THURSDAY, JANUARY 28, 1897.

DARWIN AND DARWINISM.

Charles Darwin and the Theory of Natural Selection. By Edward B. Poulton, M.A., F.R.S., F.G.S., F.L.S., &c., Hope Professor of Zoology at the University of Oxford. Pp. 224. (London, Paris, and Melbourne: Cassell and Company, Ltd., 1896.)

AFTER the one-volume "Life and Letters" by Francis Darwin, and the admirable little book by Grant Allen in the "English Worthies" series, there seemed to be little room for another English work upon the same subject; yet the present small volume is markedly original, and while following pretty closely the general lines of the "Life and Letters," introduces much new matter, and gives a fuller account of what may be termed the critical points of Darwin's theories than are to be found in any of the works here referred to. It is written in a thoroughly sympathetic, though impartial, spirit; and without introducing any actual criticism, either of the views of Darwin or of his opponents (which would have been manifestly out of place in a popular work), it yet makes clear the differences of opinion that now exist as to some of Darwin's most cherished theories, and, while briefly stating the main facts and hypotheses on both sides, leaves the reader in no doubt, both as to the exact nature and importance of the opposing views and the kind of evidence that is required in order to decide which is most in accordance with the facts of nature.

The first seven chapters deal with Darwin's life down to the year 1856, the facts of which are so widely known that they call for no special notice. Though much condensed, they supply all the information needed by the general reader; and we will only quote the following estimate of character as due to heredity, which is very suggestive:

"It appears probable that Charles Darwin's unique power was largely due to inheritance of the imagination of his grandfather, combined with the acute observation of his father. Although he possessed an even larger share of both these qualities than his predecessors, it is probable that he owed more to their co-operation than to the high degree of their development."

While believing this estimate to be generally correct, it appears to the present writer that two other important factors have been usually overlooked—the solitude of the five years' voyage and the persistent ill-health. During a very large portion of the five years with the *Beagle*, Darwin must have been practically alone and thrown on his own mental resources, not only on the ship when all the officers would be engaged on their duties, but during his numerous land-journeys and excursions on shore; and this mental solitude of an active mind, furnished continually with new and interesting facts on which to exercise the imaginative and reasoning powers, led to the formation of those original and suggestive ideas which were the foundation of his greatness. Hardly less important was the almost continuous ill-health, which, while not preventing work or shortening life, obliged him to live in the country, free from the distractions of society, and where his active mind could only be satisfied by continual study and experiment. Without the solitude of the voyage the fundamental idea of natural selection might never have been attained; with vigorous health that wonderful series of experimental observations in the quiet and solitude of Down, without which the "Origin of Species" would have lost much of its convincing power, would almost certainly not have been made.

Chapters viii. to xii. are devoted to the relations between Darwin and the present writer, about which nothing need be here said, except that they contain some new matter, and while too flattering to myself, appear to be quite accurate as to the facts.

The next six chapters are devoted to a sketch of the writing and publication of the "Origin," and the influence of Darwin upon his more eminent friends and correspondents; and of these chapters the most original and important is the eighteenth, on the "Influence of Darwin upon Huxley." Prof. Poulton here points out the misconceptions prevalent as to Huxley's exact views, showing that the one and only point on which he considered the theory to fail in logical completeness was the absence of proof of infertility arising among the most divergent races of domestic animals, a difficulty which still exists, but which may possibly be set at rest by systematic and long-continued experiment. This difficulty, however, applies equally to all other theories; while, if the argument of the present writer is sound—that, under certain conditions which are frequently present, the variations in fertility which undoubtedly occur will be accumulated by natural selection, we not only have the general occurrence of infertility between allied species explained, but we also see why such infertility does not arise among varieties due to man's selection, since he has never attempted to produce it. A more thorough examination of this problem seems, therefore, to be called for.

Chapters xix. and xx. are devoted to an interesting exposition of the various misconceptions and misrepresentations of the theory of natural selection, which caused so much trouble and annoyance to Darwin, misconceptions which are still prevalent, as shown by Lord Salisbury's recent address, and by passages in Prof. Cope's last book (see NATURE, vol. liii. p. 554). These chapters are therefore very opportune, and may do something to show the public that a large proportion of Darwin's critics have not taken the trouble to understand the theory to which they take exception.

The next two chapters are perhaps the most original and important in the volume, since they contain a very careful summary of Darwin's celebrated theory of Pangenesis. To most of the readers of this work these chapters will be entirely new, and will give them in a very readable form some idea of the exceedingly varied and complex phenomena of "inheritance" which the theory was formed to explain. Among these are sexual and asexual reproduction, the complex phenomena of variability and inheritance, the diversity of embryonic changes during development of allied groups, the phenomena of graft-hybrids, the reproduction of lost parts, the sterility of hybrids, reversion to ancestral forms, and many others. Besides these there are the

doubtful phenomena of the inheritance of the effects of use and disuse and of other acquired modifications of the individual by external conditions, which Darwin accepted as a fact, though he remarked upon it: "Nothing in the whole circuit of physiology is more wonderful."

Every one who reads this account of Pangenesis will feel admiration for its ingenuity, and surprise at the completeness with which it can be made to explain all the varied phenomena of inheritance, though some of these explanations seem more verbal than real. Readers will also understand the fundamental difference between this theory and that of Weismann; and will see, that in order to decide which best explains the whole series of phenomena, the inheritance or non-inheritance of acquired characters, as a matter of fact, must first be settled.

The difficulty of conceiving the actual operation of the theory of Pangenesis may be best illustrated by an example. Taking a bird, such as a peacock, the theory implies that not only every cell and fibre of bone, muscle, skin, and all internal organs gives off gemmules which all find their way into every one of the cells constituting the sperm or reproductive fluid, but that every one of the feathers also sends gemmules from each of the cells that build up its wonderfully complex structure, not only in the adult stage, but in the condition they assume in the young and adolescent birds; and further, that every detail of varying colour of the barbs of these feathers send off their gemmules, and that all this inconceivable number of gemmules must travel through the whole structure of the quill, and through all the tissues of the body, till they reach the reproductive organs, and every one of these gemmules must reach all or most of the sperm-cells, failing which there would be a corresponding deficiency in the offspring. But as important deficiencies of feathers, or of colour on the various feathers, which produce the beautiful patterns and ornaments of a bird's plumage only rarely occur, we must assume that the passage of the millions of gemmules from the ends of the feathers of a peacock's train through the whole length of the shaft, and then to the sperm-cells, is almost always successfully accomplished. In addition to the enormous difficulty, on any theory, of conceiving the processes of growth and development of the complex parts of living organisms, we have, on this theory, an equal or greater difficulty in the reverse process, by which the gemmules from every cell get back again to the sperm and germ cells. Without asserting that this process is impossible or inconceivable, it is well to endeavour to realise what it really is and its almost incredible complexity.

Prof. Poulton gives a brief account of the experiments made by Mr. Galton and the late Mr. Romanes to test the theory of Pangenesis, by the transfusion of blood and the transplantation of skin, from one variety of animal to another, and then breeding from the modified individuals; but in no case was any effect produced on the characters of the offspring. Though, perhaps, not quite conclusive, these experiments indicate that there is no such continuous transference of gemmules as the theory requires.

The remaining three chapters deal with the descent of man and sexual selection, the various botanical works, and a series of hitherto unpublished letters to Prof. Meldola, chiefly interesting as illustrating Darwin's kindness to all students of natural history, and the amount of trouble he took to be of use to them.

On the whole, Prof. Poulton is to be congratulated on the production of so interesting a book, which in a wonderfully limited space gives a connected account of Darwin's life and work, and especially of some portions of his theories which have been almost neglected by other writers. A good print, from a photograph, of Darwin's statue in the Natural History Museum, forms the frontispiece of the volume.

ALFRED R. WALLACE.

LIFE OF BRIAN HOUGHTON HODGSON.

Life of Brian Houghton Hodgson, British Resident at the Court of Nepal. By Sir William Wilson Hunter, K.C.S.I., M.A., LL.D. Pp. 389, 8vo. (London: John Murray, 1896.)

IN this charming volume Sir William Hunter has compiled a worthy memorial of one of the most famous of our Indian civilians, one of the very few who have been able to rise above the details of their daily work, and to take a real intellectual interest in the history or the science of the strange people and lands in which their life is cast.

Born in 1800, young Hodgson, who had influential relatives, was in 1816 offered a nomination to the East India Company's service, and entered Haileybury College, where all the civilians were then trained. Malthus was then Professor of Political Economy in the college, and happened to be an old college friend of an intimate friend of the Hodgsons. Advantage was taken of this to introduce the new scholar, and Malthus not only made him his guest during the first session, but remained throughout the lad's college residence his constant friend. Henry Walter had also just joined the college as Professor of Chemistry and Natural History, and Sir James Mackintosh became Professor of Law two years afterwards. No doubt the future scholar and collector owed very much to the teaching of Malthus and Walter, and to the personal friendship of the former; though the traces of their influence on any other of the collegians of the time are not conspicuous.

In December 1817 Hodgson passed out of Haileybury as gold medallist and head of his term, and sailed in the following year, round the Cape, to Calcutta. Sir Charles D'Oyly, the Controller of Customs, a connection of Hodgson's family, and a man of much artistic and literary culture, welcomed him, and made his house his home. Not only were the D'Oylys leaders in Calcutta society, but Sir Charles had only lately brought out a book on the antiquities of Dacca. And it was through the influence of Lady D'Oyly, a near connection of the Governor General's, that young Hodgson was shortly appointed assistant to the Commissioner of Kumaun—one of those appointments in the hills, then very few in number, reckoned among the prizes of the Service.

Kumaun had only just been taken from Nepal by the English; and the duties of the new Assistant consisted chiefly in helping to make a revenue settlement in the new province. The fine air of those lofty valleys soon

restored his health, which had seriously suffered in Calcutta. Both his duties and his sport brought him into close contact with the people. But he was not to remain there long. In 1820 the Assistant-Resident at the Court of Nepal died, and Hodgson succeeded to the post. Two years afterwards he returned for a short time to the Secretariat in Calcutta, but in 1825 he was re-appointed to the Assistant-Residentship in Kathmandu. In 1833 he became the Resident, and remained in that appointment until he left the Service in 1843.

The daily duties of such a Resident at an independent Court are, in quiet times, not onerous. But now and again, when in the never-ceasing struggles of palace intrigue the anti-English feeling, naturally always existing, comes to the front, the position of Resident becomes suddenly of importance ; his work becomes all-absorbing, and constant demands are made upon his judgment, his tact, and even occasionally upon his personal bravery. Sir William Hunter is an excellent guide through the intricacies of the palace cabals, and sets out the dismal story of the deposition, exile, or murder of successive nominal rulers, and of the rise to power of the real rulers, the mayors of the palace, three out of four of whom came also to a violent end. Throughout these crises it was acknowledged on all hands (with one exception) that Hodgson conducted the necessary negotiations with wisdom, tact, and courage beyond praise. But that exception was the Governor General. When he was convinced, at last, that the Resident was acting less on the orders given than on his own view of the position, Lord Ellenborough dismissed him from his post, and offered him a minor appointment in Simla. This the sensitive spirit of Mr. Hodgson could not brook, and he resigned the Service in 1843.

During his long service at Kathmandu the Resident had never lost an opportunity of adding to his wide knowledge of the history of the zoology of Nepal and Tibet. And when he was thus forced out of the Service, his name was already known and honoured throughout the world. Nepal had been for centuries an asylum for the Buddhism which had died out in its original home in the valley of the Ganges. There and there alone are to be found those Sanskrit Buddhist MSS. on which the Buddhism, not only of Nepal itself, but of Tibet and China, of Japan and the Korea, is based. No less than 423 of these otherwise inaccessible records of the Buddhist movement were either bought or copied by Hodgson, not for himself, but in order that, with a generosity as unequalled as was his intellectual ardour, they might be presented either to the Asiatic Society in Calcutta, or to similar learned bodies in England and France. So far as it was possible for one, not himself a Sanskrit scholar, to discuss or elucidate the problems of the history of the ancient faith of Buddhism, he endeavoured to do so, and spared neither trouble nor expense in gathering from the *pandits* of the Nepal capital such knowledge as they possessed. This he communicated, from his solitary outpost in the hills, to the Asiatic Society of Bengal ; and these results of his researches in what was then an almost unworked field aroused the enthusiastic appreciation of scholars throughout the world. He had hoped that the MSS. he presented would enable Sanskrit scholars to carry on, from the original sources, the researches he had thus begun from the mouths of living witnesses. In only one instance were his hopes realised. The MSS. he sent to Paris lured Eugène Burnouf from his other pursuits, and led him to devote his genius and scholarship to those studies in early Buddhism which really laid the foundation of all we now know on the subject. (His first great work on Buddhism is dedicated to Hodgson.) Nearly half a century elapsed before even a catalogue appeared of the Hodgson MSS. in Calcutta, and that is an inaccurate and unsatisfactory work. The much better catalogue, entirely trustworthy, so far as it goes, of the Hodgson MSS. in the Royal Asiatic Society, had appeared a few years before. But no English scholar had worked at them. It is only in the last few years that they are beginning to be a little utilised, to be appreciated at their right value. Foreign scholars have devoted themselves to the work ; and notably M. Senart in Paris has taken up, in a masterly manner, the work left unfinished by the premature death of Burnouf. So year after year the gratitude of historical students will go out in increasing measure to the enlightened generosity of the scholar who has provided for their use the largest body of original documents on Buddhism which, up to his time, had ever been gathered together either in Asia or in Europe—documents whose very existence had been previously unknown.

When he left the service, Hodgson, after a short stay in England, settled in Darjiling, and began then to take up seriously a quite different branch of historical inquiry in which he had also been always interested. This was the very complicated question of the non-Aryan races of the Himalayan valleys. He contributed numerous papers on the language, religion, customs, and social condition of these tribes to the Asiatic Society of Bengal. His work in this field of inquiry was not only that of a bold pioneer, who laid down with admirable judgment the right method of inquiry, but has also remained in most instances till to-day the best that has been done, and, with regard to almost all the tribes with which he dealt, it is the foundation of all subsequent work. As year by year the importance of the non-Aryan element in all questions relating, not only to the physique, but also to the history of the religious and social ideas of the Indian peoples, becomes more and more recognised, the value also of this branch of Hodgson's researches has been more and more appreciated. It was fully acknowledged at the time by those most competent to judge, and he was elected an Honorary Fellow of the Ethnological Society—a distinction then shared, amongst Englishmen, only by Darwin, Layard, and Rawlinson.

Meanwhile, during the whole time of his residence in India, Hodgson never lost his interest in what was then called natural history. He wrote no less than eighty papers for scientific societies (mostly for the Bengal Asiatic Society) on the Himalayan mammals, and contributed more than any one else, except only Blyth and Jerdon, to our knowledge of the birds of India. Though his opportunities were confined to two of the smaller districts, he added fully a hundred good new species to the Avi-fauna of British India. "He trained Indian

artists," says Hume (whose joint work with Marshall on the "Game Birds of India" is dedicated to Hodgson), "to paint birds with extreme accuracy from a scientific point of view; and under his careful supervision admirable large scale pictures were produced, not only of all these new species, but also of several hundred others, and in many cases of their nests and eggs also. These were continually accompanied by exact, life-size, pencil drawings of the bills, nasal orifices, legs, feet, and claws (the scutellation of the torso and toes being reproduced with photographic accuracy and minuteness), and of the arrangement of the feathers in crest, wing, and tails." Unrivalled as a collector, Hodgson's generosity with his specimens and drawings was equally unrivalled, and practically the whole of them were given to public libraries or scientific societies.

We would not have the appreciation which his biographer has lavished upon his many-sided intellectual activity diminished by a single word. It is only strange that the marked absence of anything of the kind in other civilians should not have seemed to Sir William Hunter to call for any limitation of that exuberant optimism with which he regards the ways and works of every official (except Lord Ellenborough) that he has to mention. No doubt the results of the system of Indian government have been, from a material point of view, encouraging. The members of the Service have developed administrative qualities of a high order. But is there nothing at all that is lacking? Is not intellectual alertness sometimes smothered under a mass of detail, and any really scholarly or scientific knowledge tabooed or discouraged as waste of time? And is not the best executive ability apt to strike cold when it wants the charm of intellectual sympathy? Nothing is more evident in this book than the way in which Brian Houghton Hodgson's wide knowledge and intellectual sympathy helped him in his official work, unless indeed it be the degree in which, in those qualities, he stood alone. We need not wonder that he received from the Indian Government none of those titular honours that were bestowed on many of his contemporaries, now forgotten.

The biography is delightfully and lucidly written, and enriched by contributions from specialists in the various subjects dealt with in Hodgson's works. The charm of the narrative is such that the reader will probably find it only too short. And a word of acknowledgment must be given to the beauty of the illustrations, especially of the striking picture taken by Mrs. Hodgson, to whom the work is dedicated.

OUR BOOK SHELF.

Manual of Determinative Mineralogy, with an Introduction on Blowpipe Analysis. By G. J. Brush. Revised and enlarged by S. L. Penfield. Pp. vi + 208. (New York: Wiley. London: Chapman and Hall, Ltd., 1896.)

THE manual of the veteran mineralogist, and present Director of the Sheffield Scientific School at New Haven, has been in constant use since 1874, and has passed through thirteen editions. The present volume is the beginning of a new and revised edition which has been undertaken by Prof. Penfield. The determinative tables, originally based upon von Kobell's "Tafeln zur Bestimmung der Mineralien," remain as they were in the thirteenth edition, but they are now preceded by four chapters on the qualitative analysis of minerals, which have been in great part re-written by Prof. Penfield. These chapters are, as might be expected from this able mineralogist, entirely excellent. The description of the apparatus and methods employed is most simple and clear, and is rendered attractive by numerous good illustrations, which are in large part new.

The book abounds in practical hints of the greatest value to a beginner. The course consists of a series of simple experiments so arranged as to illustrate the reactions of the various elements, and many of these are designed to illustrate the *difficulties* which attend their use, and the risk of drawing erroneous conclusions, *e.g.* "The mistake is sometimes made of testing carbonates with acids which are too concentrated, as illustrated by the following experiment," &c.; or again, "In order to show that there is sometimes danger of overlooking a small quantity of a carbonate, test as follows."

The rarer elements are treated, as well as those which the student is more likely to encounter, and due regard is paid to newly-discovered reactions. Thus mention is made of the method of testing recommended by Haamel, in which the material is heated in the oxidising flame after being moistened with hydriodic acid, or tincture of iodine, as suggested by Wheeler and Luedeking; and it is recommended that a plaster of Paris tablet should be used to collect the coloured sublimates produced. It is perhaps unfortunate that this method does not find a place in the summary of blowpipe and chemical reactions, which constitutes Chapter iv.

The fundamental principles of qualitative analysis (*e.g.* the nature of the flame, and the action of charcoal) are more fully explained than in the preceding editions; and for these and other reasons, the volume is a more satisfactory handbook for an elementary student than any with which we are acquainted.

The new edition is to be completed by the revision of the determinative tables, and Prof. Penfield promises to add to these a chapter on crystallography and the physical properties of minerals. It is, we think, to be regretted that the publishers have brought out the new edition in an incomplete state.

