the other side for seven months. Again, after seven days, the patient said he could not bear it any longer. The doctor ordered him to lie down on his back for seven months, but he could bear this for seven days only. Then the doctor told him that he was quite well now, and that he knew beforehand the patient would be well in *three times seven*[1] days, but if he had told him so at the outset he would never have lain down even for so short a time.

This Jīvaka was a respectable man, an esteemed friend of Buddha himself, and a pious Buddhist. That the science of medicine had reached a comparatively high stage of development at the period when the Buddhist scriptures were compiled (say about 350 B.C.) is proved by the chapter on medicaments found in the "Vinayapitaka,"[2] and by the various stories told of Jīvaka. Yet there are traces even in these stories showing that physicians were considered as a class of uncanny creatures. "The physicians are cunning people," says King Pajjota, one of Jīvaka's patients. In the ancient Hindu, *i.e.* Brāhmanic, law-books, a very low social position is assigned to the physicians. They rank with temple-priests (who are in attendance to some popular idol), sellers of meat, hunters, usurers, women of bad character, outcasts, thieves, and eunuchs. They are not admitted to funeral meals and sacrifices, they receive no hospitality from members of the highest castes, and no orthodox Brāhman is allowed to accept food from a physician.

This degraded position of the medical profession in ancient India is, no doubt, due to the fact that in India, as in other countries, the physician is the direct descendant of the wizard and sorcerer. And although I do not believe that Sir Alfred Lyall[3] has succeeded in proving witchcraft to be "the aboriginal and inveterate antagonist of *religion or theology*"—the witchcraft practices of the ancient Hindus, and of all primitive people, rather prove an intimate connection between witchcraft and popular religious belief—yet I think he would be right if he had said only "*theology*" instead of "*religion or theology*." Witchcraft is always opposed to theology, and there is a natural rivalry between the wizard and the priest. And, as in India, the Brāhmans, the professional theologians, became the most dominant class, their antagonists—the wizard and his descendant, the physician—were naturally degraded and excluded from the higher ranks of society.

This antagonism between witchcraft and theology is the same as that between science and theology in more recent times. For the witch who depends not merely on supernatural agencies, but on actual observation of natural phenomena and on some sort of reasoning (which may not be *logical*, but can always be justified on *psychological* grounds) is, after all, the humble precursor of the man of science. To quote again Sir Alfred Lyall, "he is just touching, though he may only touch and let go, a line of thought which points, albeit vaguely and most crookedly, towards something like mental independence." It is this historical connection between witchcraft and science that gives an intrinsic scientific interest to the study of folk-medicine.

M. WINTERNITZ.

[1] See W. G. Black, "Folk-Medicine," p. 32 *seq.*

[1] Compare the importance of this number in the witchcraft practices mentioned above.

[2] See "Sacred Books of the East," vol. xvii. p. 41 *seq.*

[3] "Asiatic Studies," 1884, p. 76.

GUTTA-PERCHA AND INDIA-RUBBER.

BOTANISTS who are interested in the cultivation of *Sapotaceæ* on a commercial scale, are beginning to realise the consequences of the careless methods that have denuded the Indo-Malayan regions of Taban trees. Cable-manufacturers complain very seriously of the great falling-off in quality of gutta-percha during the past few years, and the small hope of obtaining better supplies in future. This degeneration of the cultivating industry is beginning to make itself felt in the Treasury Reports of the gutta-percha producing countries; not so much in the quantity annually shipped, as in the prices paid for a given weight each year.

For instance, the Sarawak (Borneo) Treasury Report of revenue and expenditure for 1897 gives comparative figures relating to the condition of supply and demand of gutta-percha and india-rubber; the following table, drawn up from the Report, shows the fall in prices of gutta-percha during the four years 1894–1897, inclusive, and indicates a corresponding degradation of quality. (The "picul" is, for our purpose, taken as 133⅓ lbs., and the Sarawak dollar as 1*s.* 11*d.*)

Gutta-percha exported from Sarawak.

Year.	Quantity.		Value.				Average price per picul.			
	Piculs.	Tons.	$	£	*s.*	*d.*	$	£	*s.*	*d.*
1894	1937	115·3	162,233	15,547	6	7	83·75	8	0	6¼
1895	2782	165·6	194,120	18,603	3	4	69·77	6	13	8¾
1896	2820	167·9	190,939	18,298	6	5	67·70	6	9	9
1897	2867	170·7	185,532	17,780	3	0	64·71	6	4	0½

With this may be compared the increased demand for, and steady value of india-rubber throughout the same period.

India-rubber exported from Sarawak.

Year.	Quantity.		Value.				Average price per picul.			
	Piculs.	Tons.	$	£	*s.*	*d.*	$	£	*s.*	*d.*
1894	1259	74·9	85,775	8,220	2	1	68·12	6	10	6¾
1895	1392	82·8	95,493	9,151	8	3	68·60	6	11	5¾
1896	1624	96·7	108,813	10,427	18	3	67·00	6	8	5
1897	2130	126·8	146,229	14,013	12	3	68·65	6	11	7

From another source we are able to give the total weights of gutta-percha landed in England, from all gutta-percha producing countries, since 1895.