Grundriss der Entwicklungsgeschichte des Menschen und der Säugethiere. By Dr. Oscar Schultze. Erste Hälfte. Pp. 177. (Leipzig: Engelmann, 1896.)

THIS work, which is a revision of Prof. Koelliker's book, is intended especially for students and practitioners. Although Dr. Schultze writes his descriptions of the various developmental processes in a concise manner, avoiding controverted and purely theoretical points as far as possible, still he has introduced into his book all the more recent important observations on mammalian embryology. The work appears to be throughout in all points quite up to date. The well-chosen figures, which are numerous and nicely reproduced, are all taken from mammalian embryos, and it will doubtless be a satisfaction to a student of human embryology to find such illustrations instead of the oft-repeated figures of fowl, reptile, and even invertebrate embryos common in text-books on human development. Our present knowledge of the early stages of mammalian embryos quite justifies the omission of such figures in an account of mammalian development. Dr. Schultze has succeeded in making his history of the embryology of man and mammals hang well together. As the work is sure to be extensively used, it is to be hoped that an English translation will shortly be forthcoming. The second part is promised at the end of this year.

LETTERS TO THE EDITOR.

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

The Oyster Question.

PROF. THORPE'S allusion to myself in connection with oysters and their ways in a recent[1] number of NATURE (p. 106) has reminded me that I also have something to say on the subject, *à propos* of the "Yellow Book" issued by the Local Government Board.

First, I wish to state that several references to my work, made in that and other recent publications on oysters and disease, ought rather to be to the work of my colleague Prof. Boyce, or to our joint work.

In conjunction with Prof. Boyce, I have published three notes on the subject, and the bacteriological parts of these have, naturally, been contributed by my colleague. The first note was read (and circulated) at the Ipswich meeting of the British Association in September 1895, the second was brought before the Liverpool Biological Society in January 1896, and was published that same month in the Annual Report of the Lancashire Sea Fisheries Laboratory for 1895, while the third was read (by Prof. Boyce) to Section I at the Liverpool meeting of the British Association last September, and reprints have since been circulated. The points that we believe we have demonstrated (I do not say that they were all new when announced—some were known, others suspected, some denied; but I think we have given definiteness to all) are as follows:—

(1) The beneficial effect of free change of water round the oysters.

(2) The deleterious effect of keeping the oysters in stagnant water.

(3) The considerable toleration of sewage shown by the oyster, and its power of absorbing large quantities of fæcal matter.

(4) The great increase (*e.g.* from 10 colonies to 17,000 per sample) in the bacterial contents of the pallial cavity and of the rectum when the oyster is laid down in close proximity to the mouth of a drain.

(5) The presence of more bacteria in the pallial cavity than in the alimentary canal of the oyster.

(6) The fact that the typhoid bacillus does not flourish in sea water. There is no initial or subsequent multiplication; on the contrary, it seems to die off very rapidly as time increases after inoculation.

(7) The fact that the typhoid bacillus does not multiply in the stomach or tissues of the oyster.

(8) The presence of a "pale green" disease, characterised by a leucocytosis, in certain oysters.

(9) The fact that the dark blue-green colour of the Marennes oysters has nothing to do with copper.

(10) The fact that perfectly fresh oysters contain fewer bacteria than those that have been stored or kept in shops.

(11) The enormous number of the common colon bacillus present in very many oysters obtained from shops.

(12) The possibility of getting rid of bacterial infection by placing the oyster in a stream of running water. There is a great diminution or total disappearance of the *B. typhosus* under these circumstances in from one to seven days.

Perhaps it is on the last of these conclusions that Prof. Thorpe has founded his remark, that the oyster has confided to us its preference for clean water. Whatever it may *prefer*, Dr. Bulstrode has abundantly demonstrated in his report, that the oyster is not always *found* in clean water; and the practical conclusion of all these investigations and reports ought to be the enforcement of the two sanitary measures which Prof. Boyce and I recommended a year ago, viz. "(1) the strict examination of all grounds upon which oysters are grown or bedded, so as to ensure their freedom from sewage, and (2) if practicable, the use of "dégorgeoirs" in which the oysters should be placed for a short time before they are sent to the consumer"[2] ("Rep. Lanc. Sea-Fish. Lab." 1895, p. 72).

I am interested to see that Dr. Bulstrode (in the Local Government Board Report) independently corroborates our discovery of a pale green disease in some relaid oysters in this country. This is especially important, since Dr. Carazzi, of Spezia (whose results differ from those of most other investigators of molluscan structure and physiology), in a recently published paper, has doubted the existence of this green disease—probably because he has never met with it. He has drawn his conclusions mainly from the normal green Marennes oyster. We distinctly stated that the pale green disease had nothing in common with the dark blue-green of the "huitres de Marennes," and that we regarded the latter as being healthy and normal.

It is evident, then, that there are several distinct kinds of greenness in oysters. All recent investigators are agreed (except, possibly, Dr. Carazzi—I cannot venture to answer for him) that the green colour of the Marennes oyster has nothing to do with copper. Prof. Boyce and I have shown, and Dr. Bulstrode supports it, that the green of the (*e.g.* Fleetwood) relaid American oyster is due to a disease or leucocytosis, while now Prof. Thorpe tells us that (as was originally supposed, and then doubted) the greenness of the Falmouth oyster is really due to copper.

W. A. HERDMAN.

Liverpool, January 9, 1897.

P.S.—In connection with the correspondence which has taken place in NATURE, since Prof. Thorpe's article, I am glad to be able to add my testimony to that of Dr. Cartwright Wood and others as to the purity and healthy state of the Pyfleet oyster. I have visited the locality, have seen the oysters dredged up, and have examined (both biologically and gastronomically) many specimens, with entirely satisfactory results.

The Symbols of Applied Algebra.

I AM glad to see that attention is being forcibly drawn to the value and importance of considering the symbols in physical equations as primarily denoting quantities, and not mere numerical multiples of some unincluded standards. The latter mode of considering them, though often practically convenient, is entirely subsidiary, and a deduction from the primary equations between the quantities themselves.

The equation $w = mg$ is a special case of Newton's second law; it represents a fact of nature, and has nothing to do with systems of units. It is true in any units:—*e.g.*

$$\begin{aligned} 981 \text{ dynes} &= 1 \text{ gramme weight} \\ &= 1 \text{ gramme-mass} \times 32{\cdot}18 \text{ ft./(sec.)}^2. \end{aligned}$$

The curious discussion about so simple an equation is kept up by those who wish to make all equations numerical only. To do this they must have a system of standards or units which themselves satisfy the equation. The numerical coefficients will then also satisfy the same equation, and the standards or units may be cancelled or omitted. The metric system has acquired the desired units by the invention of the dyne; and to do the same for the British system requires one of three alternatives:—(1) To take as unit of mass 32·18 lbs. or (say) a "perry," instead of 1 lb.; (2) to take g (32·18 ft./(sec.)^2) as unit acceleration; or (3) to employ a special unit of force, based directly upon Newton's second law, and upon the pound, the foot, and the second. Any of these conventions will serve: they are only needed for arithmetical interpretation of the equation, and, of them, the last is, on the whole, the simplest for general application, besides being in accordance with the universally adopted metric convention.

ALFRED LODGE.

Coopers Hill, January 18.

PROF. LODGE gives the formula $s = \frac{w}{v}$ as connecting the weight, volume, and specific gravity of a body. Does he seriously suggest that this is "independent of every system of units"? Surely it requires that the unit of weight should be the weight of unit volume of the standard substance. Would he give this formula to a student who measured forces in poundals?

The formula neatly illustrates the objection to the poundal. The C.G.S. system is theoretically perfect; the system in which the pound is the unit of force is, no doubt, theoretically objectionable, but is practically extensively used.

[1] This letter was written before the Christmas vacation, but has been delayed by examination and other engagements.

[2] Probably the most satisfactory method for all concerned—producers, customers, and sanitary authorities—would be to have all oyster beds, parks, layings and ponds inspected and "licensed," and to have no oysters exposed for sale except such as come from a certified locality.

The "poundal" system is equally objectionable theoretically (witness Prof. Lodge's formula $s = \frac{w}{v}$), and is not in practical use.

Then why introduce it? C. S. JACKSON.

Conductorless X-Ray Bulbs and Tubes.

IN October 1896 (NATURE, vol. liv. p. 594), a description was given by me of an exhausted bulb used in conjunction with a Tesla coil which gave X-rays and its photographic effects. Since these experiments I have found other phenomena, which throw some light on the relative positions of the conductor carrying the oscillations and the greenish fluorescence within the bulb or tube. The relationship is shown in the following diagrams :—

(1) A B is the conductor, with its axis parallel with O X, carrying the oscillating current of the Tesla secondary coil; S S the exhausted sphere, F D E a ring of greenish fluorescence, the plane of the ring being at right angles to the axis of the conductor A B. The X-ray effects were strongest at D, a point in O Y furthest from the conductor A B. The limits of the position of the edges of the fluorescence were easily traced by means of a minute fluorescent screen, placed at the end of a vulcanite tube, furnished with a cup-shaped end to cover the eye.

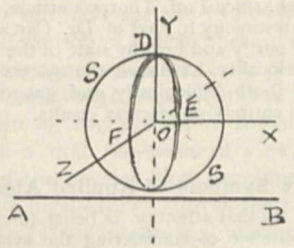


FIG. 1.

When the sphere was rolled, or moved parallel with itself along the length of the conductor, the plane of the glow-ring, F D E, kept its original position and moved perpendicular to the conductor. I have not been able to obtain the effects from an ordinary induction coil giving an 8 cm. spark only with the Tesla coil.

An exhausted tube was next placed within an open coil carrying the Tesla oscillations; the following beautiful effects were produced.

A B, exhausted tube; C C C, the spiral conductor; D D D, the glow in the form of a spiral within the tube. When the glass tube was about 4 mm. internal diameter, and the conductor, a gutta-percha covered copper wire, touched the glass, the spiral glow was very bright, and the glass became warm.

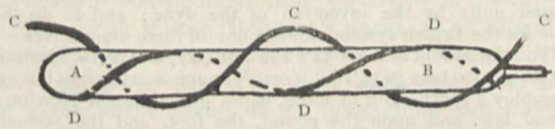


FIG. 2.

If a cross section be made through the tube and wire at right angles to the axis of the tube, a point in the glow is situated 180° from a point in the conductor, the section of the axis, the central point, being taken as the origin. The Tesla spark in air was 5 mm. long, and the coil formed a part of the spark circuit.

Oxford, January 14. FREDERICK J. SMITH.

Patterns produced by Charged Conductors on Sensitive Plates.

IN reply to the request of Mr. J. I'Anson for a reference to any former observations on the interesting effects described in your current number, he will find in the B.A. Report for 1888, and more fully in the *Philosophical Magazine* for December of that year, an account of the phenomenon as observed by the present writer, using cut-out patterns of tinfoil as conductors. This action of electrified conductors in contact with the photographic film was subsequently employed in a refined way by Rev. F. J. Smith, in making very beautiful and interesting prints from electrotype and other printing blocks. His results were shown at a conversazione of the Royal Society on May 10, 1893.

My own paper was chiefly occupied with a description of the figures produced by allowing sparks from an induction coil to play in various ways over photographic plates; and now that induction coils have become so much more widely distributed, it seems worth while to again draw attention to the exceedingly beautiful and interesting effects easily produced in this way.

A very fine set of prints from similar spark traces was exhibited by Mr. A. A. C. Swinton, at the Royal Society's conversazione of June 15, 1892. J. BROWN.

Belfast, January 22.

The Problem of the Sense Qualities.

(1) IN his very friendly notice of my "Outline of Psychology" (NATURE, December 10, 1896), Mr. W. E. Johnson points out what he takes to be a fallacy underlying the calculation of the number of possible sensation qualities in that and other text-books. I believe with Mr. Johnson that the qualitative series is in many cases (not all: *cf.* taste, *e.g.*) continuous. But I do not think that this makes the calculation of distinguishable qualities fallacious.

Mr. Johnson's argument is briefly as follows :—Let A B C D be stimuli of the same physical continuum (*e.g.*, wave-lengths), whose values are such that the sense qualities corresponding to A and D are just noticeably different. Then we have :—

Stimulus	...	...	...	A	B	C	D
Sensation	...	...	...	*a*	[*b*]	[*c*]	*d*;

and the syllogism runs :—

a is not *d*,
b is *d*,
∴ *a* is not *b*.

But by hypothesis, *a* is *b*, being indistinguishable from it. Hence to make difference = distinguishableness in calculation leads to a logical fallacy.

If now it were a case of diversity in logical predicate *vs.* identity in experience, the psychologist would be found to decide in favour of experience. But I think that the whole syllogism is erroneous. As a matter of fact, going from left to right, we have the series :—

Stimulus	...	...	..	A	B	C	D
Sensation	...	...	...	*a*	*a*	*a*	*d*

and, going from right to left, the series :

Stimulus	...	...	...	A	B	C	D
Sensation	...	...	...	*a*	*d*	*d*	*d*

from which the only conclusions are :—

Some *a* is not *d*,
Some *a* is *d*, . . .

i.e., two particular propositions. It is of the very essence of the just noticeable difference that it is cognised under certain conditions, and not under all.

So far, then, the fallacy turns out to be imaginary. There are no sensations *b* and *c*, qualitatively distinct from *a* or *d*. Nor can there be, whatever value of stimulus be taken as starting-point for the determination. An observer working with stimuli B C D E . . . would get the sensation series *b e i m* . . . which would be qualitatively indistinguishable from the series *a d h l* . . .

Calculation of qualities by arithmetical progression presupposes, of course, a constancy (found as in tones, or calculated as in colours) of the *absolute* difference limen. Weber's law holds only of sensation intensities, which I expressly decline to calculate (p. 70). There is one qualitative series in which a uniformity resembling Weber's law obtains: the black-white series. But this series is in many respects anomalous, its qualities seeming to have the function of visual intensity; and neither its physiology nor its psychology is at present very satisfactory. (For the calculation of the number of brightness qualities, see Prof. König's paper, Ebbinghaus' *Zeitschrift*, vol. viii. pp. 377 ff.)

(2) Mr. Johnson further objects to my analysis of the process

of comparison. If I had said only what he quotes me as saying, his criticism would have been justified. As it is, I say (in the same context):—

"Verbal association and judgment are, in themselves, comparatively simple processes; but when the word associated or predicated is a fully formed concept, we realise that the simplicity of form is deceptive, that much mental elaboration lies behind."

"Likeness" and "difference" are concepts, and have conceptual significance. I devote a section to the formation of concepts in general (pp. 294 ff.). It is not, however, the duty of Psychology, but of Anthropological Psychology, to show the genesis of particular concepts (pp. 292, 300). I was concerned simply with the process of comparison as introspection reveals it in the adult mind, not with its logical or genetic aspects.

E. B. TITCHENER.

(1) As regards the difficulty involved in counting sensation qualities, the point of difference between Prof. Titchener and myself is subtle, but philosophically interesting. I think we may both admit that the question cannot be settled by considerations of purely formal logic. In fact, Prof. Titchener's two premisses logically lead to the conclusion that "One sensation *a is not the same as* another sensation *a*, although the two are, *ex hypothesi*, indistinguishable." The question between us is as to the interpretation of the relation "not the same as" in this connection. My contention is that the *one* and the *other* sensation differ—not merely numerically or extrinsically—but qualitatively or intrinsically. Since the one sensation *a* is distinguishable from *d*, and the other sensation *a* is not distinguishable from *d*, it seems to me that this difference between them cannot be referred to merely extrinsic conditions, but must depend on a sensationally qualitative difference in the sensation-qualities themselves.

(2) If I have unintentionally misrepresented Prof. Titchener's views on the process of comparison, I should be glad to take this opportunity of making amendment by quoting a passage from p. 299, which seems to me sound:—"In every association two ideas are brought into connection. When the connection itself has become the object of attention, when, *i.e.* we have formed an idea of connection, as distinct from the ideas which are connected, we speak of it as a *relation*." If this passage is applied to the relation of likeness or difference apprehended in the process of comparison, I have no ground of dispute with Prof. Titchener. Only in this case I fail to see how any significance or importance can be attached to the phrase "verbal association" employed in describing the process of comparison.

W. E. JOHNSON.

Durham Degrees in Science.

AMONG the official notices of the University of Durham, I find it recorded that, on Tuesday, December 15, six gentlemen received the degree of Master in Science *by vote of Convocation*.

The degree of Master in Science has in the past been purely a *merit* degree. It was conferred only upon those who had previously taken the degree of Bachelor in Science, who were of, at least, two years' standing, and who succeeded in passing an additional examination in some branch of one of the scientific subjects professed at the University. The degree was, in fact, until to-day, an authoritative statement that the holder was not only a specialist in his particular subject, but also that he had received that sound University training in science and general knowledge of which the Bachelor in Science degree is a proof.

This has now been changed. The degree has been granted merely "by vote of Convocation" for no specified cause. Before December 15, it was evidence of merit of a particular kind. Now it is not. Apart from other considerations, this is a great hardship upon many other graduates in science. Grouped together in the list of Masters in Science are those who have gained the honour by their scientific attainments, and those who have received it for non-specified reasons by vote of Convocation.

Such a radical change in the nature of a degree deserves public notice, and this must be my apology for troubling you with this letter.

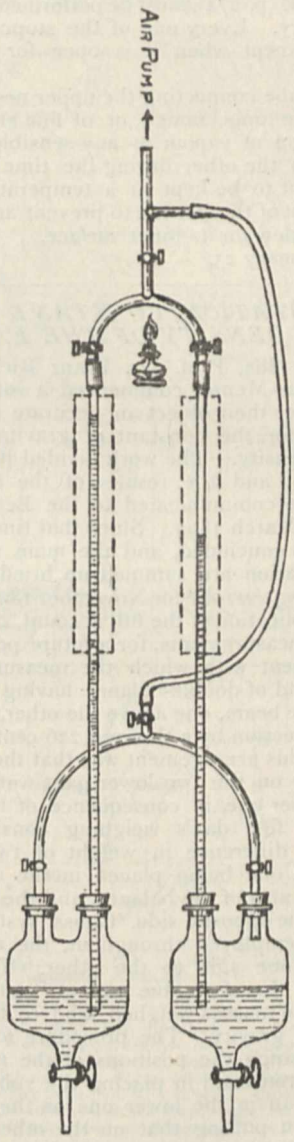
X.

January 1897.

NOTE ON METHOD SUGGESTED FOR MEASURING VAPOUR PRESSURES.[1]

THE distillation of vapour from one of the vertical tubes to the other, referred to at the end of Operation No. 4, in my communication published in last week's NATURE (p. 373), may be wholly got quit of by the following simplified mode of procedure.

Operate first on one only of the liquids until it is got into equilibrium, with its upper level at any convenient marked point in its glass tube, and nothing but its own



vapour between this surface and the closed stopcock immediately above it; the upper-neck stopcock over the bottle for this liquid being also closed.

Operate similarly on the other liquid; and close both the air-pump stopcocks, so that now we have all the stopcocks closed.

Open now very gradually the upper-neck stopcocks of the two bottles. While doing so, prevent the liquid from rising in either tube above the marked point by working the air-pump and very slightly opening the lower air-pump stopcock. When both the upper-neck

[1] See NATURE, p. 274.

stopcocks are wide open, any adjustment that is considered desirable for the level of the liquid standing higher than the other in its glass tube, may be deliberately made by drawing out or letting in a little air through the lower air-pump stopcock.