Total Weight of Gutta-percha landed in England.

Year.	Tons.
1895	716
1896	318
1897	396
January to April 1898	626

The present year shows a very marked rise in the demand for gutta-percha; this is more apparent when it is remembered that the 626 tons was all landed between January 1 and April 30, and that the quantity landed in April alone was 149 tons.

We may sum up the condition of the gutta-percha cultivation industry in a few words: there is an increasing demand, a degeneration of quality, and an almost total disregard of the future. Experimental efforts have, we believe, been made to produce a steady supply of high-quality gutta-percha, but so many years are required to establish the scheme on a profit-earning basis, that it is almost beyond the powers of private enterprise to make it a success.

TREATMENT OF THE SURFACE OF MEDALS.[1]

SILVER.

IN this country medals have been issued for centuries with the tables or flat surfaces smooth and mirror-like, while a more or less frosted texture has been given to the portions in relief. This is especially the case in medals which have been struck as specimen pieces, for after highly-polished dies have been used for a certain time the difference between the appearance of the tables and the parts in relief becomes less and less marked. As is well known, medals with polished surfaces rapidly tarnish, and even blacken, by exposure to the ordinary atmospheric influences. In France a different system has long been adopted concurrently with the one just described. Unpolished dies are employed, and care is taken to impart to the medals struck from them a dead or frosted surface by rubbing them with fine pumice. Recently, at the French Mint, medals have been subjected to the process known as "sand blasting" by the aid of an appliance which projects against the surface of the medal a small jet of air, carrying with it fine sand, and having a velocity of about 180 feet per second. When thus treated the surface of the medal becomes minutely granular or frosted, and may then be further treated in several ways. Sometimes the surface is darkened by exposure to an aqueous solution of a sulphide, followed by rubbing with very fine pumice, which removes the dark layer of sulphide from the portions in high relief, and leaves dark lines in the more deeply-cut recesses. It is, however, preferable to cover the medal with a layer of platinum, and this is effected by immersing it in an alcoholic solution of chloride of platinum until a blackened surface is produced. Subsequent rubbing with a brush and very fine pumice changes the blackened surface to a delicate grey; and if this operation is conducted skilfully, graduated shadows may be left wherever the artist considers their presence to be desirable. The beauty of medals so treated, and the fidelity with which the details of the design are revealed, are beyond question; but it may be doubted whether the surface of the medal is permanently protected. A medal with a frosted platinised surface has, however, a great advantage over one with a polished table, as the platinised medal is merely deepened in tone by exposure to the atmosphere, and, unlike medals which have been struck in the ordinary way, does not become disfigured by blotches of tarnish. The frosted platinised medal may be restored to almost its original freshness by careful rubbing with a soft leather; while a polished silver one cannot be so renovated, as the tarnish attacks the surface and destroys the polish.

During the past year, for the first time in the history of the Mint, medals have been issued with frosted and platinised surfaces. More than 27,000 large silver medals were platinised by a slight modification of the above method. It became necessary, therefore, to provide an appliance for producing the sand blast, and this, together with a small 1 H.P. motor for driving it, has been fitted up in the basement of the Assay Department.

BRONZE.

Medals of bronze differ considerably from those of silver, as their surfaces are far more liable to be influenced either by the slow operation of the constituents of the atmosphere or by the more rapid action of chemical agents. Ancient silver coins, for instance, which have been long buried in the earth, do not show anything like so wide a range of colour in their patina or crust, as is revealed on coins of brass, bronze or copper, which have been hidden in the same way. This is due to the fact that silver is far less affected than copper by the chemical action of the constituents of soils, or by atmospheric influences. The patina acquired by an ancient coin or medal often constitutes no small part of its value. "You would laugh at me," said Philander, in Addison's charming dialogues upon the usefulness of ancient medals, "should I make you a learned dissertation on the nature of rusts; I shall only tell you that there are two or three sorts of them which are extremely beautiful in the eye of the antiquary, and preserve a coin better than the best artificial varnish." The object of the medallist is accurately expressed in the above sentence, for he endeavours to protect the surface of all medals in which copper is the main constituent, by a patina or film of oxide, so as to preserve the medal from further change. This may be effected in various ways. The medals of the Italian Renaissance were not struck, but cast by the method of *cera perduta*, already described in these Reports,[1] and much of the beauty of the medal was due to the "skin" or pellicle of oxide which the medal acquired during casting. The skill of the artist in arranging the composition of the bronze, and fixing the temperature at which it was cast, was revealed in the texture of the medal's surface.

In modern times most medals to which the name of bronze is given are really of copper, "bronzed" or coloured artificially on

[1] From a memorandum by Prof. Roberts-Austen, C.B., F.R.S., in the Twenty-eighth Annual Report of the Deputy Master and Comptroller of the Mint, 1897.

[1] Sixteenth Report (1886), pp. 24, 49; Seventeenth Report (1886), p. 15.

the surface. The process by which this colouring is effected has long been employed, and is thus described in an old receipt. Apply with a brush to the surface of the medal common crocus powder, jewellers' rouge, previously made into a smooth paste with water. When dry, expose the medal over a clear fire for about one minute; lastly, when the medal is sufficiently cold, polish it with a plate brush. The exact composition of the superficial layer of oxide which is formed, has, I believe, never been ascertained; but it is well known that the tint varies greatly from light brown to deep chocolate, according to the particular variety of oxide of iron which is used.

With a view to ascertain whether this old method could not be replaced with advantage, it was natural to turn to the work of Japanese artists, who are masters in the art of giving protective surfaces of varied tints either to copper in its pure state or to copper alloys. I have shown elsewhere [1] that in conducting such operations the Japanese employ dilute boiling solutions of certain salts of which verdigris and sulphate of copper are the more important.

The following solution [2] has been found to answer fairly well, even when the ordinary European verdigris, which is a basic acetate of copper, is employed:—

Verdigris	87 grains
Sulphate of copper	437 ,,
Nitre	87 ,,
Common salt	68 ,,
Sulphur	233 ,,
Water	1 gallon

In Japan, however, "verdigris" is made by the action of plum-juice vinegar on plates of copper which contain certain metallic impurities. Such native verdigris has consequently a very complex constitution. It is called "Rokusho," and cannot be procured in this country; but I am indebted for a sample of it to Mr. W. Gowland, formerly technical adviser to the Japanese Mint at Osaka. He obtained it from a famous maker of verdigris at Osaka, who persistently refused to give any information respecting its mode of manufacture. Mr. Gowland also gave me an elaborate description of the method of employing this verdigris in the colouring of copper medals, a method which has only been adopted in Japan as the result of a long series of experiments. Guided by an analysis which was made of this "Rokusho," a mixture was compounded which produced quite as fine patina on copper as the native "Rokusho," though its action was less certain and less rapid. The series of tints which may be obtained by slight variations in the composition of the "Rokusho" is truly remarkable. These tints range from golden yellow through deep brown to bright red, the colour mainly depending on the relative amounts of malate, urate, and chloride of sodium which are present.

The quality of the copper also exerts a very great influence on the tint of the patina; the difference, for instance, between ordinary "best select" copper of the smelter and "electro" copper, is very marked, as the former becomes dark brown and the latter golden yellow when boiled in the same solution of "Rokusho." Since the close of the year 1897, over 5000 medals have been treated by the method which has just been described. Apart from the mere tint of the medal, the Japanese artists attach much importance to producing a sheen or damascening which shows through a transparent patina. This is effected by developing the crystalline texture of the copper by a preliminary treatment of the medal before it is boiled in the solution of "Rokusho."

In France, medals of true bronze containing much zinc are struck, and although the colour is heightened by superficial oxidation, produced by gentle heating, no true patination is effected.

[1] A paper "On the Use of Alloys in Art Metal-work." (*Journal* of the Society of Arts, June 13, 1890.)

[2] A similar solution for heightening the colour of gilded metals is described by Benvenuto Cellini in his "Trattato dell' Oroficeria in Fiorenza, 1568."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BY the will of the late Mr. Edward O. Bleackley, the Owens College, Manchester, receives 500*l.* for "Bleackley Scholarships."

WE have more than once in these columns called attention to the views expressed by Prof. Meldola and others concerning the futility of occasional instruction in miscellaneous subjects as carried on at great cost to the county by many Technical Instruction Committees, more particularly in rural districts. An advocate of these views has now been found in the person of the Countess of Warwick, who, acting on the advice of Prof. Meldola, has established a small school of science at Bigods, near Dunmow in Essex, on her own estate. The school at present contains about sixty pupils of both sexes, and by way of a beginning it is proposed to select twenty of the most highly qualified for instruction under the "School of Science" curriculum of the Science and Art Department. Lady Warwick deserves every encouragement in this praiseworthy effort to bring systematic instruction within the reach of a class of the community more in need of such assistance even than the inhabitants of large towns, and we learn that the Essex County Council has wisely determined to co-operate in the movement. The experiment is one in every way deserving of success, and the results will be watched with interest all over the country. One of the weakest points in modern technical education schemes has been the lack of such institutions in the thinly-populated agricultural districts, and the county of Essex has done well in taking part in an experiment which cannot but lead to results of the greatest importance. Mr. E. E. Hennesey, of the Royal College of Science, has been appointed principal of the school, which is provided with laboratories, lecture and class rooms, a workshop and laundry, garden plots, &c., and is situated in a most pleasant and secluded corner of the county, about a mile and a half from Dunmow railway station. The mansion adjoining the school has been handed over by the Countess for the use of the staff and of boarders, and the neighbouring farm is available for field demonstrations.

SCIENTIFIC SERIAL.

Symons's Monthly Meteorological Magazine, June.—Lightning conductors, by A. W. Preston.—The author refers to a theory put forth by some architects that old churches which have never been struck by lightning do not require conductors, as the probability is they never will be struck. The editor of the *Magazine* will be glad to receive any evidence upon the subject.—Results of meteorological observations at Camden Square, London, for forty years. These show that the mean of all the highest readings was 78°·1, and of all the lowest 33°·8; the average rainfall is 1·92 inches, against 2·26 inches in the present year.—Summer rainfall, by A. B. MacDowall. Based upon the rainfall at Greenwich Observatory since 1841, the author finds (1) that in the first five years after sunspot minimum years, there have always been more dry summers than wet, and (2) that in each group of five consecutive years ending with a sunspot minimum year, there have been (with one exception) more wet summers than dry. These facts point to a tendency for a wet summer this year.—This number contains a long, if not unique, well record, containing the approximate height (in feet above Ordnance datum) of the top of the water in Mr. L. Wood's well at Chilgrove, near Chichester, since 1836.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 9.—"On the Heat dissipated by a Platinum Surface at High Temperatures." By J. E. Petavel, 1851 Exhibition Scholar. Communicated by Lord Rayleigh, F.R.S.