Either or both liquids may be thoroughly stirred at any time to ensure homogeneousness by alternately exhausting and letting in air to the bottle or bottles by means of the air-pump and the lower air-pump stopcock, the upper three stopcocks being kept closed.

Operation No. 6 of my article on the subject, in last week's NATURE (p. 274), must be performed as often as is found necessary. Every one of the stopcocks must be kept closed except when it is open for operation or observation.

The metal tube connecting the upper necks of the two bottles must be long enough, or of fine enough bore, to prevent diffusion of vapour to any sensible extent from either bottle to the other during the time of an observation. It ought to be kept at a temperature somewhat higher than that of the bottles, to prevent any liquid from condensing as dew on its inner surface. KELVIN.

Glasgow, January 23.

THE GRAVITATION CONSTANT AND THE MEAN DENSITY OF THE EARTH.

IN the year 1884, Prof. Dr. Franz Richarz and Dr. Otto Krigar-Menzel commenced a series of experiments having for their object an accurate determination of the values for the constant of gravitation and the earth's mean density. The work divided itself naturally into two parts, and the results of the first series of weighings were communicated to the Berlin Academy of Sciences in March 1893. Since that time the second series has been concluded, and the main results of the whole investigation are summed up briefly in the same society's *Sitzungsberichte* for November 1896, the authors leaving the publication of the full account, containing the details of the measurements, for a future period.

The instrument with which the measurements were made was a kind of double-balance having two pans on each side of the beam, one above the other, connected in the vertical direction by a thin rod 226 centimetres long. The point of this arrangement was that the acceleration due to gravity on the two lower pans was greater than that on the upper one, in consequence of the difference of level. The first day's weighing consisted in determining the difference in weight of two practically equal spheres, one being placed in the upper pan on one side of the arm of the balance, and the other in the lower pan on the opposite side. Gauss' system of double weighing was employed throughout, the masses being changed from one side to the other. The measured difference was therefore due to two sources—to the inequality of the masses weighed, and to the difference of the force of gravity. The procedure for the second day was to change the positions of the masses being weighed; this consisted in placing the sphere that was in the upper pan in the lower one on the same side of the arm, and in putting that on the other side of the beam in the upper pan: a second series of weighings was then made. Such a series of measurements as these was included in the work recorded in the first publication. It was found that the measured difference was not the same on the two days, for although the difference in weight of the masses always remained the same, the difference in the value of gravity, due to the virtual displacement of the masses, altered its sign. By subtracting these differences for each day's work, the mass-difference was entirely eliminated, and there only remained that between the two values of gravity due to the two heights of the scale-pan.

In the second part of the work, for obtaining the mean density of the earth, a large cubic block of lead, having a mass of 100,000 kilograms, was used. This was supported firmly on massive pillars under the upper and above the lower scale-pans, the connecting-rods of the latter passing through holes in the block. The presence of this great attracting mass had the effect of apparently increasing and decreasing the value of gravity acting on the spheres in the pans according to their position—that is, according as they were in an upper or a lower pan. In the system of arrangement adopted—namely, that of placing the spheres in an upper and lower pan on opposite sides of the fulcrum—the acceleration of gravity in the upward direction was lessened by double the amount of the attraction of this great mass of lead. By connecting to two days' weighings, instead of double the diminution of the value of gravity with the height, the result was lessened by four times the attraction of the block of lead. A combination of the results obtained, both with and without the leaden cube, gave the fourfold attraction of the leaden cube free from the variations of gravity.

Very elaborate precautions were taken to eliminate effects of air currents, changes of temperature, &c., and these seem to have been fairly overcome both practically and theoretically. It is also needless to state that the number of weighings made was very considerable.

The value thus finally deduced for the constant of gravitation was

$$G = (6{\cdot}685 \pm 0{\cdot}011)10^{-8}\ \frac{\text{cm.}^3}{\text{gr. sec.}^2}$$

Using this value, the mean density of the earth obtained was as follows:—

$$\Delta = (5{\cdot}505 \pm 0{\cdot}009)\ \frac{\text{gr.}}{\text{cm.}^3}$$

This value, as will be seen from a perusal of the following table, falls between those found by Poynting and Boys:—

Observer.	Method.	Mean density of earth.
Cavendish	Torsion balance ...	5·45
Reich	,,	5·49 and 5·58
Baily	,,	5·67
Cornu and Baille ...	,,	5·56 and 5·50
Ph. von Jolly	Long-arm balance ...	5·692
J. Wilsing	Pendulum apparatus	5·594
The same with elimination of known sources of error	,,	5·577
J. H. Poynting	Balance	5·4934
C. V. Boys	Improved torsion balance ...	5·5270
Richarz and Krigar-Menzel	Double balance ...	5·505

TUBES FOR THE PRODUCTION OF RÖNTGEN RAYS.

MANY and various are the forms of the bulbs and tubes employed for the production of Röntgen rays, as may be seen from the designs that are represented in the accompanying illustration from *La Nature*. Different experimenters favour different tubes, and believe that the forms they use possess advantages over all others. Up to the present, however, it may be said that three processes are utilised in the production of Röntgen rays. There is (1) the old form of Crookes' tube, in which the kathode rays impinge directly upon the glass or screen in front of the kathode; (2) the form of tube in which the kathode rays fall upon, and are reflected by the anode; and (3) the tubes in which both direct and reflected rays are utilised. In the accompanying illustration, the first

method is exemplified by Nos. 1, 2, 3, 4, 6, 7, 10, 11, 12, 13, 14, 17, 18, 20, 21, 24, 26, 28, 32 ; the second system, by the adoption of which instantaneous Röntgen photography became possible, is adopted in the tubes numbered 5, 8, 9, 15, 16, 23, 25, 27, 29, 30 ; and the third principle is illustrated by Nos. 19, 22, 31. The Crookes' tube, represented by No. 1, is very well known, and is still used for Röntgen photography on the continent. No. 2 represents a form of tube used when the movement of the kathode stream by a magnet is desired, so that the rays can be made to impinge upon different parts of the glass. In No. 3, the concave kathode is brought very near to the glass, so that its focus is really outside. No. 4 shows a tube with a kathode which can be revolved in a plane at right angles to its own face. No. 5 has two kathodes, and the rays from them are reflected from a platinum anode. In No. 6 the anode is formed of an aluminium disc, which is traversed by the kathode rays ; but the advantages of this form are not very clear. Two kathode streams are utilised in No. 7. The form of tube which workers in this country find gives the best results, is represented in No. 8, and is known as the "focus" tube, or tube of Jackson pattern. In this the kathode rays fall upon, and are reflected by, a platinum mirror which forms the anode. No. 9 has two anodes, one of them a hollow platinum cone which reflects the kathode rays. The tube shown in No. 10 is especially suitable for use with currents of high frequency ; it is uni-polar, and has an external anode. No. 11 has pointed poles, either of which may be the kathode. The tube No. 12 has a platinum kathode, covered on its convex side by a glass insulator so as to reduce the loss of radiation. No. 13 is found to give good effects on fluorescent screens. No. 14 is for use with currents of high frequency, and has only one pole in the tube. No. 15 is a useful form of tube, one of its advantages being that two photographs can be taken at the same time by the reflection of the rays from the kathode on either side. In the tube represented by No. 16, a circular disc forms the kathode, and at its centre is set a hollow cone of platinum as an anode. No. 17 represents a form of tube for the investigation of the action of kathode rays upon a substance. The end of the cylinder is made so that substances can be introduced into the tube. Another kathodic cylinder is shown in No. 18 ; the kathode is situated at the place usually occupied by the anode, the latter pole being at the top. No. 19 combines the actions of both the direct and reflected rays. The kathode passes through a concave anode of platinum, and all the rays emitted by it are utilised either directly or after reflection. A cylinder employed at the commencement of work with kathode rays is shown in No. 20 ; a good point about it is that the poles are some distance apart, so there is little fear of sparking outside the tube. A cylinder with an interchangeable window opposite the kathode is represented in No. 21. A tube with two anodes (No. 22) is designed on the principle of the reflection of the kathode rays, the kathode being placed centrally inside a reflecting anode. Another bi-anodic form is the large bulb shown in No. 23. The next figure (No. 24) has slips of aluminium as poles, and either of them may form the kathode. No. 25 is constructed so that the platinum cone which forms the anode, reflects the rays from four kathodes placed around a circumference, and kept in action by as many coils. A tube, useful for showing the place of origin of active rays, is shown in No. 26. The next (No. 27) has two anodes and two kathodes ; the two kathode streams are reflected from the anodes, and, meeting one another, are given additional power. No. 28 resembles No. 10, but it has the defect that it rapidly becomes heated. In No. 29 the kathode is formed of an annular aluminium plate, the rays from which strike upon the central platinum cone and are concentrated to a point by reflection. No. 30 is designed to show the effect of the reflection of kathode rays in a space as small as possible. The tube has an electrode of palladium. The tube No. 31 is very good for use with fluorescent screens, the kathode rays being reflected from a large anodic surface, with the result that the phosphorescent area of the glass is exceptionally great. The tube shown in No. 32 represents the first form used by Prof. Röntgen.

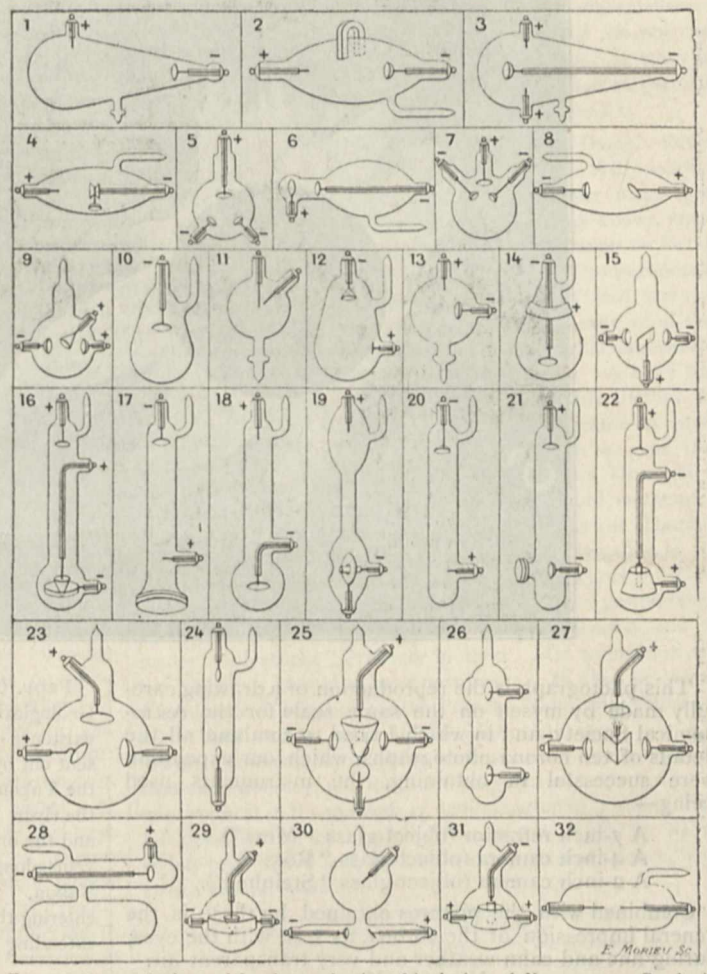
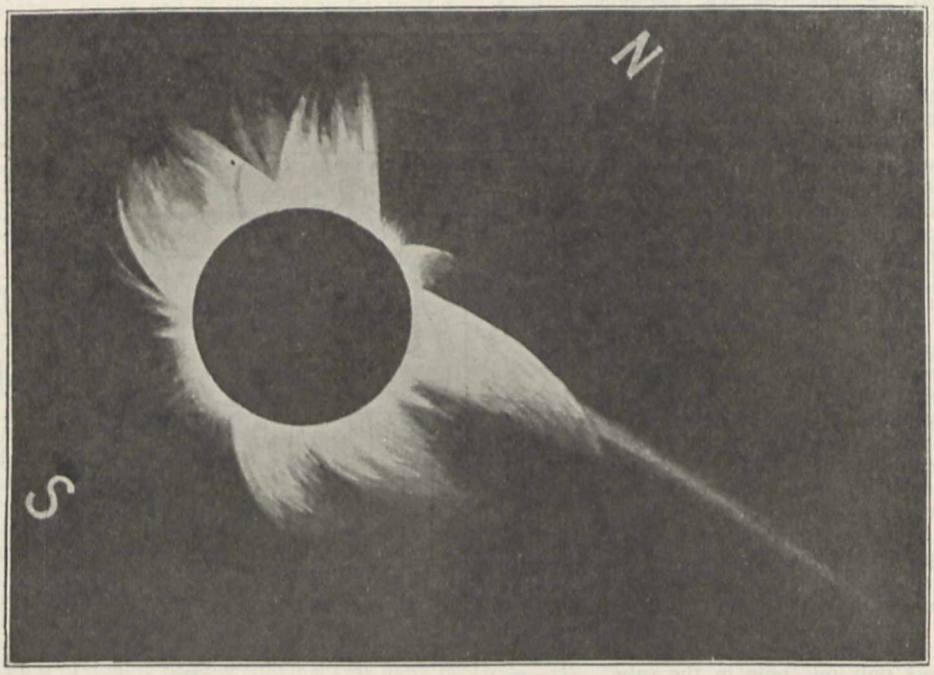


FIG. 1.—Forms of tube used for the production of kathode and X-rays. 1, 2, Crookes' tube ; 3, Séguy tube ; 4, Wood tube ; 5, Séguy tube ; 6, Chabaud and Hurmuzescu tube ; 7, Séguy tube ; 8, "Focus" tube ; 9, Séguy tube ; 10, d'Arsonval tube ; 11, Séguy tube ; 12, Puluj tube ; 13, Séguy tube ; 14, d'Arsonval tube ; 15, Le Roux tube ; 16, 17, 18, Séguy tubes ; 19, Rufz tube ; 20, Crookes' tube ; 21, 22, 23, Séguy tubes ; 24, Röntgen tube ; 25, Brunet-Séguy tube ; 26, 27, Le Roux tubes ; 28, Colardeau tube ; 29, Séguy tube ; 30, Colardeau tube ; 31, Séguy tube ; 32, Röntgen tube.

RUSSIAN OBSERVATIONS OF THE CORONA OF AUGUST 9, 1896.

I HAVE for many years been a reader of your honourable and interesting journal of science, NATURE. I beg you to accept for it the accompanying picture of the solar corona, as I had the opportunity to see it on August 9, 1896, in Sii-Kavuopio (on the Upper Muanio, in Lappania), where I went last summer as a member of the Lappanian Solar Eclipse Expedition of the Russian Astronomical Society.



This photograph is the reproduction of a drawing carefully made by myself on the same scale for the Astronomical Society, and in which I tried to combine all the details of ten corona-photographs, which our expedition were successful in obtaining, the instruments used being—

A 7-inch refractor (object-glass "Merz").
A 4-inch camera (object-glass "Ross").
A 2-inch camera (object-glass "Steinheil").

Combined with the pictures obtained by these is the general impression of the corona, as seen with the eyes, during fine and calm weather and very transparent air.

NICOLAS KAULBARS,
Lieutenant-General, and Chief of Staff of the Finland Military District.

NOTES.

AT the last meeting of the Chemical Society it was announced that Mr. J. J. Tustin had made a donation of one thousand guineas to the Research Fund of the Society.

M. FILHOL has been elected a member of the Section of Anatomy and Zoology of the Paris Academy of Sciences, in succession to the late M. Sappey.

THE Paris Academy of Sciences has been invited to send representatives to the International Congress of Naval Engineers and Architects, to be held in London next July. Efforts are being made to ensure that the forthcoming meeting in London shall be as brilliant and generous in hospitality as the last one held in Paris.

THE German Emperor is always ready to recognise deserving work in science. He has just conferred the Order of the Crown on Dr. Hauchecorne, the Director of the Prussian Geological Survey and of the Berlin School of Mines, and the Order of the Red Eagle on Dr. Hampe, the eminent Professor of Chemistry at the Clausthal School of Mines, and on Dr. Loretz, of the Prussian Geological Survey.

PROF. CHARLES D. WALCOTT, Director of the United States Geological Survey, reports to the Secretary of the Interior the existence of an enormous gold belt in Alaska. An expedition sent out by the Survey in May last, investigated the valley of the Yukon River, from the British boundary to the mouth of the river. All the well-known placer deposits were examined, and the origin of the gold in them was found to be the quartz veins along the head-waters of the various streams entering the Yukon. The length of the gold belt in Alaska is 300 miles, entering that territory near the mouth of Forty-Mile Creek, and extending westward along the Yukon valley at the Ramparts.

M. FAYE, whose contributions to astronomy and meteorology are of world-wide renown, was elected a Member of the Paris Academy of Sciences in January, 1847. In honour of his jubilee, at the meeting of the Academy on Monday, M. Chatin, the new President, delivered an eloquent tribute to a life devoted to the advancement of science, and enumerated his most notable achievements. At the close he presented M. Faye with a gold medal representing the astronomer's effigy surrounded by an inscription affirming the pride of his colleagues in his friendship, and their admiration for his work. We learn from the *Times* that at a dinner at the Grand Hotel on Monday evening, presided over by M. Jannsen, M. Faye received from General Billot, Minister of War, the insignia of the Grand Cross of the Legion of Honour, bestowed upon him by special decree of the President of the Republic. M. Rambaud, Minister of Education, was also present, and among those who spoke were M. Loewy, Director of the Paris Observatory, and General Toulza, of the École

Polytechnique. M. Faye's numerous friends and pupils at this school offered him a group in bronze. M. Faye was the favourite pupil of Arago, and is now eighty-three years of age.

IN connection with the International Committee of Aeronautics, the second ascent of sounding balloons will take place on Monday next, February 1, at 11 a.m., local time, at each station participating in the work. The balloons are fitted with instruments for registering temperature and altitude, and have an ascending force more than five times greater than that due to the total weight. Any one who should happen to witness the descent of one of the balloons should carefully look after the records, and send them to the office of the *Aerophile*, 14 rue des grands Carrières, Paris.

IT will be of interest to botanists and zoologists throughout the world, to learn that a biological survey of Alabama has been organised and put into operation. The survey will be carried on under the auspices of the Alabama Polytechnic Institute, and will be manned by the specialists engaged at that institution in the various lines of biological investigation. It will have for its object the study, in field and laboratory, of all plants and animals occurring in the State, and of the various conditions affecting them. The work will be done systematically and thoroughly, and all the results published. In a region so interesting and little worked as this portion of the Southern United States, careful and extended research will be sure to yield results of the greatest value. Large quantities of material in all groups of plants, and of animals (especially insects) will be collected and properly prepared. In connection with the survey there has been founded an Exchange Bureau, from which will be distributed all duplicate material. Any one desiring to correspond relative to specimens, literature, or the work of the survey, should address, "Alabama Biological Survey, Auburn, Alabama."

AT the General Horticultural Exhibition to be held in Hamburg from May to September in the present year, there will be a scientific department, managed by a committee, of which Dr. Zacharias and Dr. Klebahn are members. Exhibitions are invited and prizes offered in the following special subjects: (1) Diseases of cultivated plants produced by mechanical causes, or by conditions of atmosphere or soil; (2) animal and vegetable enemies of horticulture and fruit-growing; (3) animal and vegetable friends of horticulture; (4) abnormalities and sports; (5) comparative experiments on manures; (6) wild ancestral forms of cultivated plants; (7) living exotic useful plants in pots; (8) collections of the most important exotic useful plants (dried specimens), or of preparations from them; (9) collections of plants, or parts of plants, from morphological or biological points of view; (10) results of scientific experiments on pollination; (11) scientific aid to horticulture—implements, tables, models, &c. Information of intended exhibits should be sent to the Director of the Botanic Garden, Hamburg, before March 1.

MM. CORNU has been elected President of the Botanical Society of France for the current year.

THE Annual Meeting of the German Botanical Association will be held this year in Frankfurt-a-Main, commencing on September 22.

A BOTANICAL MUSEUM has been established at Weimar, at the sole cost of Prof. Haussknecht. It is designed to be "a Central Institution for investigations in systematic botany," and will be under the control of the Thuringian Botanical Union.

A VIOLENT earthquake is reported to have occurred in the district of Delvino, in Epirus. Several villages are stated to have been destroyed, and it is feared that there has been serious loss of life.

THE death is announced of Mr. T. Gwyn Elger, well known by his numerous contributions to selenography, both in the form of drawings and notes of the principal features of the lunar surface. Mr. Elger became a Fellow of the Royal Astronomical Society in 1871, and was in his sixtieth year at the time of his death.

WE notice with regret the announcement of the death of Dr. Edward Ballard, author of many papers and works on medical and scientific subjects. Dr. Ballard was elected a Fellow of the Royal Society in 1889. He was eminently distinguished as an investigator of causes of disease, and as a promoter of scientific sanitary administration. Among numerous other works, he published a valuable paper "On the influence of weather and season on public health, based on the statistical study of 272,000 cases of sickness (1857–68)." He was also the author of many important reports to the Local Government Board on particular outbreaks of disease, local, or more or less general.

TOWARDS the end of last year, George Daniel Eduard Weyer, the Professor of Mathematics and Astronomy at the Kiel University, passed away. Prof. Weyer was a great favourite among the students, and was as well known among the officers of the Merchant Service of Germany as he was among those of the Royal Navy. On account of his astronomical calling, he was familiarly known as "alte Seni," and every one loved him—from Admiral to Lieutenant—for nearly all of them had been his pupils at some time or other, and this was how they expressed their familiarity for their old teacher. A brief summary of the positions Prof. Weyer held during his lifetime will serve, perhaps, to show how he eventually became so closely connected with the Navy. Born at Hamburg in the year 1818, he spent four years (1839-43) at the Hamburg Observatory. For the next two years he studied astronomy and mathematics in Berlin. From 1847–50 he was assistant at the Hamburg Observatory, and teacher at the School of Navigation in connection with the observatory. When the School for Naval Cadets was established in Kiel, Weyer accepted a position there. In 1852 he was a "Privatdocent" at the University, and was made "Ordentliche" Professor in 1860. His connection with the Navy may be said to have now begun. In 1864 he was the Examiner in Navigation for the Prussian Navy, and lectured for more than twenty years at the Marine-Akademie in Kiel. Weyer was the author of many works, most of which related to nautical astronomy, and his aim throughout was directed to the improvement of the methods of determination of position at sea. His death will be felt by all his friends and pupils, for he was widely known, and last, but not least, by nautical science, which loses a faithful student.

> "Mein Sohn, nichts in der Welt ist unbedeutend,
> Das erste aber und Hauptsächlichste
> Beim allem ird'schen Ding ist Ort und Stunde."
> (Seni in *Wallenstein's Tod*, I. Part.)

FOR the last month (says the *Times*) the Colonial Office, the Natal and Cape Governments, and the Board of Agriculture have been in communication as to the best means of preventing the cattle plague in South Africa from spreading into either Natal or the Cape Colony. Various inquiries have been made as to what steps should be taken, and on Thursday last, at the Board of Agriculture, a special conference of heads of departments concerned was held to consult together on the subject. The chief officials concerned of the Board of Agriculture and the Colonial Office met the Agents-General of Natal and the Cape Colony and other Cape authorities. Further meetings will be held on the subject, and it is contemplated that the Government will sanction every effort to save the colonies of Natal and the Cape from rinderpest.

SINCE the plague was officially recognised in the Bombay mortality returns on September 26, and despite the decrease in

the population, 9835 deaths have occurred in excess of the average for the last five years. These are attributed by the *Times of India* to the plague. Continental Governments are showing great activity in regard to precautionary measures. The Austrian Academy of Science has decided to despatch three medical men to Bombay to study the circumstances connected with the prevailing epidemic. A special sanitary mission, sent by the Medical Board and accompanied by the French delegate, has left Suez for the quarantine stations on the coast of the Sinai Peninsula, in order to determine what measures are necessary to assure the immunity of Egypt from contagion. The *Times* correspondent at St. Petersburg states that the Russian newspapers continue to complain of the British Government for delaying to take measures against the spread of the plague. To secure the safety of Russia's Asiatic possessions, the Minister of the Interior has issued instructions for the opening of fourteen stations of medical observation along the land frontiers of Persia, Afghanistan, and Chinese Kashgar. A special commission has been appointed by the Tsar to take measures for the prevention of the importation of the plague into Russia. Practically all the European Governments have appointed representatives for the Sanitary Conference to be held at Venice on February 10.

THE weather has continued very wintry during the past week, sharp frost occurring at night over the entire kingdom, and snow has fallen on most days over a large part of the country. A heavy north-easterly gale occurred on Friday and Saturday, the storm, coupled with the high sea which was running, doing much damage on our east coasts. The gale was accompanied by a heavy fall of snow, deep drifts being formed in the midland, southern, and eastern districts of England, and occasioning much inconvenience and delay to the ordinary traffic. In places trains were blocked, and some few deaths have occurred owing to the severity of the weather. There was a temporary give in the frost on Monday, owing to the arrival over the northern part of our islands of a cyclonic storm area from the Atlantic. There was a renewal of the gales on our coasts, and snow fell again in many places. In London a heavy snow squall occurred at about five o'clock on Monday afternoon, and was accompanied by thunder and lightning. The frost was very sharp again on Tuesday and Wednesday, but the changes of temperature continue very fitful.

THE worked flints obtained by Mr. W. J. Lewis Abbott from the Cromer Forest-Bed are described by him in the February number of *Natural Science*. For the benefit of those not familiar with the geology of the Cromer district, it is pointed out that the valley to the west of Cromer, towards Sherringham, is still cloaked with a palæolithic gravel, below which come the fantastically-twisted and folded glacial beds, termed the contorted drift, and under this occurs the Forest Bed series. This series is, however, not a Forest-Bed at all, but was deposited in the estuary of a river. The flints obtained by Mr. Abbott have every appearance of having been fashioned by man. The conclusion arrived at is: "Bearing past history in mind, and the reception which has been accorded to these specimens, the unquestionable evidences they offer of being artificially worked, the unmistakable positions from which they were obtained, and the conditions under which some of them were found in the matrix, are we not justified in admitting the existence of man in Britain in the Forest Bed period?"

MR. J. LL. WILLIAMS has a very curious note in the number of the *Journal of Botany* for January, on the drunken habits of certain humble-bees. The intoxicant is the honey produced by the crowded flowers of the capitulate heads of certain Compositæ (*Carduus nutans* and *lanceolatus*, and *Centaurea scabiosa*), and Dipsacaceæ (*Scabiosa Succisa*). The intoxication is indicated by rolling on the back, striking the legs wildly in the air, and general helplessness. The bees rapidly recovered from the effects, and, in most cases, were eager to repeat the debauch; but one individual, which had been shut up in a vasculum with copious supplies of *Centaurea Scabiosa*, manifested, the next morning, a praiseworthy remorse and disgust, "raising its head and fore-legs as high as it could above the plants, then precipitately hurrying away as soon as released." The most dissolute species appears to be the neuter of *Bombus lapidarius*. The author suggests that this may in time become a normal mode of cross-pollinating the flowers in queston.

SOME interesting experiments by Prof. Felix Plateau, of Ghent (*Bulletin de l'Académie Royale de Belgique*), tend to disprove the view, so often advanced, that the brightly coloured petals of flowers are necessary to attract insects. The method of observation adopted—viz. by removing the corolla and watching whether insects continue to visit the flower—had previously led to contradictory results in the hands of different observers, including Charles Darwin. These discrepancies the author attributes to want of care in removing the petals; care must, indeed, be taken to avoid handling the flowers, or doing anything which might influence an insect's sense of smell. Prof. Plateau removed the brightly coloured corollas from the flowers of *Lobelia Erinus*, *Œnothera biennis*, *Ipomœa purpurea*, *Delphinium Ajacis*, *Digitalis purpurea*, and *Antirrhinum majus*, and the blue barren florets from the capitulum of *Centaurea cyanus*. In every case, except that of *Antirrhinum majus*, the mutilated flowers were observed to be freely visited by various kinds of insects (bees, bumble-bees, flies of the *Syrphidæ* family, and an occasional butterfly), no special preference being exhibited for flowers that were left intact. The insects not only sucked honey from the mutilated flowers, but they often circled round them without alighting. In the case of the snapdragon, several bumble-bees hovered round the mutilated heads, but subsequently left them for those with entire flowers, a result explained by the peculiar mode in which bees have to enter the corolla, which would render the absence of that organ perplexing to them. Finally, Prof. Plateau covered several of the large umbels of *Heracleum Fischerii* with rhubarb leaves, and it was found that even when thus masked they were freely visited by insects. These results suggest that insects are guided to flowers largely by their sense of smell.

IN the same publication, M. Victor Willem describes experiments showing that the variations observed by Semper and Varigny, in the development of fresh-water mollusca (*Limnæa*, *Planorbis*), are attributable to the greater or lesser aëration of the water in which they grow, those specimens which are reared with free access of air developing to the largest size.

PROF. D. MAZZOTTO has completed a determination of the index of refraction of water for electric waves of length varying from two metres down to twenty-five centimetres. The experiments, which are described in the *Atti dei Lincei*, show that between these limits the index is constant and equal to 9·00 at 19°, thus agreeing well with the theoretical value (8·85) obtained by taking the square root of the dielectric constant.

IN a part of the *Proceedings* of the Biological Society of Washington, just issued, Dr. C. H. Merriam describes a very remarkable small, short-eared, tailless rabbit, which has recently been discovered on Mount Popocatepetl, in Mexico, at the height of about 10,000 feet. This singular animal, which, instead of moving by leaps, like an ordinary rabbit, runs about on all-fours, in the grass of the mountain, has been named by Dr. Merriam *Romerolagus Nelsoni*. The clavicles in this new form are complete, and not imperfect as is usual in the family *Leporidæ*.

THE mammals collected by Dr. Donaldson Smith, during his recent expedition to Lake Rudolf, have just been described at Philadelphia by Mr. S. N. Rhoads. The collection contained representatives of fifty genera and seventy-seven species, seven of which are now characterised as new. These are mostly rodents. Perhaps the most noticeable discovery is that of a second species of the very peculiar African genus *Lophiomys*, which Mr. Rhoads proposes to call *Lophiomys Smithi*. Dr. Donaldson Smith also obtained a specimen of the curious hairless mole-rat, *Heterocephalus glaber*, of which only two examples had been previously captured.

MR. FREDERIC W. TRUE, the Curator of the Department of Mammals in the U.S. National Museum, has just completed and published an excellent review of the Moles of North America, based principally on the large series of specimens of these insectivorus mammals under his charge. He recognises two sub-families of Moles as occurring in the Nearctic Region, *Talpinæ*, with four genera, and *Mygalinæ*, with one genus. Special attention is paid to the distribution of these animals in America, which presents several interesting features. Two of the five genera of Moles are strictly confined to the Pacific Coast, while the three remaining genera are only met with east of the Rocky Mountains. The most remarkable form, perhaps, of the American Moles is the so-called Star-nosed Mole (*Condylura cristata*), which carries an enlarged fleshy disc at the extremity of its snout, obviously for use as a highly developed tactile organ.

THE insects which affect the cotton plant in the United States are described by Mr. L. O. Howard in *Bulletin* No. 33, published by the U. S. Department of Agriculture. The cultivation of cotton in the United States has gone through a curious change with regard to the depredations of insects. Not very long ago, the average annual loss to the cotton-growers from the work of a single species of insect amounted to 15,000,000 dols. This insect was the so-called cotton caterpillar, or cotton-leaf worm (the larva of *Aletia argillacea*, Hübn.). Down to the year 1881 the damage done by this insect so far exceeded that inflicted by any other species that other forms had received but little consideration. Since about 1880, however, the cotton-worm has ceased to be a serious enemy to cotton. It is undoubtedly much less abundant and destructive than it was fifteen years ago, and no longer holds the first position among the insect enemies of the cotton crop. The so-called bollworm (the larva of *Heliothis armiger*, Hübn.), which a few years ago did much lesss damage than the cotton-leaf worm, now ranks as the most prominent enemy. It is curious to note this decline of one harmful insect and rise of another. Students of biology will remember many similar instances.

THE uncertainty which still exists as to the ultimate causes of volcanic outbursts is illustrated by two papers which appear, at no great distance apart, in the *Proceedings* of the Boston Society of Natural History for 1896. The author of each paper starts out with the consideration of certain phenomena occurring on a small scale, and eventually applies his conclusions to the problem of the distribution of volcanoes; but both start and conclusion are widely separate in the two cases. Mr. N. S. Shaler begins with the escape of gases from a viscous liquid, and noting how, once a path is opened up, a regular procession of bubbles follows along it, applies this first to explain the vertical jets of water and gas that issued from the ground at the Charleston earthquake, and then to the repetition of volcanic eruptions at the same locality. He suggests that it is the water included in deposited sediments which becomes the explosive steam of a volcanic outburst, and regards rapidity of sedimentation and the conductivity of the earth's crust as correlated factors in the establishment of volcanic action in any region of the earth's surface. Mr. J. B. Woodworth, on the other hand, deals with the details of fracture under strain, and his paper is illustrated with some very beautiful photo-reproductions of the fracture-surfaces of fine-grained homogeneous rocks. He compares the distribution of volcanos (particularly in the Sandwich Islands and western coast of the Pacific) with the distribution of fracture-lines at the margin of a joint surface. Whether this comparison be justified by further study or not, the paper is a most valuable addition to the literature of fracture-structures.

AN interesting note on the Australian Snow Country has been received from Mr. John Plummer, of Sydney. A railway journey of only thirteen hours separates Sydney from the threshold of a region of ice and snow, where, even during the hottest days of the Australian summer, fires and blankets are necessary, while residents on the interior plains are suffering from the sweltering heat. Mount Kosciusko, the highest peak in Australia, being 7171 feet above sea-level, is in that cool region. It forms part of the Muniong Range, the northernmost portion of the Australian Alps, which extend across the upper waters of the Murray into Victoria, the whole of the surrounding country being more or less mountainous. The hills of the Muniong Range are popularly known as the Snowy Mountains, portions of their summits being above the line of perpetual snow. There is no Alpine climbing to be done in scaling Mount Kosciusko. The ascent begins in reality twenty-five miles away from the summit, and the slope is so gradual that it may be performed without fatigue by any one in ordinary health. Highest Australian mountain though it is, the visitor can drive to the top of it. There are no trees within some miles of the mountain top; but gigantic mosses grow there, and beautiful wild flowers. Loveliest of all, perhaps, are the mountain snowdrop and the elychrisan, or everlasting flower, which in this district has a black centre instead of the more common yellow one. Another interesting feature of the locality is the number of small lakes formed by the melting of the snow in basins between the hills. The highest of these lakes—it is the highest sheet of water in Australia—is situated about 300 feet from the summit of Mount Kosciusko.

ALTHOUGH milk has so frequently been held responsible for the dissemination of diphtheria, yet curiously but few exact investigations have been made on the behaviour of diphtheria bacilli in milk. Hesse found that cholera bacilli underwent deterioration in raw milk; that, in fact, when kept in these surroundings at a temperature of 37° C., they were entirely destroyed within 22 hours. Caro of Naples, on the other hand, working with anthrax bacilli in raw milk, states that these microbes flourish abundantly in milk, and abate no jot of their virulence under these conditions. Prof. Schottelius has repeated these experiments, and has entirely confirmed them; he has, however, extended his investigations to the behaviour of diphtheria bacilli in milk. In a recent number of the *Centralblatt für Bakteriologie*, Part i., a summarised account is given of these researches, and it appears that in fresh milk diphtheria bacilli find an exceptionally satisfactory material for growth and multiplication. In sterilised milk, however, their growth was not so abundant, and was less strongly marked than in the ordinary broth used for cultivation purposes. As the milk was only sterilised for half an hour by means of the ordinary Soxhlet apparatus, this difference in the vitality of the diphtheria bacilli in the raw and heated milk, respectively, could not have been due to the milk having become acid through heating. Hesse has shown that when milk is subjected to prolonged sterilisation at a high temperature it exhibits an acid reaction. Prof. Schottelius concludes his paper with a warning, now so often

repeated, of the danger attending the consumption of milk in its raw unsterilised condition.

THE origin and evolution of human marriage is a subject that appeals to many minds, and much has been written upon it by more or less competent students. In *The American Anthropologist* for November 1896, W. J. McGee deals with some marriage observances of a few American aboriginal tribes. He traces an instructive sequence, beginning with the Seri Indians, who are probably the most primitive people in North America, and about whom very little has previously been published. Amongst these peoples the man is a suitor, not so much from personal inclination as from tribal incentive; individual caprice is subordinated to the welfare of the community, and the matter is regulated by his female relatives and the maiden's mother and maternal uncles. Theoretically they are monogamous; marriage takes place only between members of different clans, but invariably within the tribe, infringement of the latter law being their greatest vice. The organisation of the Zuñi remains essentially maternal, the chief modification being the relaxation of the fierce tribal endogamy. The would-be bride is the chief suitor, as among the Tarahumari Indians of northern Mexico, where, according to Lumholtz, the maiden is a persistent wooer. Essentially the same stage is represented by the Seneca Indians, a more warlike tribe than the two last. The characteristic features of these and other American tribes organised on the basis of mother-descent, are monogamy, clan exogamy, tribal endogamy, the absence of bride purchase, and rudimentary personal inclination. Among the Indians of British Columbia, as described by Boas, mother-descent is merged with or passed into paternal organisation. A temporary exchange of property on the part of the groom, who is the suitor, occurs among the Kwakiutl, and the laws of monogamy, clan exogamy and tribal endogamy are materially relaxed. This tendency is increased among the Omaha and neighbouring Siouan Indians; individual inclination becomes dominant, and wife-purchase obtains, with a concomitant degradation of woman; finally, the monogamic principle is almost wholly lost. In all the higher forms there are various vestiges of antecedent customs, so that every stage can be traced in observance and decadence.