The first part of the paper refers to the emissivity of a bright platinum surface in air, hydrogen, carbon dioxide, and in other gases.

In the case of each of the above gases the values of the emissivity are given at three distinct pressures; namely, 6, 76 and 228 centimetres of mercury.

The temperature measurements are based on the researches of Callendar and Griffiths, confirmed by the recent determinations of Heycock and Neville. To check the calibration of the thermometers at higher temperatures, the melting point of palladium was used. In all cases observations were made from a temperature of 100° C. to temperature of 1200° C., and a number of the curves are extended to 1779° C. by a direct measurement of the emissivity of platinum and palladium at their melting points.

The platinum wire, which served at the same time as radiator and thermometer, was 0·112 cm. in diameter. It was placed in the axis of a vertical glass cylinder, which formed the enclosure.

The effect produced by a change in the size, shape, material, and temperature of the enclosure and in the position and diameter of the wire are also studied.

The temperature is expressed in degrees Centigrade, and the emissivity in C.G.S. units.

Part ii. consists of a bolometric study of the radiation emitted by platinum at temperatures ranging from 500° C. to the melting point of the metal. It is shown that for theoretical reasons the true rate of change of the total radiation with temperature lies between the values obtained by measuring the heat lost by the radiating body and those deduced from the readings of any form of bolometer or thermopile.

By comparing the observations of Dr. J. T. Bottomley and Schleiermacher, based on the first method, with those of F. Paschen and of the author, made by the second method, a criterion is obtained by which to test any formula intended to express the law of thermal radiation.

The formulæ of Dulong and Petit, of Stefan, and of Rosetti fail when tested in this manner; whilst Weber's formula, from 400° to 800° C., gives results in close agreement with the true rate of change of total radiation with regard to temperature.

The second part of the paper also contains a description of some points of interest in the design of the bolometer which was used during this work.

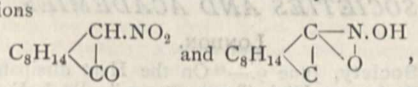
Part iii. refers to the variation of the intrinsic brilliancy of platinum surface with temperature.

The results may be expressed by the following formula:—

$$(t - 400) = 889{\cdot}6 \sqrt[6{\cdot}9]{b},$$

where t is the temperature in degrees Centigrade, and b the intrinsic brilliancy in candle power per square centimetre. The constant 400 is taken as the temperature limit at which the visible radiation falls to zero.

Chemical Society, June 16.—Prof. Dewar, President, in the chair.—The following papers were read:—Preparation of a standard acid solution by direct absorption of hydrogen chloride, by G. T. Moody. The author prepares an accurately standardised solution of hydrogen chloride by determining the increase in weight consequent on absorbing the pure gas in water.—Researches on the terpenes. III. Halogen derivatives of fenchene and their reactions, by J. A. Gardner and G. B. Cockburn. An α- and a β-chlorofenchene hydrochloride are obtained by treating fenchene with phosphorus pentachloride; both readily yield a crystalline chlorofenchene $C_{10}H_{15}Cl$, which can be converted into a chlorofenchenephosphonic acid.—Researches on the terpenes. IV. On the oxidation of fenchone, by J. A. Gardner and G. B. Cockburn. Fenchone is very slowly oxidised by hot nitric acid with formation of isocamphoronic acid, dimethyltricarballylic acid, dimethylmalonic acid, isobutyric acid, acetic acid, and nitrofenchone.—Nitrocamphor and its derivatives. Part I. Isodynamic forms of nitrocamphor, by T. M. Lowry. Although solutions of nitrocamphor show multirotation the author has not been able to isolate the isodynamic forms of the constitutions



yet the corresponding forms of π α'-bromonitrocamphor seem to exist.—Cannabinol, by T. B. Wood, W. T. N. Spivey and T. H. Easterfield. Cannabinol is a mixture which yields a liquid and a crystalline acetyl-derivative, $C_{21}H_{26}O_2$.—An improved form of gas-analysis apparatus, by W. A. Bone.—Preliminary note on the action of light on acetylene, by W. A. Bone and J. Wilson. On exposing acetylene to sunlight a greasy brown deposit is formed which is still under examination.—Reversible zymohydrolysis, by A. C. Hill.—The solubility of isomeric substances, by J. Walker and J. K. Wood. The authors find that the rule that the order of solubility of isomerides is independent of the solvent is not strictly applicable.—Note on nitration and substitution in nitro-compounds, by A. Lapworth and C. Mills.—Hydroxydibromocamphorsulphonic acid. A correction, by A. Lapworth and F. S. Kipping.—Enantiomorphism, by F. S. Kipping and W. J. Pope.—Azobenzene derivatives of chrysin, euxanthone, gentisin and morin, by A. G. Perkin. Chrysin yields a disazo-derivative of the composition $C_{15}H_8O_4(N_2Ph)_2$; similar compounds have been prepared from other analogous colouring matters.—Constituents of the Indian dyestuff "waras," by A. G. Perkin. Waras, a purplish powder covering the seed pods of *Flemingia congesta*, contains flemingin, $C_{12}H_{12}O_3$, homoflemingin and two resins $C_{12}H_{12}O_3$ and $C_{13}H_{14}O_3$; it dyes silk a golden yellow shade.—Note on the oxidation of charcoal by nitric acid, by G. Dickson and T. H. Easterfield. By a process involving oxidation with fuming nitric acid and potassium chlorate, charcoal may be made to yield one-fourth of its weight of crystalline ammonium mellitate.