IT is pointed out in the *Bulletin of Miscellaneous Information* of the Royal Botanic Gardens, Trinidad, that the rainfall for that island is slowly but surely decreasing. The average rainfall for the decade 1862–71 was 66·715 inches; for the next decade (1872–81) it was 65·993, and for the third decade (1882–91) it was 65·037. The decrease indicated by the first and third values is 1·678 inches, or 2·51 per cent. during the thirty years from 1862 to 1891. Presuming that the same rate of decrease runs on for the next sixty years, Trinidad will then suffer from a rainfall diminished by about 8 inches. Mr. Hart points out that a rainfall decreasing at such a rate is alarming; and, if the inference is carried on, it follows that within a measurable distance of time Trinidad must become an arid desert as barren as the Great Sahara. The cause of the decrease is said to be the disappearance of the forests.

WE have received from Mr. A. L. Rotch an interesting pamphlet, reprinted from *Appalachia*, vol. viii., and entitled "The Exploration of the Air," containing a brief account of all the leading experiments, either in balloons, on mountains, or by means of kites, made for the purpose of solving such problems as decrease of temperature and humidity with elevation, the heights to which areas of high and low barometric pressure extend, and the circulation of the atmosphere at various heights; also containing good photographic views of some of the prominent observatories, and a diagram of comparative altitudes attained. The highest meteorological station in the world is that at El Misti, in Peru (19,200 feet), which was established by the Harvard College Observatory. It is impossible for observers to remain at this station, so it is provided with automatic instruments, which require only occasional attention. Among the other most notable mountain stations are Rocher des Bosses on the Alps (14,320 feet), and Sonnblick (10,170 feet). The only way in which the temperature and humidity of the highest regions can be obtained is by means of unmanned balloons, which have reached altitudes of over ten miles. Recent experiments by these balloons have given temperatures of 90° below zero of the Fahrenheit scale. Recent improvements in kites have allowed observations to be recorded at a height of nearly 4000 feet, and have revealed many interesting facts. It seems not improbable that this simple method of "sounding" the atmosphere will in the future be used, in connection with observations made at the earth's surface, in forming synoptic charts for forecasting weather.

THE *Oesterreichische Botanische Zeitschrift* for November 1896, gives some interesting particulars of Herr Sintenis's botanical expedition in Greece.

The second annual general report upon the mineral industry of the United Kingdom, for the year 1895, by Prof. C. Le Neve Foster, F.R.S., is published as a Blue Book. The report is a unique collection of statistics upon the minerals raised in Great Britain and Ireland, and the persons employed in mines.

AT the annual general meeting of the Geologists' Association, to be held on Friday, February 5, at University College, the President, Mr. E. T. Newton, F.R.S., will deliver an address on "The Evidence for the presence of Man in the Tertiary Period."

A NUMBER of good reproductions of photographs of lightning, and of effects produced by the discharge, accompany an article, by Mr. Jeremy Broome, in the February number of the *Strand Magazine*. In the *English Illustrated Magazine*, Mr. W. A. Horn gives a good general account of the results of the scientific expedition to Central Australia, the cost of which was generously defrayed by him. Some of the illustrations from the report on the geology and botany of the region traversed (see NATURE, p. 185) accompany the article.

THE third part of Mr. Sydney Rowland's "Archives of Clinical Skiagraphy" (the Rebman Publishing Company) has just appeared. It will be remembered that the publication consists of a series of collotype illustrations with descriptive text, representing applications of Röntgen photography to medicine and surgery. The new part contains Röntgen photographs of fracture of the olecranon treated by suturing with wire, fracture of lower end of humerus, with separation of the external condyle, a case of hip-joint disease, supernumerary toes, a double human monstrosity, united fracture of both bones of the forearm before and after union by wiring, and the cardiac area.

MR. W. L. DISTANT makes his bow in the January number of the *Zoologist*, and delivers his prologue as editor of the series commenced under his guidance. He inaugurates the new era in the life of our contemporary by announcing that the official reports of Natural History Societies will be discontinued. Prehistoric man, his past history, physical peculiarities, and connection with the old British fauna, is to be given his place in the pages; and, to show that our remote ancestors really ought not to be disregarded by zoologists, Mr. E. W. Brabrook contributes to the present number an article on "Man in Zoology." No longer is man to be considered as outside the domain of zoology. "Evolution," remarks Mr. Distant, "is now the established corner-stone of the zoological edifice," and upon it the new series is apparently to be built. Facts

are, however, as necessary as philosophy; therefore full space will be given to recording them, the only conditions being that they are original. These are admirable designs, and if future numbers of the new series carry them out as well as the opening one, a full measure of success will be the reward.

THE Smithsonian Report for 1894 has just been received. As is now well known, and it cannot be too widely known, the Report of the Smithsonian Institution not only exhibits the financial affairs, operations, and conditions of the Institution, but also comprises a selection of miscellaneous memoirs of interest to every one engaged in the promotion of knowledge. This appendix in the present Report runs into more than 600 pages, and is made up of reprints of thirty-seven papers, written by leaders in many branches of science. All these papers deal with important scientific work or problems, and they possess the additional advantage of being written in language easy of comprehension. Seventy plates illustrate the papers, and there are numerous figures in the text. The publication of such collections of papers as have been included in the Smithsonian Reports since 1889, embracing a considerable range of scientific investigation and discussion, is of enormous value to all who are interested in the progress of natural knowledge.

IN Part iv. of the quarterly *Journal* of the Sanitary Institute (vol. xvii.), just published, are several papers of interest. Small-pox and the beneficent effects of vaccination are the subjects of two papers. Dr. Arthur Newsholme describes a number of positive instances of the spread of enteric fever by means of sewage-contaminated shell-fish; Dr. Sims Woodhead urges the inspection of dairy farms, and the bacteriological examination of the milk therefrom, as well as of the agencies which distribute it; Mr. W. Hunting discusses tuberculosis in relation to public health; and Dr. H. Scurfield lays down an anti-tuberculosis programme. Among other subjects dealt with are the bacterial filtration of public water-supplies, by Mr. Wolf Defries; dangerous constituents of colliery air, by Prof. Frank Clowes; sanitation in Denmark, by Dr. J. Carlsen; the treatment of sewage (several papers); the planning of secondary schools, by J. Osborne Smith; the bacterial examination of water and sand filtration, by Prof. Percy Frankland, F.R.S.; the effect of cold weather upon health, by Dr. A. Lockhart Gillespie. All these papers were read at the Congress held at Newcastle-upon-Tyne last year.

AN important relation between the optically active forms of methylmannoside, $C_7H_{14}O_6$, and the inactive racemic form of the same substance, has been brought to light by Prof. Emil Fischer and L. Beensch. The active forms can be separately recrystallised from warm water without undergoing any change. When they are both dissolved in water so as to produce an inactive solution, crystals of the racemic form are deposited, provided that the temperature of the liquid is above 15°. If the temperature, on the other hand, be below 8°, the two active forms separate out in individual crystals, which can be mechanically separated, and some of which are found to consist of the pure dextro-compound, others of the pure lævo-compound. Both the active and the inactive forms crystallise without water, and this is the first instance in which this phenomenon has been observed in the absence of water of crystallisation. In all previously known cases the racemic form has crystallised with less water than the active forms, a fact which might be expected to favour its formation at a higher temperature.

THE name of glycogen may still convey to some the idea of the substance that forms grape sugar; but it is used in a wider sense in a recent work by Dr. Charles Creighton. The work is "Microscopical Researches on the Formative Property of Glycogen," and the first part of it, dealing with the physiologica side of the subject, has just been published by Messrs. A. and C. Black. Not with the sugar-yielding character of glycogen, but with its tissue-making property, is Dr. Creighton concerned; and the present publication describes the researches of others and himself on this problem of glycogen in formative processes. The observations on the presence of this substance in hibernating animals furnish a few new facts. From the evidence so far obtained, Dr. Creighton states:—"We find that in hibernation glycogen is present, and may be abundant, in the liver, which is against the rule of starving animals; that it is present in some peculiar way in the muscular and pulmonary tissues, and that it is found in granules in fat-cells. Any attempted interpretation of these facts cannot but be hazardous while so many other relevant facts remain to be determined exactly; but it seems probable, as Voit has conjectured, for the hepatic glycogen, that the store of fat is utilised by being converted into glycogen. As to the hibernating gland, its function appears in some way correlated to the wasting of the fat-store during the winter, the gland-substance becoming physiologically most active in correspondence with the wasting of the animal's fat in general. We await the completion of Dr. Creighton's work before reviewing it.

THE additions to the Zoological Society's Gardens during the past week include two Four-horned Antelopes (*Petraceros quadricornis*, ♂ ♀) from India, presented by Colonel W. W. Lean; two Buzzards (*Buteo vulgaris*) from South Wales, presented by Mr. H. Edgar Thomas; two Carrion Crows (*Corvus corone*), British, presented by Mr. Alfred Greaves; a Golden Eagle (*Aquila chrysaetus*) from Greece, presented by Dr. H. O. Forbes; a Goosander (*Mergus merganser*) from Holland, purchased.

OUR ASTRONOMICAL COLUMN.

OXYGEN IN THE SUN.—Herren Runge and Paschen have recently suggested (*Astrophysical Journal*, No. 5) a criterium by which the presence of oxygen in the sun may be directly ascertained. They have found that in a vacuum tube filled with oxygen, the line at 7775, discovered by Piazzi Smyth, has two components, the strongest being the most refrangible and the weakest the least refrangible; the wave-lengths of the three are 7772·26, 7774·30, and 7775·97. In the solar spectrum about this region there are, comparatively speaking, few lines, but, corresponding with the above wave-lengths, there is a triplet which has the same characteristic intensities. Herren Runge and Paschen think that their origin is probably not atmospheric, for the spectrum of the oxygen vacuum tube differs widely from the absorption spectrum of atmospheric oxygen. Mr. F. McLean has examined his photographs of the high and low sun, and has found that these lines do not depend on the altitude of the sun, which fact still further points to a solar origin. A crucial test would be to examine the opposite limbs of the sun, and find out whether any displacement of the lines occurs.

THE POLAR CAP OF MARS.—We have received the following information from America:—"A telegram received at Harvard Observatory, on January 11, from Lowell Observatory, now located near the city of Mexico, says that a rift has been observed since January 7 in the north polar cap of Mars in longitude 40°." This "rift" is probably similar to those observed at the opposition of 1894, in the southern cap. Prof. W. H. Pickering, with a 6-inch telescope, found one on May 22, crossing the cap from longitude 330° to 170°. This grew very considerably in size, measurements made on June 6 and 15 indicating a width of 100 and 350 miles respectively. Mr. Douglass also during the same month, June 10, detected a second and a third rift, the latter running from longitude 170° to 90°. The sequence of phenomena observed seems to indicate that they are due to the lower levels at the poles being uncovered; in this way, as the snow melts, the bare ground is exposed, appearing dark in contrast to the snow still lying on the more elevated heights. Their broadening is then a natural result of the departing snow, and indicates that the polar cap is at that time in a far advanced state of disintegration.

THE QUESTION OF CARBON IN BRIGHT LINE STARS.

THE spectrum of carbon is one which is subject to very great changes when examined under different experimental conditions, and an acquaintance with these variations is essential to an adequate discussion of the spectra of the heavenly bodies.

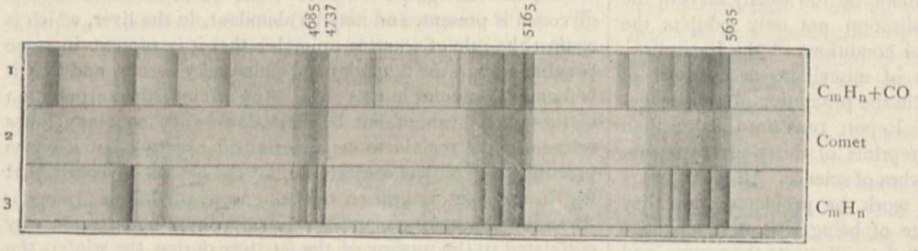


FIG. 1.—(1) Spectrum of mixture of hydrocarbons and oxy-carbon obtained from meteorites, with small coil and jar. (2) Spectrum of Comet III. 1881. (3) Spectrum of gases from meteorites, with large coil and jar (Vogel).

Every one knows the considerable development of the spectrum of carbon in most cometary phenomena; and there is a band which Dr. Vogel some years ago attributed to carbon, although it does not coincide with the most familiar carbon spectrum, that of the Bunsen burner. Dr. Vogel gave his reasons for this allocation, and illustrated them by a diagram[1] in which it is shown that in the spectrum of the comet, the blue band has its maximum about 470, and fades away nearly equally in both directions. If one's knowledge of the carbon spectrum were limited to that of the Bunsen burner, indicated at the bottom of the diagram, the comet band could not be ascribed to carbon.

But another spectrum of carbon, obtained by Dr. Vogel (given at the top of the diagram), shows the blue band of exactly the same form, and in the same position as that in the comet. Hence, Dr. Vogel argued that the blue band in the comets, though not coinciding with the carbon group at wave-length 4737, seen in a Bunsen flame, was still due to carbon.

When I was discussing the spectrum of the bright line stars in my general survey, a band in very nearly, if not absolutely the position of the cometary band, was found recorded. Most unfortunately I had completely forgotten Dr. Vogel's paper of 1881, and I set to work to study its origin for myself.

In the course of the previous thirteen years I had taken some hundreds of photographs of the spectrum of carbon compounds under a great variety of conditions; and I was driven to carbon because one of the most conspicuous features of the spectrum of many of the bright line stars is a broad blue band, a part of which falls within the limits of the group of carbon flutings at 4737, which is seen in the Bunsen, although its brightest part in the stellar spectra is about wave-length 468; that is, some distance further towards the blue than the brightest part of the Bunsen group. Forgetting Vogel's prior labours, I looked through my photographs, and found what he had found, that, under certain conditions, the maximum of the band is shifted, under some conditions of pressure and temperature, from 4737 to about 4685. One of my photographs, taken in December 1886, is reproduced in Fig. 2.

The spectrum at the top of Fig. 2 is the spectrum of alcohol vapour at a relatively high pressure; and among the most notable differences from the lower pressure spectrum at the bottom of the diagram, is the enhancement of the more refrangible part of the group of flutings commencing at 4737. This is still more marked in the spectrum at intermediate pressures, as shown in the middle spectrum in Fig. 2. In short, the brightest part of this group now agrees, very nearly, with the blue band of some of the bright line stars. It is very difficult to estimate the middle of such a broad, diffuse band as that in question; but the wave-length of the brightest part is approximately 4685.

As Dr. Vogel had previously done for comets, I was particularly careful to point out that the carbon band in the bright line stars was not seen under the same conditions as that in the Bunsen flame.[1]

I next append some observations of the band in both comets and bright line stars:—

Comet.	Maximum of band.	Observer.	Star.	Brightest part.	Observer.
Winnecke. 1868	469	Huggins	} No. 3821	469	Huggins
Comet IV. 1873	469	Vogel			
Comet III. 1881	468·5	Vogel	} No. 4601	468	Huggins
Comet III. 1881	468	Copeland			
Comet IV. 1881	470	Copeland			

Notwithstanding the difficulty of determining very exactly the brightest part of a diffuse band, it will be seen that the bands in two of the stars are exactly coincident with bands which have been measured by trustworthy observers in three comets. In the fifth comet, named above, the variation in the wave-length of the band is not greater than that between two individual measures in stars.

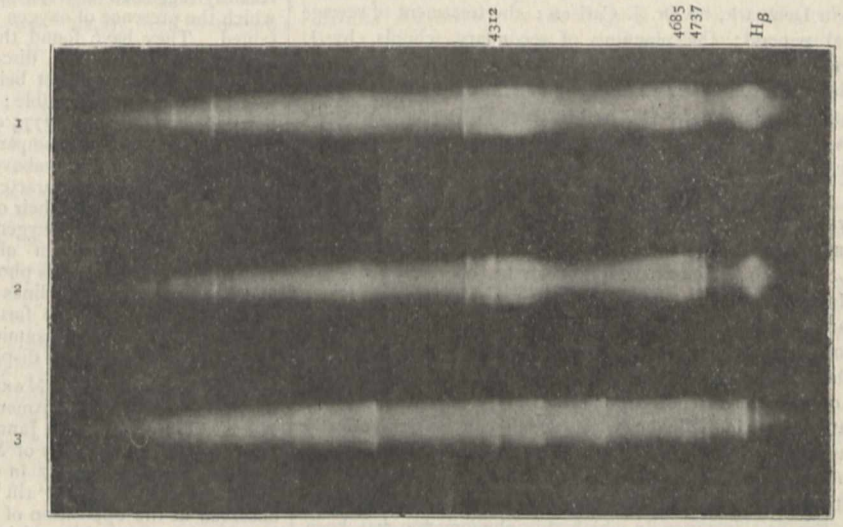


FIG. 2.—Spectrum of alcohol vapour. (1) Highest pressure. (2) Intermediate pressure. (3) Lowest pressure.

The fact that, so far as I know, this explanation, the whole credit of which is due to Dr. Vogel, has never been called in

[1] Potsdam Observations, 1881, II. p. 173.

[1] In 1888 I wrote: "This band is evidently the bright band of carbon, commencing at 474, with a maximum about 468, as observed and photographed at Kensington" (*Roy. Soc. Proc.*, vol. xliv. p. 35). Later in the same year I added: "It is necessary to state that the maximum luminosity of the blue band, under some conditions, is about 468. . . . The conditions under which this band has its maximum luminosity at 468 in Geissler tubes seem to be those of maximum conductivity" (*Roy. Soc. Proc.*, vol. xlv. p. 167).

question in relation to comets, would indicate that it may be equally unobjectionable in the case of the bright line stars.

But there was more evidence behind with regard to the other carbon flutings.

The spectrum of carbon does not consist of the blue band alone, so that some account must be rendered of the other parts of the carbon spectrum, more especially of two groups of flutings in the green. We should not expect the green flutings to be so easily visible as the blue in stars, for the reason that they fall in the brightest part of the continuous spectrum; while in comets where there is little continuous spectrum, they are the most conspicuous bands.

In the star BD + 36° 3956, for example, Vogel's observations gave indications of the two green bands which are seen in the spectra of carbon compounds, and are the chief characteristics of the spectra of comets at mean distances from the sun.

It was in 1890 that Dr. and Mrs. Huggins formulated objections, based on some new measures, to my view as to the probable carbon origin of the blue band in the bright line stars.

Thus, in two cases they found, as Vogel had found before them, that the brightest band was still more refrangible than the brightest part of the modified carbon band; but in each of these cases they found, also, a band about the position of 4685.

As a result of their work, they made the following statement:[1] "Our observations appear to us, however, to be conclusive on the main object of our inquiry, namely, that the bright blue band in the three Wolf-Rayet stars in Cygnus, and in DM + 37° 3821, is not coincident with THE BLUE BAND OF THE BUNSEN FLAME."

The capitals are mine. It will have been seen how carefully Vogel in the case of comets, and myself in the case of stars, had pointed out that it was not a question of the Bunsen flame!

Dr. and Mrs. Huggins do not admit that the observed variations of the band in the carbon spectrum are sufficient to explain the position and appearance of the band at 4685 in the stars, basing their objections on experimental evidence afforded by Hasselberg.

Vogel's researches, as well as my own, on the carbon spectrum, however, indicate a much greater concentration of luminosity of the band about 4685 than appears to have been observed by Hasselberg. But this is not to be wondered at, since every change in the experimental conditions may have an effect on the spectrum.

I am not aware of any other objection to my view than the above, and it will be remarked that Dr. Huggins is silent altogether in regard to the existence of the band in comets.

Very fortunately for science, a great mass of new work on this part of the subject has been brought together since the Meteoritic Hypothesis was published, chief among the workers being Prof. Campbell.

Let us turn to this new work, therefore, and see in what direction it tends.

We may take the case of one of the brightest stars of this class in Argo, the spectrum of a star which my friend Respighi and myself were the first to see on a very hot night in Madras in 1871, a beautiful spectrum with many bright lines. Prof. Campbell, in 1893, included the study of this bright line star in his work at Lick. What is his result with regard to the band at 4685? He finds a band at 4688.[2] In my first discussion I took the position of the brightest band as 4682, depending upon measurements made by Ellery, at Melbourne, in 1879. In a more general examination of all the Wolf-Rayet stars in 1894,[3] he finds a band at 4688 to be the most constant feature, and in some stars it appears almost alone! This in itself would be almost sufficient to prove carbon.

Prof. Campbell does not discuss the origins of the lines and bands which he has measured, but it will be seen that for such a diffuse band as that in question, his wave-length 4688 does not differ materially from that already given for the modified carbon band.

There is now, therefore, in the light of the newest and best work, no question about the fact that in the bright line stars there is a band at 468, the wave-length of the modified carbon band; and this was my original contention.

The new measures obtained by Dr. and Mrs. Huggins, therefore, do not affect my views as to the origin of the blue band of the bright line stars recorded at places varying between λ 468 and λ 469.

[1] *Roy. Soc. Proc.*, vol. xlix. p. 46.
[2] *Astronomy and Astrophysics*, 1893, p. 555. [3] *Ibid.*, 1894, p. 448.

With regard to this band, then, the first conclusion is now firmer than ever, strengthened as it is by Campbell's new work.

Dr. and Mrs. Huggins object to another point.

It has already been remarked that Vogel's observations suggested the presence of the green flutings in one of the stars.

On this point Dr. and Mrs. Huggins remark that, when observing the bright line stars with small dispersion, "it might easily be supposed that the spectrum is brighter at the position of the green carbon band"; with high dispersion, however, they can see "no sensible brightening" in that part of the spectrum. In the case of another line distinctly seen with small dispersion, they remark that with high dispersion it was so indistinct that they could not determine whether it was D or D_3;[1] so that their observations do not demonstrate the absence of the green fluting of carbon.

Observations made at Kensington strengthen the idea that the green flutings are present in the spectra of bright line stars. When high dispersion is employed, flutings are weakened in much greater proportion than lines; so that comparatively small dispersion must alone be employed in observations of this kind.

Campbell shows that while the average position of the brightest blue band in one group of stars is 4688, in another group it is 4652. These two bands are frequently associated in the same spectrum, but occasionally each occurs by itself.

As to those stars in which a band appears about λ 465, it is quite possible that we may still have to deal with carbon. At present I am not aware of any experimental evidence; but the possibility of a band at this wave-length, under a certain still untried condition is suggested by the fact that a band about this position was observed in Brorsen's comet in 1868 and 1879.

But the existence of a band at 465 surely does not negative the existence of a band at 4685!

The present position of the question of carbon, then, is this. The new work of Campbell justifies us in associating, not only in comets, as first suggested by Vogel, but in bright line stars, as suggested by myself, the blue bands at 468 with carbon; and a study of the spectra of comets suggests, but does not demonstrate, that the other band at 465 has the same origin. The feeble appearance of the green bands is no doubt due to their superposition upon the brightest part of the continuous spectrum.

Hence the idea of the chemical and physical kinship of comets, nebulæ, and bright-line stars is strengthened.

J. NORMAN LOCKYER.

THE SAVING OF VANISHING KNOWLEDGE.

IT is well from time to time to take stock of our knowledge and of our methods of inquiry, to see whether we are working on sound lines. As the business man finds it necessary to periodically go over his stock and balance his books, so, too, the scientific man, especially the biologist, should perform an analogous operation, lest perchance he find out too late that he has been entering on a comparatively unprofitable line of work, or has been neglecting valuable opportunities. While it is impossible to say what scientific work is ultimately unprofitable, it may not be difficult to suggest that particular subjects for investigation are of more immediate importance than others.

Let us for the moment divest ourselves of all preconceived ideas and pet fancies, so as to discover what is at the present time the most urgent need of science. In order not to complicate the question, we will dismiss the practical applications of science by admitting that they are of immediate importance. This leaves the field clear for scientific subjects which are studied solely for their own sakes.

We can, perhaps, gain a clearer view of the question by looking at it from the standpoint of our successors—What will be the opinion of the naturalist of a hundred, or of a thousand, years hence? What is the scientific work that he would wish us to have undertaken? This question is an easy one to answer.

He would not consider it very necessary for us to elucidate the structure, development or physiology of every common animal; these matters can be done at any time. The investigation of the life in the oceans—whether on the surface, in shallow water, or in abysmal depths—can be done by him as well as by us. We may safely leave for the present the problems of the Ant-

[1] *Roy. Soc. Proc.*, vol. xlix. p. 44.

arctic polar basin; if this generation does not learn the secrets of the palæocrystal ice, another can and will do so.

Our future naturalist will certainly and most justly complain if we busy ourselves with problems that can wait, that he can solve as well as we, and at the same time neglect to do that work which we alone can do. Our first and immediate duty is to save for science vanishing knowledge; this should be the watchword of the present day.

Those students of botany, zoology, and anthropology who have at all considered the matter, are impressed with the fact that the present is a very critical time for the native flora and fauna of many parts of the world. Owing to the spread of commerce, the effects of colonisation, and the intentional or accidental importation of plants and animals, a very rapid change is affecting the character of the indigenous life of numerous districts. This is notably the case in oceanic islands, the area of which is often extremely limited, and as a consequence the native forms are the more likely to be swamped by the immigrants; but it is just those spots which are of especial interest to the naturalist, on account of their isolation from the great land areas. Thus the flora and fauna of many of the districts most interesting to the field-naturalist are in our day becoming largely exterminated before they have been adequately recorded. The investigation of disappearing animals and plants can, in many cases, be undertaken by us alone—and even now much has disappeared and more is fast passing away. It is, perhaps, scarcely necessary to point out that this investigation is not a matter of interest to the systematist only, but it is of great importance in connection with the problems of the geographical distribution of animals and plants which open up such fascinating vistas of the extension of continents in former ages, and of their partial submergence; not to speak of the bearing of specific and individual varieties on the intricate questions of the origin of species; or the adaptation of those peculiar forms to their particular localities, and those wonderful inter-relations between plants and plants, plants and animals, or between animals and animals, and between all and their environment.

Some years ago a Committee was appointed to investigate the zoology of the Sandwich Islands, and they sent out Mr. R. C. L. Perkins, who has done most excellent work. His researches in the Hawaiian group prove that quite a noticeable decrease in the indigenous fauna is taking place each season. The district around Honolulu was perhaps originally the richest in endemic forms, but now introduced forms are in vast preponderance; the distinctive fauna of the plains, if there was one, has quite disappeared. Captain Cook found certain birds, for example, near the shore; of these, some are extinct, and others are to be found only in the mountains. In a letter recently received, by Dr. D. Sharp, dated from Lihue, Kauai, he states: "This place has been a dead failure. The country where I camped here was a low-lying, densely-covered forest bog-land, at first sight a paradise for Carabidæ (ground beetles), and differing from any other place known to me. Its fauna is entirely lost for ever. I turned during my stay thousands of logs, any one of which at 4000 feet would have yielded Carabidæ; of all these there was not a single one under which *Pheidole megacephala* had not a nest, and I never beat a tree without this ant coming down in scores." This is an introduced ant which is overrunning the islands, and which exterminates the native insect fauna. Mr. Perkins finds that earwigs alone can withstand this ant, and his only chance of collecting endemic insects is to get ahead of the ant. The area of the whole group is somewhat larger than Yorkshire. If the diminution of the fauna is so marked in such a comparatively large group as the Hawaiian Islands, how much greater must it be in the small islands.

Mr. Knight, in his entertaining book "The Cruise of the *Falcon*," describes the prostrate forests of the island of Trinidad in the South Atlantic. We never can know what was the nature and extent of this vanished flora and fauna.

What is taking place in the small islands holds good to a somewhat less extent for the larger ones. In New Zealand the Government is taking steps to preserve certain well-known vestiges of its ancient fauna which are in imminent danger of extermination; but it does not interest itself in the inconspicuous forms, which are subject to the same danger, nor does the New Zealand Government systematically investigate the existing fauna of the group.

It is necessary that such investigations should be undertaken by competent naturalists. They should not only be good collectors, but keen observers, in fact, naturalists in the true sense of the term; for unless the work is well done, it had almost be better left undone. There are many examples of collecting being so imperfectly done as to lead to very erroneous conclusions. It takes time for a naturalist to become acquainted with the local types. The endemics do not show themselves, as usually the conditions of life are such that insects, for example, live retired lives and are not seen, while those that manifest themselves are often foreigners.

The extermination of animal life is more rapid and striking than that of plants, but what has been stated for animals must be applied to plants as well.

Not less important than the foregoing is the study of the anthropology of these districts. The Tasmanians have entirely disappeared, and we know extremely little about this interesting people. In many islands the natives are fast dying out, and in more they have become so modified by contact with the white man and by crossings due to deportation by Europeans, that immediate steps are necessary to record the anthropological data that remain. Only those who have a personal acquaintance with Oceania, or those who have carefully followed the recent literature of the subject, can have an idea of the pressing need there is for prompt action. No one can deny that it is our bounden duty to record the physical characteristics, the handicrafts, the psychology, ceremonial observances and religious beliefs of vanishing peoples; this also is a work which in many cases can alone be accomplished by the present generation.

The late Prof. H. N. Moseley was so impressed with this fact during his voyage on H.M.S. *Challenger*, that he concluded his "Notes by a Naturalist on the *Challenger*" by pointing out that the physical conditions and fauna of the sea can be investigated at leisure at any future time. "On the surface of the earth, however, animals and plants and races of men are perishing rapidly day by day, and will soon be, like the Dodo, things of the past. The history of these things once gone can never be recovered, but must remain for ever a gap in the knowledge of mankind. The loss will be most deeply felt in the province of Anthropology, a science which is of higher importance to us than any other as treating of the developmental history of our own species. The languages of Polynesia are being rapidly destroyed or mutilated, and the opportunity of obtaining accurate information concerning these and the native habits of culture will soon have passed away. The urgent necessity of the present day is a scientific circumnavigating expedition which shall visit the least-known inhabited islands of the Pacific, and at the same time explore the islands which yet remain almost or entirely unknown as regards their botany and zoology; these promise to yield results of the highest interest if only the matter be taken in hand in time."

There is no difficulty in finding men willing and competent to undertake such investigations if the funds were forthcoming; experience has shown that an annual sum of at least 400*l.* is necessary to equip and maintain one naturalist.

Here, then, is a great opportunity for the millionaire. No one doubts that the work is worth doing; it is essential that it should be done at once: capable men are ready to undertake it—only the means are lacking.

The British Association has appointed a Committee to report on this matter, of which Sir William Flower, Director of the Natural History Museum, South Kensington, is the Chairman, and the present writer the Secretary; so there exists a machinery ready to be put in action when funds are available. Will not one wealthy man, or a syndicate of rich men, contribute to do this work for the world? The opportunity if neglected is lost for ever.

A. C. HADDON.

SIR MARTIN CONWAY'S CROSSING OF SPITZBERGEN.

SIR MARTIN CONWAY read a paper on the first crossing of Spitzbergen at the meeting of the Royal Geographical Society on January 25, illustrating his description by a series of fine lantern slides of Spitzbergen scenery. He landed at Advent bay, accompanied by Dr. J. W. Gregory, Mr. E. S. Garwood, Mr. A. Trevor-Batty, and Mr. H. E. Conway, two Norwegian sailors, and two ponies. The descriptions of previous travellers had led him to expect a series of boggy coast valleys leading up to an interior plateau covered with snow or ice, on which sledging would be practicable. The actual conditions were very different. The northern and southern parts of Spitzbergen are, in the main, covered with great accumulations of

ice, except along the west shore of Wijde bay, where is a relatively fertile area. The middle of the island, west of the main watershed, is a region of boggy valleys, fertile slopes, and mountain ridges, or the remains of a high plateau. The nature and interest of this country can be shown by a few specimen areas. The east shore of Wijde bay is formed by a long and very uniform slope, about 1000 feet high. The ice-sheet almost reaches the edge of this slope, except at a few places where the plateau has been broken down into valleys, whereby tongues of ice reach or approach the sea. That is an example of a plateau protected from denudation by ice. Along the north-east side of the Sassendal there is a similar plateau, from which, however, the ice-sheet has been withdrawn in recent times. Denudation has begun, and the plateau is being cut down by narrow and precipitous cañons, from which it derives the name Colorado Berg. These cañons are not being gradually lowered, but they are gradually creeping back. However short, all are practically of the same depth. It is at their heads that they are formed. Each is eating its way back with considerable rapidity, and the whole is the first stage of the formation of a mountain group.

From the whole area west of the Sassendal, between it and Advent bay, bounded on the north by Ice fjord, and on the south by Advent dale, the ice that once covered it appears to have been gradually withdrawn, beginning from the west. As one goes westward one comes to mountains in a more advanced stage of manufacture. The hills that look down upon the Sassendal are the bluff-fronted remains of a plateau, only a little more cut down than the Colorado Berg. Except in two cases, the valleys that penetrate them from the Sassendal are short. Further west come rounded hills, such as Mount Lusitania. Beyond De Geer valley are maturer peaks, with clearly defined arêtes and faces such as are familiar in ordinary mountain regions.

Where mountains are most developed valleys are oldest. Advent dale may be taken as type of these. As the ice retreated eastwards, Advent dale widened and crept back, receiving the drainage of a constantly developing valley-system, whose eastern watershed ran close behind the Sassendal bluffs. Later on the Sassendal tributaries became more active, and ate their way back, stealing one after another of the headwaters of Advent dale. The Esker valley is a good instance of this. It was formerly drained to Advent dale; now it drains in the opposite direction. Brent pass divides the drainages, but will not long continue so to do, for already a small stream, descending almost on to the pass, is in process of being stolen by the Esker. It now divides its waters upon its fan when in flood, one stream going to Advent dale, the other to the Esker. Fulnar valley, which formerly drained into Agardhs bay, has been similarly invaded by the Sassendal, and many more instances might be quoted.

The great interest, therefore, of this peculiar island of temperate climate in the midst of Arctic ice-sheets, lies in the fact that there is one of the very best examples in the world of the processes of mountain and valley manufacture. This fact altered the plan of the expedition, and showed that it was a far more important matter to make a fairly detailed examination of one portion (in itself, however, not inconsiderable) of Spitzbergen, than to scamper hurriedly across two or three separate belts. Sir Martin Conway and his companions crossed from sea to sea along three different lines; but, instead of being as far as possible from one another, these lines were so arranged that each should display the flank of the next. The crossings were from Advent bay to Van Mijen bay, from Van Mijen bay to Sassen bay, and from Sassen bay to Agardhs bay and back, finally returning along the shore of Sassen bay to Hyperite Hat, and completing the work by expeditions into the heart of the important mountain region which has been already referred to.

Sir Martin Conway proceeded to describe the incidents of the various journeys across the island, the journey being made both wearisome and dangerous by the constant rain, the boggy floors of the valley and the still more treacherous slopes of rotten snow. Thawing was going on very rapidly, and the rivers were so numerous, that fifty-two, which required to be forded, were counted in a single mile near the head of Advent dale. Some gleams of sunshine allowed of comprehensive views being obtained over the maze of valleys and broken plateau. The party carried on much of their work separately, thus being able not only to survey a large part of the island for the first time, but also to devote special attention to the geology and the conditions of the numerous large glaciers and innumerable moraines which were encountered.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. N. Shaw, F.R.S., has been appointed a member of the General Board of Studies. Mr. Middleton-Wake, the Sandar's Reader in Bibliography, will this term give a course of four lectures on the invention of printing, with special reference to book-illustration. Mr. C. H. Robinson, who has been elected University Lecturer in the Hausa language, will give an inaugural lecture on the Hausa people on February 2. Mr. E. J. Stone, F.R.S., and Prof. J. J. Thomson, F.R.S., have been nominated as examiners for the Adams prize to be awarded in 1899. Dr. Somerville is this term lecturing on agriculture and forestry at the University Chemical Laboratory. He announces also a special lecture on the "finger and toe" disease of turnips on February 6.

A SPECIAL educational supplement is published with the *Academy* of January 23. In it will be found some suggestive notes on the use of illustrations and models in teaching, and records of scholastic events in the principal public schools during the third term of 1896.

THE annual general meeting of the Association of Technical Institutions was held in the Clothworkers' Hall, London, on Friday, January 22, when the Right Hon. A. J. Mundella, M.P. (the retiring President), presided over a large attendance of members. Mr. Henry Hobhouse, M.P., was elected President for the year 1897, and delivered his inaugural address. It was resolved to request the Council to take into consideration and to report to the next general meeting as to the best means of promoting full recognition of the attainments of technological students, and also as to the best method of securing a closer co-operation with the Examination Board of the City and Guilds of London Institute; in considering this important matter the Council is to have power to co-opt such persons as it may deem desirable. The Council for the year was elected as follows:—President: Mr. Henry Hobhouse, M.P. Vice-Presidents: The Right Hon. A. J. Mundella, M.P., Mr. W. Mather. Treasurer: Councillor R. F. Martineau. Hon. Secretary: Prof. J. Wertheimer.

A NOTEWORTHY event in the annals of technical education in the United States will be the forthcoming celebration of the twenty-fifth anniversary of the Stevens Institute of Technology, on February 18 and 19. From the *Journal* of the Franklin Institute we learn that the institute was founded by the late Edwin A. Stevens, of Hoboken, N.J., and in 1870 the erection of a building was commenced. Dr. Henry Morton, at that time secretary of the Franklin Institute, was tendered the presidency of the institute, and gathered a faculty of eight members about him. To this number others have, from time to time, been added as the work of the institute increased, until at the present time the faculty includes twenty-two professors and instructors. The total number of student graduates is 675, and the number in attendance during recent years has been about 260 each year. The Stevens Institute has always taken high rank among the institutions devoted to technical education in the United States, and its twenty-five years of successful effort is amply exemplified in the work accomplished by its graduates in all departments of mechanical and electrical engineering.

FROM the Berlin correspondent of the *Lancet* we understand that there is some uneasiness in German University circles. In Germany a university student has to pay a fee each half-year for every lecture he attends, and this money becomes the property of the individual teacher. In addition to the students' fees, the professors receive a fixed salary from the Treasury; but the great majority of associate professors and *privat-docents* do not get any remuneration from the Government. In order to redress this inequality, the Government proposes to introduce a Bill providing that lecture fees exceeding 4000 marks (200*l.*) in Berlin University and 2000 marks (100*l.*) in the provincial universities shal be divided between the lecturer and the Treasury. The fund thus obtained will be used to increase the remuneration of the teaching staff of the university. The announcement of this contemplated innovation has caused a sensation among the members of the universities. They point out that the new measures will induce the members to raise the fees, and that the expense of university education will thereby be increased. The Bill would also restrict the liberty and freedom of action

at present possessed by the universities, and place them in a position of dependence on the Government. Although it is intended that the new regulations shall only come into operation gradually as new appointments are made, and shall not be applicable to the professors who already occupy chairs, the effect has been to cause so much uneasiness in university circles that the Government may possibly abandon the proposal.