Zoological Society, June 21.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair.—Mr. J. Graham Kerr exhibited some specimens of *Lepidosiren* collected by him in the Gran Chaco of Paraguay during 1896–97. The adult males exhibited the characteristically varying appearances of the hind limb in the periods before, during, and after the breeding season. Mr. Kerr also exhibited specimens of the young of *Lepidosiren*, illustrating especially the external gills and sucker, the disappearance of these organs, and the change in the colour of the animal associated with the surrounding conditions of light or darkness. A small collection of Teleostean fishes collected in the same swamps in which *Lepidosiren* was found, and identified by Mr. Boulenger, was also exhibited.—The Secretary called the attention of the meeting to the arrival in the Society's Gardens of four living specimens of the Australian Lung-fish (*Ceratodus forsteri*), deposited by Mr. D. O'Connor, who gave an account of the mode in which he had obtained them and brought them to England.—Mr. G. A. Boulenger, F.R.S., exhibited specimens of the remarkable fish *Polypterus lapradii*, from the Lower Congo. They were provided with highly-developed external opercular gills, the presence of which, he remarked, was not dependent on age, as had been heretofore supposed, because they were retained for a long period, if not, in some cases, throughout life.—Mr. R. E. Holding made some remarks on some interesting animals he had observed during a recent visit to the Zoological Gardens at Belle Vue, Manchester.—Prof. Howes exhibited, on behalf of Mr. E. W. L. Holt, a specimen of a new British fish (*Argentina silus*), obtained eighty miles south-west of the Scilly Islands.—Mr. Abbott H. Thayer, of New York, explained his method of demonstrating, by actual experiments, the underlying principle of protective coloration in animals, and invited the members present, and their friends, to witness an exhibition of his demonstrations which (as arranged with the Secretary) would take place in the Society's Gardens next day.—Mr. G. A. Boulenger, F.R.S., read a memoir on the collection of fishes made by Mr. J. E. S. Moore in Lake Tanganyika during his expedition in 1895–96. Twenty-six new species were described, of which eight were made the types of new genera.—Mr. R. I. Pocock read a paper on the scorpions, spiders, and *Solifugæ* collected by Mr. C. S. Betton in East Africa between Mombasa and Uganda. Of the seven species of scorpions, six species of *Solifugæ*, and thirty species of spiders represented in the collection, five of the *Solifugæ* and twelve of the spiders were described as new, one species of the latter, viz. *Eucratoscelus longiceps*, being made the type of a new genus.—A communication was read from Mr. J. Stanley Gardiner containing an account of the fungoid corals collected by him in the Central Pacific. Twenty-one species were treated of, of which six were described as new. It was proposed to absorb the genus *Tichoseris* into *Pavonia*, and the genera *Maeandroseris*, *Coscinaraea*, and *Plesioceris* into the genus *Psammocora*.—On behalf of Dr. A. Dugès, Mr. G. A. Boulenger communicated the description of a new genus of Ophidia, proposed to be called *Geatractus*, for the reception of *Geophis tecpanecus*, recently characterised by M. Dugès.—Dr. G. H. Fowler presented three papers relating to the surface and midwater collections made by him on H.M.S. *Research* in the Faeroe Channel in 1896 and 1897. The first of these, by Mr. I. C. Thompson, dealt with the *Copepoda*; the second, by Mr. E. W. L. Holt, treated of the collection of fish-larvæ, and included an account of the larval ontogeny of *Scopelus glacialis*; and the third, by Dr. Fowler, contained a description of his new midwater net, and a discussion on the general features of the midwater fauna.