THE annual general meeting of the Association of Technical Institutions was held on Friday last. Mr. Hobhouse, M.P., in the course of his presidential address remarked that he hoped the rising generation of agriculturists, as of other classes, would listen to the wise advice given them by such men as the Duke of Devonshire, Lord Rosebery, and Sir Henry Roscoe, and would avail themselves of every opportunity to acquire skill and apply knowledge in adapting their industry to the altered conditions of the times. As to how far this kind of instruction was to be carried, he urged that they should extend and advance their instruction as far as ever their funds would permit. It was somewhat extraordinary to see the same men who were willing to pour money out like water on new ironclads and regiments for meeting the remote contingency of an invasion by foreign troops grudge a few thousands a year for checking, and, if possible, defeating, the immediate and actual invasion of our country by foreign products and foreign workmen. As to the conditions under which technical instruction should be given, he pleaded that specialised training should not begin too early in life, but should as far as possible be based on a solid foundation of literary and general culture; and they should bear in mind the importance of a well-balanced and truly educational curriculum. They would, further, all agree that in a properly-managed institute there should be no cramming for examinations; that neither children nor adult pupils should be treated as grant-earning machines; and that they ought to aim at securing that continuous "low-pressure" system of work that was induced by enlightened and helpful inspection rather than an intermittent "high-pressure" system resulting from mechanically-conducted paper examinations.

THE Technical Education Committee of the Derbyshire County Council have already provided definite systems of applied technical instruction for agriculture and mining—the two great industries of the county, but they have found a difficulty in doing anything for the smaller and more scattered industries. For these it is often not possible to do more than provide general secondary education and instruction in scientific principles. From a report just issued by the Committee, it appears that in the north-west of the county there is, in a comparatively small area, a large development of the calico-printing industry, involving a capital expenditure of over half-a-million, and giving employment to 2000 hands. Recent inquiry has shown a definite want of technical instruction in this industry. At a meeting of manufacturers, attended by Mr. Percy Hawkridge, the Organising Secretary, it was shown that they obtain their colours from Germany, and that their composition is not known in this country by the people engaged in their use. They are bought and used in accordance with instructions supplied by the German colourist. Most of these colours are, however, definite chemical compounds derived from coal-tar. They are understood thoroughly by English chemists, and there is no valid reason why they should not be produced in this country, in association with the industries employing them. Indeed, the Committee reports that, even with the ordinary chemical appliances in use at New Mills, valuable results have been achieved. As a result of the meeting referred to, it has been resolved to ask the Derbyshire County Council to construct a laboratory to be specially devoted to this work. The scheme commends itself to the Committee on account of its decidedly practical nature, and also on account of the unique development of the calico-printing industry in the neighbourhood of New Mills.

SCIENTIFIC SERIALS

American Journal of Mathematics, vol. xix. 1 (Baltimore, January, 1897).—Theorie der periodischen cubischen Transformationen im Raume R_3, by S. Kantor, contains a full account (in 59 pages) of the theory on the lines of the same author's Theorie der endlichen Gruppen von eindeutigen Transformationen in der Ebene (1895).—Mr. Basset, in theories of the action of magnetism on light, discusses the theories of Maxwell, Fitzgerald, and Larmor. His object is twofold. First, he subjects Mr. Larmor's theory to a searching examination, and maintains that instead of being an improvement on its predecessors, it is open to a variety of additional objections and defects. In the next place, by means of a modification of the fundamental hypothesis, he proposes to show that the theory of Rowland and himself may be placed on a perfectly satisfactory basis, and that the difficulty with regard to the discontinuity of the tangential component of the electro-motive force at an interface may be removed.—In the article on the roots of Bessel- and P-functions, Mr. Van Vleck confines his attention to those functions which are symmetrical in their properties with respect to the real axis of the complex variable. The first part of his work aims at proving that between two successive positive or negative roots of $J_n=0$ there lies one, and only one root of $J_n+_1=0$. He gives an extract from Gray and Mathews' treatise on Bessel Functions, but in so quoting he spells each author's name incorrectly. He proves, in the second part of his article, a similar theorem for contiguous Riemann P-functions.—Herr Kantor contributes a short note, Ueber Collineations gruppen an Kummer'schen Flächen.—Two more notelets are: note on linear differential equations with constant coefficients, by F. Franklin; and on certain partial differential equations connected with the theory of surfaces, by T. Craig, the editor.—An excellent portrait of Prof. L. Fuchs faces the title-page.

American Journal of Science, January.—The worship of meteorites, by H. A. Newton. (This lecture, delivered by the late Prof. Newton in 1889, has not hitherto been published. We hope to be able to refer to it fully in a later number.)—The spectra of argon, by J. Trowbridge and T. W. Richards. The two characteristic spectra of argon were studied by means of a high-tension accumulator of 5000 cells, which gives a more uniform discharge than either the induction coil or the influence machine. A tube 15 cm. long was filled with the gas. The red glow of argon was readily obtained with a voltage of about 2000. At higher pressures a higher voltage is required; but when the discharge has once set in, it may be continued with lower voltages. The introduction of a capacity in the circuit made no difference as long as the condenser was quiet; but as soon as the condenser began to emit its peculiar humming sound, the beautiful blue glow so characteristic of argon immediately appeared. Examined by a revolving mirror, this glow was seen to consist of intermittent discharges. The blue glow was changed to red by introducing a small coil of about 8 ohms resistance and a self-induction of ·015 henry. The same conversion may be brought about by introducing a simple resistance or self-induction, or by increasing the pressure of the gas, and consequently its resistance. The blue glow may also be produced by sending an exceedingly strong current through the tube for very short intervals. In this case it is probably the capacity of the battery itself which produces the necessary oscillations. A tube containing argon at suitable pressure shows the blue colour at once on being brought near a Hertz oscillator giving 115 million oscillations per second. The tube may be used as a sensitive detector of electric waves, and the author proposes to give it the special name of talantoscope.—Some queries on rock differentiation, by G. F. Becker. The homogeneity of vast subterranean masses, called for by the hypothesis of differentiation, is unproved and improbable. The difference between well-defined rock types are more probably due to original and persistent heterogeneity in the composition of the globe. Hypogeal fusion and eruption tend rather to mingling than to segregation, and transitional rocks may be accidental mixtures of the diverse primitive masses composing the earth's crust.—Igneous rocks from Smyrna and Pergamon, by H. S. Washington. Describes an augite-andesite rock from Mount Pagos, near Smyrna, and a biotite-dacite from Pergamon.—Revision of the genera of the Ledidæ and Nuculidæ of the Atlantic coast of the United States, by A. E. Verrill and K. J. Bush. Describes five new genera, chiefly belonging to the family of Ledidæ, from the U.S. Fish Commission dredgings. The paper is accompanied by twenty-two diagrams.—An experiment with gold, by M. Carey Lea. Of a 10 per cent. sodium hypophosphite solution, 15 cc. are placed in a beaker, and 1 cc. of a gold chloride solution containing 1 gr. of gold to 10 cc. of solution is added, and then one drop of H_2SO_4. As soon as the solution begins to darken, 30 cc. of water are added. The solution then assumes a deep green colour, due to very

finely divided blue gold suspended in the yellow solution.—Note on a new meteorite from Sacramento Mountains, Eddy County, New Mexico, by W. M. Foote. This was seen to fall in 1876. It weighs 237 kgr., and measures about 80 × 60 × 20 cm. It contains 91·39 per cent. of iron, and shows splendid etching figures.

Bulletin of the American Mathematical Society (December 1896).—Dr. W. J. A. Young reviews the "Introduction à l'étude de la Théorie des Nombres et de l'Algèbre supérieure," by Messrs. Borel and Drach. This is an interesting work founded on lectures by M. Jules Tannery. These lectures were delivered during the scholastic year 1891-2, before the students of the third year, in the Ecole Normale Supérieure. Dr. Young characterises it as a book to be read and not to be used as a book of reference. The scanty table of contents offers but little assistance to one, who, without having read the book, or at least having familiarised himself with the details as to its contents, wishes to consult its pages on a specific question. It gives clear and concise outlines of general principles stripped of illustrations and amplification. One great blemish appears on the surface, for hardly any references are said to be given either to the original sources of the material used, or as guides to those who wish to study the subject further. Some of the references which are given are not as clear as could be wished: thus the proof of the proposition that every integer can be expressed as the sum of four or fewer squares, which is based on the properties of continued fractions, and which makes use of determinants, is assigned to Mr. Smith. To those who know this is, of course, the proof by Prof. Henry Smith. To add to the unsatisfactoriness, no indication is given of the way in which "Mr. Smith" expressed his proof. Many such blemishes (apparently) are to be met with, which mar a book of considerable value.—"Quaternions" is a highly commendatory notice of Prof. Hathaway's "Primary Quaternions," by Prof. J. B. Shaw.—Prof. Hathaway briefly discusses three recent text-books: viz. "Elements of Geometry," by G. C. Edwards; "Plane and Solid Geometry," by W. W. Beman and D. E. Smith; and "Plane and Solid Geometry" (suggestive method), by C. A. Van Velzer. Each book appears to embody some new and distinctive features.—Dr. G. A. Miller, in an article on several theorems of operation groups, continues his work on the lines of his recent contributions to the *Quarterly Journal of Mathematics* (vol. xxviii.).—"Numerically regular Reticulations upon Surfaces of Deficiency higher than 1" is a short note on a generalisation of Euler's relation for convex polyhedra, by Prof. H. S. White.—The usual interesting news, under notes and publications, closes the number.

Wiedemann's Annalen der Physik und Chemie, No. 1.—On the theory of stationary electric waves along wires, by P. Drude. Electric waves are not totally reflected by a bridge laid across the wire system. They undergo a displacement of phase and a diminution of amplitude, which depends essentially upon the ratio of the length of the bridge to that of the wave. Short waves, like those in water, are greatly damped by reflection. The absorptive power of a substance for electric waves may be measured by noting the number of nodes observable along the wire.—Treatment of high-tension accumulators, by L. Zehnder. The accumulators described by the author several years ago must not be charged by stronger currents than 0·1 ampere per cell. The creeping up of acid along the lead may be prevented by spreading the plates with vaseline while hot. The copper wires may be similarly protected from mercury by burning off the latter and covering with vaseline. An important precaution against the deterioration of the battery is never to leave the cells coupled in series or single. They should be connected in parallel when not in use.—Dielectric constants at low temperatures, by R. Abegg. The specific inductive capacities of all substances increase as the temperature falls, and it is possible to approach the high dielectric constant of water by cooling other dielectrics to low temperatures.—Magnetic induction of horizontal discs rotating in the earth's field, by F. F. Martens. Describes a new method of measuring magnetic hysteresis and viscosity, the disc being a limiting case of the ellipsoid of revolution.—Absolute thermal conductivity of air, by E. Müller. Investigates all the sources of error in the vacuum-thermometer method, and tests the variations used by Winkelmann and by Kundt, Warburg and Graetz. The former method was found unsatisfactory, and the latter, which eliminates radiation by determining it absolutely *in vacuo* and deducting it, gave values which are too small. Taking into account the residual mercury vapour and the newly-determined specific heat of the glass employed, the author finds the conductivity of air to be 0·000056 in C.G.S. units.—An attempt to separate the two constituents of cleveite gas by diffusion, by A. Hagenbach. Diaphragms of gypsum having been found unsatisfactory owing to contraction, compressed powdered graphite was used instead. The original density of the gaseous mixture being 2·315 (H = 1), that of the diffused gas was 2·032, and of the undiffused gas 2·576. The author believes that he has succeeded in a partial separation of the constituents of cleveite gas by this means.—Diffusion coefficients of some gases for water, by G. Hüfner.—Corresponding temperatures, by J. A. Groshans.—Elasticity and light, by P. Glan.

In the *Journal of Botany* for December 1896, Mr. W. A. Clarke completes his "First Records of British Flowering Plants"; and two new species (?) of *Rubus* from Ireland are described by the Rev. W. Moyle Rogers. In the number for January 1897, Mr. W. P. Hiern gives a list of plants (flowering plants, Vascular Cryptogams, Muscineæ, and Fungi) gathered in the Isle of Man; Miss A. L. Smith describes some microscopic fungi new to or rare in Britain; Mr. J. Ll. Williams has an interesting note on the intoxicating effect produced on certain kinds of humble-bee by the honey of flowers belonging to the Compositæ and Dipsacaceæ.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, January 22.—Prof. Ayrton, Vice-President, in the chair.—Mr. Croft gave an exhibition of some simple apparatus. The exhibition included an ingenious form of clip to fit on an upright retort stand; a Nicol used for projecting the rings and brushes in crystals, with which it is sufficient to use the ordinary condenser of the lantern, the source of light having been moved further away from the lens than is usual; some photographs showing caustics, conical refraction, and diffraction; a stand for magnets, &c., when demonstrating the attraction and repulsion of poles; a stand for the suspension of objects for experiments on diamagnetism; a holder for X-ray tubes consisting of a spiral of wire fitting round the exhaustion tube of the bulb; an X-ray photograph taken by means of a Wimshurst machine; a model of Michelson's interference experiment; an arrangement to show subjective colours, in which a double lantern is arranged to give two partly over-lapping discs. A sheet of green glass is placed before one lantern, and the light of the other decreased till the illumination of the two discs is the same. The over-lap then appears white, while the remainder of the uncoloured disc appears red. Prof. Silvanus Thompson said he was surprised that "patent plate" was sufficiently good for Michelson's experiment. Had the author tried illuminating the discs, in his subjective effect experiment, for a very short interval, so that the eye should not have time to wander from one disc to the other? Mr. Griffith said that if you looked through a tube at one disc at a time, one appeared green and the other white. The Chairman said the point seemed to be, could you fatigue the eye simultaneously, or must it be successive? Prof. Silvanus Thompson said two common 1-inch microscope objectives were very suitable for projecting rings and brushes.—Mr. E. C. Baly read a paper on the passage of electricity through gases. In this paper, which is of a purely controversial nature, the author brings forward as arguments that electrical conduction in gases is not of an electrolytic nature the following: (1) That the sign of the change on the supposed gaseous ion is variable; (2) the initial resistance of a gas; (3) the invalidity of Ohm's law; (4) the permanence of the supposed gaseous electrolyte; (5) that every mixture of gases must equally be an electrolyte; (6) that the potential gradient in a vacuum-tube, when the current is passing, has been shown to be very uneven. It is very steep in the kathode glow, and is by no means a regular decline between the electrodes. Prof. Armstrong said it was difficult to know from what point of view the author had treated the question. The first part of the paper consisted almost entirely of a criticism of Prof. J. J. Thomson's theory and experiments. Prof. Thomson, however, is not the only observer who has dealt with this subject. The author's arguments seemed vitiated by the fact that he has looked upon the subject from one very narrow standpoint only, viz. the ionic hypothesis, and Lord Kelvin, for instance, does not believe in the truth of the ionic

hypothesis even in the case of liquids. Prof. Thomson has shown that the phenomena depend on the dryness of the gas, so that the conduction cannot depend on the gaseous molecule alone. In the case of conduction induced by a neighbouring discharge, this might be due to the expulsion of condensed vapour from the walls of the vessel. It would appear that in the dry state gases are not electrolytes. Mr. Enright said he thought it was not correct to say no work was done in electrolysis. Prof. Silvanus Thompson said that the pursuit of the analogy between the conductivity in gases and liquids was apt to lead one too far. Thus, if you compare the conduction in a mixture of H and Cl with electrolysis, your analogy will be a false one unless you import into the term electrolysis the idea of chemical separation as taking place in the solution. If a current separated a mixture of powdered zinc and sulphur, it could not be called a case of electrolysis. Prof. Armstrong said an experiment of Prof. Dewar's was very instructive. He had shown that if you cool the surface of a Crookes' tube the discharge stops. It was quite inconceivable that at these low pressures the gas became liquefied, so that this experiment seemed to show that conductivity depends on the presence of a vapourous electrolyte. Mr. Enright asked if Prof. Armstrong knew how the presence of an electrolyte assisted conduction. In a communication, Prof. J. J. Thomson said that, in the decomposition of steam by a spark, the fact that in the tube as a *whole* the amount of steam decomposed is greater than the amount of gases liberated in a voltameter in series, was no objection to the conductivity being electrolytic. The only condition imposed by the laws of electrolysis was that the excess of H or O at one terminal, and of O or H at the other, should correspond to the amount of electricity passing through the tube. Thus, suppose in a water voltameter a number of metal partitions are fixed so that the current has to pass across these plates. Then at each plate H will be given off on one side and O on the other, and by making the partitions sufficiently numerous, the total quantity of gases given off for the passage of a given current may be made as large as we please. The excess at the terminals would not be affected at all by these partitions. In the experiments made by Mr. Rutherford and himself (Prof. Thomson), they did not observe any polarisation when the conductivity was produced by Röntgen rays. With reference to Mr. Baly's objections to the electrolytic theory: (1) There is no reason to think that, under conditions other than in solution, the atom of hydrogen may not have a negative charge. (2) The electrolytic theory leads us to expect that it would require a finite electromotive force to send a discharge through a gas. Before such a discharge can take place, the molecules must be split up, and this requires an electric field of finite strength. (3) In the case of a gas, the electric field has to ionise the molecules, so that an increase in the strength of the field will not only (as in the case of a liquid electrolyte) increase the speed of the ions, but it will also increase their number, and thus the current will increase faster than the electromotive force. (4) The ion once used can again combine, and, since the ionisation is done by the electric field, it can be again split up and used again. If, however, the ionisation has been done by external sources—as, for example, by Röntgen rays—then we find that the conductivity decreases as the current passes. (5) There seems to be no reason on the electrolytic theory why, in a mixture of HCl and Cl, some of the current should not go through the chlorine. (6) A variable potential gradient would be produced if the ions moved with different velocities. Mr. Baly's process in the positive column appears to be the same as on the electrolytic theory minus the atomic charges. In a communication Prof. Schuster said: Mr. Baly criticises what he calls the electrolytic theory, but directs his arguments against a form of the theory which is, as far as the writer knows, advocated by no one. Mr. Baly appears not to have read the original papers in which the fundamental points of the theory, upheld by J. J. Thomson and the writer (Prof. Schuster), are explained. If he had done so, he could not have given, as an objection to the theory, that the conductivity of a gas increases with the E.M.F. The essential difference between a liquid and a gas is that in the liquid the number of ions is fixed by the chemical constitution of the liquid, while in a gas dissociation has, first of all, to be produced by the current itself, and hence the number of ions depends on the current. In the paper referred to by Mr. Baly, in which the fact that when a spark is passed through a gas the gas ceases to insulate for some distance round the spark is described, the explanation that this was due to a difficulty of passage of the electricity from the electrode into the gas was especially disclaimed. The explanation given being substantially the same as that now given by Mr. Baly. Mr. Baly asks what becomes of the ions that are set free? The answer, of course, is that they recombine. The view that stratifications are due to compound molecules, and do not probably occur in pure gases is not new. With reference to the author's statement that "measurements made by Wheatstone and J. J. Thomson prove that the electricity travels along the positive column from the anode to the kathode, and that its velocity is about half that of light," Prof. Thomson's results show that the break-down of the insulating power of air takes place in the manner described, but this does not show anything as to what happens when the discharge has reached the steady state. Mr. Baly is quite wrong in the excess charges he assigns to different parts of the vacuum tube. Experiments on the excess charges can count for nothing, unless they are done with continuous currents. Mr. Baly is further wrong in stating that the fall of potential is rapid in the glow. On the contrary it is very small in the glow, being very rapid in the dark space between the glow and the kathode. Mr. Baly adopts Prof. Thomson's view as to the formation of molecular chains, but in a form very difficult to accept. The whole foundation of Mr. Baly's theory is upset by his wrong assumptions as to the excess charges in different parts of the tube. The author, in his reply, said that on some points he had been misunderstood. He thought that the increase in conductivity could not be due to vapour driven off from the sides, for ultra-violet light also produced such an increase. If Röntgen rays produce ionisation, then there ought to be a reduction in the density of the gas.