Geological Society, June 22.—W. Whitaker, F.R.S., President, in the chair.—Post-glacial beds exposed in the cutting of the new Bruges canal, by T. Mellard Reade. The following beds, enumerated in descending order, were found in this cutting: (5) Argile des polders supérieure; (4) *Cardium* (*edule*)-sand; (3) Argile des polders inférieure; (2) *Scrobicularia* (*plana*)-clay; (1) Peat with the remains of trees.—High-level marine drift at Colwyn Bay, by T. Mellard Reade. This paper describes a mound of sand capped by boulder clay, which occurs 1 mile south by west of Colwyn Bay Station. It measures about 90 yards on the longer axis, which runs north-east, 50 yards on the shorter axis, and is situated 560 feet above O.D. Among the pebbles and boulders in the drift, and scattered about in the sandpit, were granites from Eskdale and the south of Scotland, small flints, and local and Welsh rocks identified by Mr. Ruddy as derived largely from the head of the Conway valley. The base of the sand is not exposed, but the author has no doubt that it is geologically above the grey till with Welsh boulders.—Observations on the geology of Franz Josef Land, by Dr. Reginald Kœttlitz. This paper opens with a detailed description of the geography and geology of various portions of the archipelago. The basaltic rocks occur in tiers from 10 to 70 feet high, and range to a height of 1300 feet above sea-level. The associated and interbedded rocks consist of shale, sandstone, and basaltic tuff. The stratified rocks are not appreciably altered by the heat of the basalt, which is often vesicular both at the base and summit of the tiers. From this and other evidence the author concludes that many of the sheets are contemporaneous flows, and that as the fossil plants and ammonites are of Jurassic age, some of the lavas date back to Jurassic time. Dykes, sills, and necks are also described. The Jurassic rocks consist of shales and sandstones; they have yielded ammonites and belemnites, a portion of a specimen of *A. Lamberti* having been found embedded in "basaltic tuff." Pebbles of radiolarian chert have also been found embedded in these rocks, and a granite-block, mentioned by Payer as having been seen embedded in an iceberg, is believed to have come from the same source The raised beaches are very numerous, and occur at various heights, from just above sea-level to 287, 310, 340, and even 410 feet, drift-wood and bones of seals, walrus, and whales having been found on them. On Cape Mary Harmsworth twelve beaches are seen in a series one above another The entire skeleton of a seal was found on the summit-plateau of Cape Neale, together with waterworn stones, at a height of 700 feet above sea-level. The highest waterworn pebbles noted were found at 1111 feet on Cape Flora. In some cases floe-ice at sea-level becomes covered over and preserved by gravel heaped upon it by the sea; and some of the raised beaches seem to consist of a similar mixture of ice and gravel, as is proved by the formation of pitfalls in them where the ice melts. Ice-masses are also sometimes preserved under taluses, avalanches, and slips. The "ice-cap" is probably not so thick as is generally supposed, and it has little downward movement. It forms domes on the summits and plateaux, but it seems to be a mere mantle on the terraced slopes, as it is rigid and dimpled, and during warm seasons raised beaches and terraces are thawed-out under the ridges. Comparatively few evidences of glaciation were met with. Roches moutonnées and rounded hills are absent, and only in the two valleys separating Cape Flora from Cape Gertrude were the rocks planed, scratched, and polished. Some of the landscape-features, including the separation of the group into individual islands, are attributed to marine action following lines of fault. The paper concludes with observations on soundings, the temperature of glaciers, the size of icebergs, and the finding of reindeer-antlers by Mr. Leigh Smith and the members of the Jackson-Harmsworth Expedition.—Notes on rocks and fossils from Franz Josef Land brought home by Dr. Kœttlitz, of the Jackson-Harmsworth Expedition, in 1897, by E. T. Newton, F.R.S., and J. J. H. Teall, F.R.S. In this communication an analysis of the basalt is given, which compares closely with those of basalts from Iceland. The silicification of the rocks, presumably by geyser action, the presence of a black analcime, pebbles of radiolarian chert, and crystals of selenite, probably formed *in situ* in shale, are also described. Notes are given on some of the fossil plants, on the drift-wood, and on apparently new species of *Inoceramus* and *Belemnites*.—On the Corallian rocks of Upware, by C. B. Wedd. The opinion usually held that the "Coralline Oolite" of the northern quarry at Upware is of older date than the "Coral Rag" of the southern quarry, gains support from the work detailed in this paper, although the results of recent excavation show that a rock of different lithological character from that of the northern quarry probably underlies the rocks of the southern quarry. A list of the fossils found in the lowest beds of the southern quarry includes eleven species not yet found in the "Oolite" of the northern quarry; a second list comprises the fossils found just below the "Rag" in the "Oolite" of the southern quarry. Both these faunas are intermediate between those o the "Rag" of the southern and the "Oolite" of the northern quarry. From the results of excavation and other evidence, the author considers that the "Oolite" can hardly be less than 40 feet thick, and that this rock is geologically below the "Rag" of the southern quarry.

EDINBURGH.

Royal Society, June 20.—Sir William Turner in the chair.—In a paper on steam and brines, Mr. J. Y. Buchanan discussed the relation of the concentration and the rise of boiling point of various solutions of salts, and instituted a comparison between the effect of pressure and the effect of concentration in producing this rise.—Dr. W. Peddie read a paper on torsional oscillations of wires, experimental and theoretical. In previous papers a relation of the form $y^n(x + a) = b$, where n, a, b are constants in any one experiment, was found to connect y the range of oscillation with x the number of oscillations. In the present paper five experimental results were given. (*a*) When the wire is subjected to great fatigue, n and b are independent of the magnitude of the initial range of oscillation; also n becomes unity when the fatigue is great. (*b*) Both log nb and log b may be regarded as linear functions of n in each of the series of experiments made, though both cannot be strictly so simultaneously. (*c*) In all of the series the linear function is such that, when n is unity, b has an absolutely constant value. This indicates a quantity which depends only on the nature of the material of the wire. (*d*) The period of oscillation has no observable effect on the results. (*e*) The time of inward oscillation over a given range exceeds that of outward oscillation. In the theoretical part of the paper a simple molecular theory of the action was investigated and was found to be in accord with observed facts, such as—the result (*e*) given above; the deviation from Hooke's law; the lessening of this deviation (as observed by Wiedemann) when an oscillation is stopped just short of zero, and again increased positively; and the relation between torsion and set.—Drs. Milroy and Malcolm read a paper on the metabolism of the nucleins under physiological and pathological conditions. It was found that the effect of nucleins and nucleic acid was to increase the number of the leucocytes in the blood, and also the amount of phosphorus excreted in the urine. Part of this phosphorus must have been derived from the tissues. On the other hand, metaphosphoric acid had no effect either on the leucocytes or on the phosphorus-holding tissue. An examination of pathological conditions in which leucocytosis was present showed that in leucocythæmia (spleno-medullary) the phosphorus excretion was diminished both absolutely and relatively to the nitrogen, while in plumbism the conditions varied only slightly from the normal. Emphasis was laid on the great caution required to be observed in drawing conclusions from the amount of alloxuric bodies secreted in cases where increased breaking down of the white blood corpuscles is suspected.

PARIS.

Academy of Sciences, June 27.—M. Wolf in the chair.—General formulæ giving the values of D for which the equation $t^2 - Du^2 = -1$ is resolvable into entire numbers, by M. de Jonquières.—On the new Giacobini comet, by M. Perrotin.—Report on a memoir of M. Lecornu, entitled "On the equilibrium of an ellipsoidal envelope submitted to a uniform internal pressure."—Observations on the Coddington comet made at the Observatory of Algiers with the 188 mm. equatorial, by MM. Ch. Trépied and J. Renaux.—Elements of the Giacobini comet, by M. I. Lagarde.—Determination of a surface by its two fundamental quadratic forms, by M. L. Raffy.—On the principle of correspondence, by M. H. Burkhardt.—On the mixing of gases, by M. Van der Waals. Remarks on a note by M. Daniel Berthelot.—Reply to the preceding, by M. Daniel Berthelot. The justification for the assumption criticised by M. Van der Waals is to be found in the close agreement between the results theoretically deduced by its aid and those of experiment.—On gaseous mixtures, by M. A. Leduc. Remarks on a note by M. D. Berthelot.—On the specific heat of air at constant pressure, by M. A. Leduc. Remarks on an error overlooked by M. Regnault in his determination of this constant. The neglect to fully correct for the expansion in the calorimeter, causes a systematic error in the final result of 0·6 per cent., the value being raised from 0·2375 to 0·239.—On the radiation of incandescent mantles, by MM. H. Le Chatelier and O. Boudouard. In the opinion of the author, there is no need to construct a special hypothesis to explain the action of the Welsbach burner. The emissive power is not greater that one, but the proportion of blue, green, and yellow radiations far surpasses that of red; and consequently the proportion of the energy given out as luminous radiations is very great. The absolute value of the luminous energy thus given out is, however, less than that which would be emitted by a black body at the same temperature.—Action of hydrogen upon silver sulphide, and the reverse reaction, by M. H. Pelabon. If the two systems, hydrogen-silver sulphide, and silver-hydrogen sulphide, are heated to the same temperature, the final state is the same in each case provided that the temperature be about 350° C. The velocity of the reaction is much accelerated by rise of temperature. The same state is finally reached if the starting system be sulphur, silver, and hydrogen.—On the heat of formation of lithium carbide, by M. Guntz. The value 11·3 calories was found by dissolving in water pure lithium carbide, details being given of the precautions necessary for the preparation of the latter.—On the combination of certain organic substances with mercuric sulphate, by M. G. Denigès. The mercuric sulphate reagent gives insoluble compounds when heated for a short time with fatty ketones, ordinary acetone giving an almost quantitative yield.—On a general method of preparation of mixed carbonic ethers of the fatty and aromatic series, by MM. P. Cazeneuve and Albert Morel. The carbonates of the phenols are heated either with the sodium alcoholate, or better, with an alcoholic solution of certain organic bases, such as pyridine.—On the nitro-derivatives resulting from the action of nitric acid upon ouabaine, by M. Arnaud. A mono- and a di-nitro derivative were isolated.—On the acids of the essential oils of geranium, by MM. Flatau and Labbé. An isomeride of myristic acid was isolated from the Indian essence.—Action of cyanamide upon chloranil in presence of potash, by M. H. Imbert. The reaction is similar to that already described for bromanil.—Contribution to the search for manganese in minerals, vegetables, and animals, by M. P. Pichard. Manganese appears to be very widely distributed. A list is given of natural orders of plants in which manganese has been found.—On the development of *Acmæa Virginea*, by M. Louis Boutan.—On the lakes of Roche-de-Rame (Hautes-Alpes), du Lauzet (Basse-Alpes), Roquebrussane, and Tourves, by M. André Delebecque.—On a method of measuring the area of the heart by radiography, by MM. G. Variot and G. Chicotot.—Improvement in the tubes employed in radiography, by M. L. Bonetti. The bulb is furnished with a sealed-in platinum wire, which can be heated by an external current.