Chemical Society, December 17, 1896.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—On the experimental methods employed in the examination of the products of starch-hydrolysis by diastase, by H. T. Brown, G. H. Morris, and J. H. Millar. From the results of a large amount of experimental work on starch-hydrolysis, the authors draw conclusions respecting the determination of solids from solution-density, the relation of $[\alpha]_j$ to $[\alpha]_D$, the determination of cupric reducing power, and discuss the limits of accuracy of the various methods.—On the specific rotation of maltose and of soluble starch, by H. T. Brown, G. H. Morris, and J. H. Millar. The specific rotation of 2 to 20 per cent. pure maltose solutions is constant, and at 15°5°, $[\alpha]_D = 137°93°$; soluble starch in 2·5 to 4·5 per cent. solutions has, at 15°5°, $[\alpha]_D = 202°0°$.—On the relation of the specific rotatory and cupric reducing powers of the products of starch-hydrolysis by diastase, by H. T. Brown, G. H. Morris, and J. H. Millar. The authors have established a definite relation between the specific rotation and the cupric reducing power of the products of starch-hydrolysis by diastase, which holds within very narrow limits.—The action of hydrogen peroxide and other oxidising agents on cobaltous salts in presence of alkali bicarbonates, by R. G. Durrant. Cobaltous solutions are turned green by hydrogen peroxide, hypochlorite, bromine, chlorine, or ozone in presence of alkali bicarbonates; the green colour is dependent on the production of a cobaltic salt and on the presence of carbonic anhydride.—Electrical conductivity of diethylammonium chloride in aqueous alcohol, by J. Walker and F. J. Hambly.—Formation of substituted oxytriazoles from phenylsemicarbazide, by G. Young and H. Annable. Substituted oxytriazoles are obtained when mixtures of phenylsemicarbazide with benzaldehyde, meta- or para-nitrobenzaldehyde, metatoluic aldehyde, terephthalic aldehyde, or cinnamic aldehyde are oxidised. — α-Bromocamphorsulpholactone, by C. Revis and F. S. Kipping. Under certain conditions an α-bromocamphorsulpholactone, $C_{10}H_{13}BrSO_4$, is formed during the sulphonation of α-bromocamphor.—Dimethylketohexamethylene, by F. S. Kipping.—The localisation of deliquescence in chloral hydrate crystals, by W. J. Pope. Great differences have been observed between the speeds of deliquescence of the various forms present on crystals of chloral hydrate.—Enantiomorphism, by W. J. Pope and F. S. Kipping. A preponderance of either right- or left-handed crystals of sodium chlorate is deposited on crystallising the material from aqueous solutions containing various optically active substances.

Linnean Society, December 17, 1896.—Dr. A. Günther, F.R.S., President, in the chair.—Messrs. James Green and J. H. Gardiner exhibited a series of sciagraphs of British batrachians and reptiles in which the details of the skeleton were very

sharply defined, and its relation to the external outline well shown. These sciagraphs, as well as those of a series of mollusca also exhibited, were taken with a Crookes' tube of the ordinary focus pattern actuated by a powerful induction-coil giving 8-inch sparks, and the prints in every case were made from untouched negatives. Prof. Howes offered some remarks on the series of batrachians and reptiles, and Mr. B. B. Woodward commented upon the details of structure which were made apparent in the sciagraphs of mollusca.—Mr. J. E. Harting exhibited a supposed hybrid between the common brown hare (*Lepus timidus*) and the Irish hare (*Lepus variabilis*) recently obtained in Carnarvonshire, where the latter species had been introduced in 1878. He compared the specimen in question with examples of both the above-named species, and contrasted their distinguishing peculiarities, pointing out the intermediate characters exhibited by the supposed hybrid. His remarks were criticised by the President, who thought that too much stress should not be laid upon external appearance and colour; that the question of hybridity should rather be determined by comparing the relative measurements of the leg-bones; and that the Irish hare should be compared in detail with the hare of Southern Europe (*L. meridionalis* or *mediterraneus*). Prof. Howes drew attention to Nathusius's observations upon the Peyer's patches of the leporines, and pointed to the necessity for examination of the viscera. Mr. Barrett Hamilton, who was present as a visitor, was inclined to regard the supposed hybrid as an example of the ordinary brown hare turning white in winter, hitherto unnoticed in this country. Mr. Thomas Christy inquired what position the so-called Belgian hare or leporine occupied in relation to the question of hybridity; and was answered that the popular notion of that animal being a hybrid between hare and rabbit was fallacious, since it was nothing more than an overgrown tame rabbit coloured like a hare.—Mr. B. B. Woodward gave a demonstration, illustrated with lantern-slides, of M. F. Bernard's researches into the development of the hinge of bivalve shells.—On behalf of Dr. A. J. Ewart, a paper was read in continuation of one previously communicated by him and entitled "Further Observations on Assimilatory Inhibition."—Mr. W. C. Worsdell gave the chief facts of a paper dealing with the development of the ovule of *Christisonia*, a genus of the Orobancheæ. Referring to Prof. Koch's detailed account of the development of the ovule of *Orobanche* he remarked that *Christisonia* as a parasitic plant was of such interest and differed so much in its vegetative structure from *Orobanche*, that it seemed to be worth while to record the facts of its embryological development. A brief description of the vegetative parts of the plant was then given. The author also described the development of the embryo-sac and the embryo. This was shown to follow essentially the same lines as in *Orobanche*. Finally, it was pointed out that in a great many plants the vegetative and the reproductive organs have not always, by any means, a parallel development. A striking instance of this was to be seen in *Christisonia*. The paper was criticised by Dr. D. H. Scott, who testified to the importance and interest of some of the facts established.—On behalf of Dr. L. O. Howard, entomologist to the U.S. Department of Agriculture, a paper was read on the Chalcididæ of the Island of Grenada, West Indies. This paper, communicated by Mr. F. D. Godman, F.R.S., dealt with the Chalcididæ collected by Mr. H. H. Smith, under the auspices of the British Association Committee for investigating the fauna and flora of the West Indian Islands. The collection consisted of from 600 to 700 specimens, and comprised six new genera and seventy-two new species, which were described. The geographical relationships of the group were discussed.

Geological Society, January 6.—Dr. Henry Hicks, F.R.S., President, in the chair.—On the structure of the skull of a Pliosaur, by C. W. Andrews. The paper deals with a specimen of the Plesiosaurian known as *Pliosaurus ferox*, Sauvage, obtained by Mr. A. N. Leeds from the Oxford clay near Peterborough, and now in the British Museum, and perhaps the finest Pliosaur skull known. The author gave a detailed description of the skull which formed the subject of the paper.—On the Pembroke earthquakes of August 1892, and November 1893, by Dr. Charles Davison. In the part of the paper referring to the origin of these earthquakes and their connection with faults, the author pointed out the possible value of the study of earthquakes in supplementing geological surveys. For more than fifty years prior to the earthquakes of 1892-93, there appear to have been no slips of importance along the fault-system of the area. After this prolonged interval of repose, the earlier movements took place along transverse (north and south) faults, and the later along longitudinal (east and west) ones. The three faults of the latter series, which the author connected with the disturbances, lie successively one to the north of the other, as if the abrupt displacement of a rock-mass over one thrust-plane impelled the advance of those immediately below. There can be little doubt that the fault-slips of 1892 affected the conditions of stress along the neighbouring transverse fault, so that the displacements along it occurred earlier than they might otherwise have done. In the discussion that followed the reading of the paper, the President said that the author's inquiries into the relationship between earthquakes and faults were of great interest. It was well known that the older rocks in Pembrokeshire have been much crushed and broken, and that thrust-faults of great magnitude occurred there. The Rev. J. F. Blake remarked upon the apparent absence of any signs of disturbance on the surface. If these earthquakes were due to slips, it was strange that none of them should yield this evidence. In the cases previously described by the author the principal evidence was the association with well-known faults, which might be lines of fresh dislocation; but in the present instance faults had to be hypothecated. Though, therefore, the speaker believed the theory to be the true one, the evidence for it appeared extremely weak.—Changes of level in the Bermuda Islands, by Prof. Ralph S. Tarr. The author gave a summary of previous writings bearing upon the geology of the Bermudas; but his own researches point to a rather more complicated series of changes than those which have been inferred by other writers. The formation of the "base-rock" or "beach-rock" occurred at some period which cannot be accurately ascertained at present, owing to the fragmentary nature of the included fossils. It may have been formed in Pleistocene or even late Tertiary times. After its formation it was converted into a dense limestone and then eroded, probably by subaerial agents, and finally attacked by the waves at an elevation of at least fifteen feet above present sea-level; during this stage it was covered by beach-deposits of pebbles and shells, which were accumulated in a period so recent that the contained fossils are of the same species as the organisms living in the neighbouring sea. Then followed an uplift, during which land-shells lived on the beach-deposits; but these were soon covered by blown sand—the principal accumulations of the islands, and the outline of the islands was perfected by the action of the winds. This was done at an elevation which was at one time certainly as much as 40 or 50 feet above present sea-level. The author adduced evidence of a depression since this accumulation, causing land to disappear and the outline of the area to become very irregular; and he proves that these changes cannot be accounted for solely by erosion, as some have maintained. There are indications that the land is at present quiescent. It appears, then, that most of the work of construction of the Bermudas has been done in recent times. (see NATURE, vol. liv. p. 101.)

PARIS.

Academy of Sciences, January 18.—M. A. Chatin in the chair.—Researches on helium, by M. Berthelot. Helium, in contact with mercury and benzene, is slowly absorbed during the prolonged action of the silent discharge. After the sparking has proceeded for some time, a fine orange glow appears, sufficiently bright to be visible in daylight, which examined with the spectroscope under ordinary atmospheric pressure shows the characteristic lines of helium and mercury, together with some hydrocarbon bands. At a red heat the resinous compound breaks up, reforming helium.—Remarks on the specific heats of the elementary gases, and on their atomic constitution, by M. Berthelot. In a *résumé* of the results obtained for the specific heats of the elementary gases, it is shown that these fall into four groups, comprising the monatomic gases, helium, argon, and mercury, diatomic gases other than the halogens, the halogens, and tetratomic gases such as phosphorus and arsenic.—Methods for comparing, with the aid of the electric spark, the times of oscillations of two regulated pendulums of nearly equal period, by M. G. Lippmann. The two pendulums are twice photographed by the sparks from a jar discharge at a known interval of time, and the exact phase of oscillation of each pendulum measured micrometrically upon the negative. The accuracy of the method is much higher than the method of coincidences.—Classification of the chemical elements, by M. Lecoq de Boisbaudran.—M. Potain presented a series of radiographs on behalf of M. Serbanesco, of subjects affected by gout or chronic

rheumatism.—M. H. Lechappe gave further details of his apparatus for producing acetylene.—On an instrument for indicating ascending or descending movements in aerostats, by M. Aug. Coret.—New nebulæ discovered at the Observatory of Paris, by M. G. Bigourdan.—Observations of the Perrine comet (1896, December 8) made at the Toulouse Observatory with the Brunner equatorial, by M. F. Rossard.—On the first integrals of differential systems, by M. P. Painlevé.—On the poles of uniform functions of several independent variables, by M. Antonne.—On Taylor's series, by M. Eugène Fabry.—On the integration of the equation $d^2u/dt^2 = d^2u/dr^2 - u$, by M. Le Roux. The law of transparency of gases for the X-rays, by M. L. Benoist. Experiments on sulphurous acid, methyl chloride, and air show that the absorption is proportional to the density of the gas employed.—On the velocity of reduction of chromic acid by phosphorous acid, by M. G. Viard. The velocity of the reaction is given by $dx/dt = K(A - x)^4$, where x is the quantity of chromic acid reduced at the time t and A the initial quantity.—Action of hydrogen sulphide and hydrogen selenide upon phosphoryl trichloride, by M. A. Besson. With hydrogen sulphide in the cold the oxysulphide $P_2O_2S_3$ is formed in small quantity; at 100° the oxychlorosulphide $P_2O_2SCl_4$ is also found. The latter forms a colourless liquid distilling at 104° under a pressure of 10 mm. of mercury. Dry hydrogen selenide with excess of phosphoryl chloride gives HCl, P_2Se_5, and an oily liquid which gives with water metaphosphoric and hydrochloric acids.—On some salts and some derivatives of dinitro-orthocresol, by M. P. Cazeneuve. The potassium, ammonium, barium and calcium salts are described, also the acetyl and amido-derivatives.—Action of ethoxalyl chloride upon pseudocumene and mesitylene, by M. E. Bouveault. The reactions were carried out in presence of aluminium chloride, and follow the normal course.—On the diminution of the nitrogenous material in wheat from the department of the Nord, by M. Ballard.—On the influence of the section of the spinal medulla, in the cervical region, upon the repletion of the heart paralysed by electrification, by MM. J. L. Prevost and C. Radzikowski.—Influence of temperature and food upon the respiratory quotient of the moulds, by M. C. Gerber. The spores of *Sterigmatocystis nigra* were cultivated in Raulin's fluid, in which the only organic substance present was tartaric, malic, or citric acids, either alone or with saccharose in the proportions met with in fruit. The ratios of $CO_2 : O_2$ found were, 1·68 for citric acid, 1·76 for malic acid, and 2·47 for tartaric acid. The results are parallel to those obtained from fruits.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 28.

ROYAL SOCIETY, at 4.30.—On the Capacity and Residual Charge of Dielectrics as affected by Temperature and Time: Dr. J. Hopkinson, F.R.S., and E. Wilson.—On the Electrical Resistivity of Electrolytic Bismuth at Low Temperatures and in Magnetic Fields: Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S.—On the Selective Conductivity exhibited by certain Polarising Substances: Prof. J. C. Bose.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electrical Interlocking, the Block, and Mechanical Signals on Railways: F. T. Hollins.

FRIDAY, JANUARY 29.

ROYAL INSTITUTION, at 9.—The Polarisation of the Electric Ray: Prof. J. C. Bose.

INSTITUTION OF CIVIL ENGINEERS, at 8.—An Experimental Investigation of the Efficiency of a Pelton Waterwheel: S. Henry Barraclough.

SUNDAY, JANUARY 31.

SUNDAY LECTURE SOCIETY, at 4.—Ancient and Modern Views of Fire: Dr. C. W. Kimmins.

MONDAY, FEBRUARY 1.

SOCIETY OF ARTS, at 8.—Material and Design in Pottery: Wm. Burton.

SOCIETY OF CHEMICAL INDUSTRY, at 8.

VICTORIA INSTITUTE, at 4.30.—Paper by Dr. J. D. Macdonald, F.R.S.

TUESDAY, FEBRUARY 2.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—General Account of his Expedition to the North Pacific: G. E. H. Barrett-Hamilton.—A Catalogue of the Reptiles and Batrachians of Celebes, with special reference to the Collections made by Drs. P. and F. Sarasin in 1893-96: G. A. Boulenger, F.R.S.—Further Contributions to the Knowledge of the Phytophagous Coleoptera of Africa, including Madagascar: Martin Jacoby.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Diversion of the Periyar: Colonel J. Pennycuick, R.E.—Cold Storage at the London and Indian Docks: H. F. Donaldson.

MINERALOGICAL SOCIETY, at 8.—On Altaite from Burma: Prof. Henry Louis.—On Nemalite from Afghánistan: F. R. Mallet.—Chemical Analysis of Derbylite: G. T. Prior.—Homogeneous Structures and Circular Polarisation: William Barlow.

WEDNESDAY, FEBRUARY 3.

GEOLOGICAL SOCIETY, at 8.—The Sub-genera Petalograptus and Cephalograptus: Miss G. L. Elles.—On some Superficial Deposits in Cutch: Rev. J. F. Blake.—Coal—A New Explanation of its Formation or the Phenomena of a New Fossil Plant considered with reference to the Origin, Composition, and Formation of Coal Beds: W. S. Gresley.

ENTOMOLOGICAL SOCIETY, at 8.—On Obscure and Little-known Microlepidoptera from the Collection of Mr. J. B. Hodgkinson: Mr. Tutt.—Seasonal Dimorphism in African Butterflies: Dr. A. G. Butler.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Meat Extracts and similar Products: Otto Hehner.—The Distillation of Formaldehyde from Aqueous Solution: Norman Leonard, Harry M. Smith, and H. Droop Richmond.—Some Analyses of Water from an Oyster Fishery; Remarks on Formaldehyde: Charles E. Cassal.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4 30.—The following Papers will *probably* be read:—On the Condition in which Fats are absorbed from the Intestine: B. Moore and D. P. Rockwood.—The Gaseous Constituents of certain Mineral Substances and Natural Waters: Prof. W. Ramsay, F.R.S., and Morris W. Travers.—Some Experiments on Helium: Morris W. Travers.—On the Gases inclosed in Crystalline Rocks and Minerals: Prof. W. A. Tilden, F.R.S.—On Lunar Periodicities in Earthquake Frequency: Prof. C. G. Knott.

ROYAL INSTITUTION, at 3.—Some Secrets of Crystals: Prof. H. A. Miers, F.R.S.

SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.

LINNEAN SOCIETY, at 8.—A Revision of the Tribe Naucleæ (Nat. Ord. Rubiaceæ): Dr. G. D. Haviland.—A Contribution to the History of New Zealand Echinoderms: H. Farquhar.

CHEMICAL SOCIETY, at 8.—The Oxidation of Nitrogen: Lord Rayleigh.—Researches in the Stilbene Series, I.: Dr. J. J. Sudborough.—Diorthosubstituted Benzoic Acids, III.; Hydrolysis of Substituted Benzamides: Dr. J. J. Sudborough, Percy G. Jackson, L. L. Lloyd.—Apparatus for Steam Distillation: Dr. F. E. Matthews.—Oxidation of Sulphurous Acid by Potassium Permanganate: T. S. Dymond, F. Hughes.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Fourth Report to the Alloy Research Committee: Prof. W. C. Robert-Austen, C.B., F.R.S.

CAMERA CLUB, at 8.15.—Flying Machines and Automatic Guns: Hiram Maxim.

CONTENTS.