NEW SOUTH WALES.

Linnean Society, May 25.—Mr. Henry Deane, Vice-President, in the chair.—On a myxomycete new for New South Wales, by D. McAlpine.—A preliminary study of the *Membracidæ* described from Australia and Tasmania, by Dr. F. W. Goding. The author has in contemplation the preparation of a monograph on the homopterous family *Membracidæ*, the Australian and Tasmanian species of which have not received much attention.—Further notes on Australian shipworms, by C. Hedley. A fresh-water shipworm from Fiji, first brought under notice by Mr. T. Steel at the Society's meeting in August 1895 is described and illustrated, under the name *Calobates fluviatilis*. *C. saulii*, Wright, in which *Teredo fragilis*, Tate, is included, is also dealt with. This species has now been traced from Adelaide, through Bass Straits to Sydney, where a second species, *C. edax*, flourishes, now first recognised as destructive to wharves in Port Jackson.—Descriptions of new mollusca, chiefly from New Caledonia, by C. Hedley. A remarkable new *Placostylus* from Dr. Cox's collection, aberrant alike geographically and structurally, is described; with further considerations on the range of the genus, dwelt on in a previous communication. Several molluscan novelties obtained during a visit to New Caledonia are made known, including a new *Teinostoma*, a *Diplommatina*, and an *Ischnochiton*.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Adressbuch für die Deutsche Mechanik und Optik, Band i. (Berlin, *Der Mechaniker*).—Stanford's Compendium of Geography and Travel (new issue): North America. Vol. 2. The United States: H. Gannett (Stanford).—Food Supply: R. Bruce (Griffin). The Making of a Daisy: E. Hughes-Gibb (Griffin).—Logic, Deductive and Inductive: C. Read (Richards).—Iowa Geological Survey, Annual Report, 1896 (Des Moines).—The Alpine Guide. The Western Alps: John Ball, new edition, by W. A. B. Coolidge (Longmans).—The Doctrine of Energy: B. L. L. (Paul).—Practical Organic Chemistry: G. George (Clive).—Wealth and Progress of New South Wales, 1896–97: T. A. Coghlan (Sydney).—Notes on Volumetric Analysis: A. Thornton and M. Pearson (Longmans).—A Short Course in Inorganic Qualitative Analysis: Dr. J. S. C. Wells (Chapman).—A Laboratory Guide in Qualitative Chemical Analysis: Prof. H. L. Wells (Chapman).—A Course of Practical Chemistry: W. G. Valentin, 9th edition, edited and revised by Prof. W. R. Hodgkinson (Churchill).—Hydrographical Surveying: Rear-Admiral Sir W. J. L. Wharton, 2nd edition (Murray).—Régularisation du Mouvement dans les Machines: L. Lecornu (Paris, Gauthier-Villars).—Müller-Pouillet's Lehrbuch der Physik und Meteorologie, Neunte Auflage, Zweiter Band, Zweite Abthg.: Drs. Pfaundler and Lummer (Braunschweig, Vieweg).—A First Year's Course of Practical Physics: J. F. Tristram (Rivingtons).—Facts about Bookworms: Rev. J. F. X. O'Conor (Suckling).

PAMPHLETS.—Additions to the Fungi on the Vine in Australia: D. McAlpine and G. H. Robinson (Melbourne).—Copenhagen (Danish Tourist Society, Copenhagen).—Publications of the Smithsonian Institution available for distribution, April 1898 (Washington).—Das Fernobjektiv im Porträt, Architektur und Landschaftsfache: H. Schmidt (Berlin, Schmidt).—Der Gummidruck: J. Gaedicke (Berlin, Schmidt).—Introduzione allo Studio dei Silicati: Prof. E. Ricci (Milano, Hoepli).—Tours in North of Ireland (Belfast, Baird).

SERIALS.—Journal of the Chemical Society, June (Gurney).—Economic Journal, June (Macmillan).—Journal of the Royal Microscopical Society, June (Williams).—An Illustrated Manual of British Birds: H. Saunders, 2nd edition, May and June (Gurney).—Field Columbian Museum Publications. Anthropological Series, Vol. 2, No. 2; Zoological Series, Vol. 1, Nos. 9 and 10 (Chicago).—Tufts College Studies, No. 5 (Tufts College).—Longman's Magazine, July (Longmans).—Chambers's Journal, July (Chambers).—Good Words, July (Isbister).—Sunday Magazine, July (Isbister).—American Journal of Mathematics, July (Baltimore).—Monthly Weather Review, March (Washington).—Natural Science, July (Dent).—Johns Hopkins University Studies, Ser. xvi. No. 6 (Baltimore).—Humanitarian, July (Duckworth).—Century Magazine, July (Macmillan).—Proceedings of the Royal Society of Victoria, Vol. x. (new series), Pt. 2 (Melbourne, Ford).—Contemporary Review, July (Isbister).—Fortnightly Review, July (Chapman).—Reliquary and Illustrated Archæologist, July (Bemrose).—National Review, July (Arnold).—Journal of the Royal Agricultural Society of England, Vol. 9, Part 2 (Murray).

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