THURSDAY, SEPTEMBER 3, 1896.

AN AMERICAN PROFESSOR.

Memoirs of Frederick A. P. Barnard, D.D., LL.D., &c., Tenth President of Columbia College in the City of New York. By John Fulton. Pp. xii + 485. (New York: published for the Columbia University Press by The Macmillan Co. London: Macmillan and Co., Ltd. 1896.)

THE name of Barnard is honourably associated with the history of education in the United States. To English readers, the best-known bearer of the name is the Hon. Henry Barnard, formerly United States Commissioner of Education, and now living in retirement at Hartford, Connecticut. As the author of numerous local and special reports, and the compiler of valuable statistics and monographs on the various aspects of public instruction; and particularly, as the editor of four or five massive volumes containing reprints of standard treatises on the philosophy and history of education in England and Germany, he has done more than any man in the American Union to promote the study of pedagogical literature.

The present volume recounts the history and doings of one who is less generally known on this side of the Atlantic—the Rev. Frederick A. P. Barnard, a versatile, fluent, and vigorous man who filled with credit many academic offices, and exercised considerable public influence, both within and without the college and university world of America. He was born in 1809, and graduated at Yale 1828, became tutor in 1829, teacher in the asylum for the deaf and dumb at Hartford and in that of New York, his own interest in children thus afflicted being greatly enhanced by the defect of hearing which troubled him through life, and which he manfully strove to fight against. In 1837 he was professor of mathematics and natural philosophy in the University of Alabama, and afterwards of chemistry, remaining in that University till 1854, when he took orders in the Episcopal Church, and became professor of mathematics and astronomy in the University of Mississippi, becoming its president in 1856. He removed to Columbia College in 1864, subsequently served as United States Commissioner to the Paris Expositions of 1847 and 1878, and wrote for the former an elaborate report on machinery and the industrial arts. His versatility and many-sided interests are well illustrated by the facts that he occasionally served as professor in literature and history, and that his published works include a treatise on arithmetic; an analytic grammar with symbolic illustration descriptive mainly of a system designed for the use of the deaf and dumb; letters on Collegiate Government, 1855; history of the United States Coast Survey, 1857; recent progress of Science, 1869; and the Metric System, 1871. Although no scientific observation or discovery of an original kind can be ascribed to him, he was a member in 1860 of the astronomical expedition to observe the total eclipse of the sun in Labrador, in 1862 he was engaged in continuing the reduction of the observations of the stars in the southern hemisphere by Gillis, and in 1863 had charge of the publication of Charts and Maps of the United States Coast Survey. He served in 1860 as President of the American Association for the Advancement of Science, and in 1872 of the American Institute. He received honorary degrees from Jefferson College, Missouri, from Yale and from Mississippi, and also that of Doctor of Literature from the University of the State of New York. During part of his life he served as editor of a review, and was a frequent contributor to newspapers and magazines, both in prose and verse.

The pious care of his widow in collecting his speeches and reports, and the facile pen of his biographer, Mr. Fulton, have produced a large volume of nearly 500 pages, which, though containing many facts illustrative of the growth of higher education in America, and much information respecting significant but ephemeral academic controversies, strikes the English reader as somewhat disproportioned to the amount of Barnard's actual achievement and force in the world. A due sense of historical perspective, and of the difference between what is temporary and what is permanent in a human life, is one of the highest and, it must be owned, one of the rarest qualifications of a biographer. Had it been possessed by the author of this volume, the narrative might with great advantage have been reduced to half its present length.

Barnard's views about the purpose of education, though not novel, showed insight and good sense.

> "It has always seemed to me," he said, "to be the great, as it is the almost universal, educational mistake of our time, that children, instead of being introduced to subjects which address the perceptive faculties, and which are adapted to furnish them with a flood of novel and clearly comprehensible ideas, are usually condemned to the dreary study of unintelligible words, which impose a heavy burden on the memory, and are only apprehended after the understanding has become matured with advancing years."

He saw also, with greater clearness than many of his associates, the intellectual dangers of that "elective system" which has obtained so much favour in the States, and the confusion which would arise, especially in small colleges, "if every student were allowed to study what he chose, all that he chose, and nothing that he did not choose." He insisted with much force that the demand for such options "did not proceed from a genuine desire for special or partial instruction, but simply and solely from the ambition to obtain the college stamp of scholarship without submitting to that severe and systematic intellectual training which alone can make the scholar."

Of his resolute opposition to Slavery, and of his sympathy with the party of Union in the Civil War, notwithstanding the prevalent feeling among his neighbours in the South, the volume gives an interesting account. It was not till his removal to Columbia College in New York, that he acquired full freedom to carry into effect his views on academic organisation and reform without being hindered by quasi-political opposition or distrust. At fifty-five years of age he was elected to the presidency of that institution, which, though with an interesting history and considerable resources, had hardly entitled itself to the rank of a university. By the development of a School of Mines and the Schools of Law and of Medicine, and especially by the provision of new means and encouragement for post-graduate research, Barnard did much to vindicate the claims of Columbia College to that rank, and to secure for it increasing repute and public usefulness. He urged on the Trustees the importance of making the College available for the advanced education of women, and succeeded after long and arduous effort in establishing what is now known as the Barnard Annexe to the College, a feminine institution practically under the care of the same professors, and aiming at the same academic course. In 1882 he took the first steps in a movement with which the name of Dr. Murray Butler has since been conspicuously associated for establishing a professorship in the literature, history, and art of Education, and for securing professional training for those students who intended to become teachers. On the whole the book, though diffuse in style and encumbered with some needless detail, is a useful contribution to educational history. It is the record of a strenuous and honourable life, of high and generous aims often obscured by discouragement, but ever kept steadily in view, and of a considerable number of experiments, both in regard to instruction and discipline, which have done much to render the solution of educational problems easier, especially in America. J. G. Fitch.

APPLIED CHEMISTRY OF NITRO-EXPLOSIVES.

Nitro-Explosives. By P. Gerald Sanford, F.I.C., F.C.S. Pp. xii + 270. (London: Crosby Lockwood and Sons, 1896.)

WE had lately under our notice a work on explosives which dealt with their manufacture more from an engineer's point of view than from that of a chemist, and consequently the various appliances were described with a detail which only a practical engineer could properly express. In the present volume the processes are placed before us exclusively from a chemist's point of view, and the appliances and machines used receive generally but a brief notice; indeed, some fifty sketches is the sum total of the illustrations covering the apparatus used in the manufacture of the numerous nitro-compounds touched upon in the book. Of these sketches a considerable number are of different pieces of chemical apparatus made use of in testing the raw or finished material.

The author first briefly considers some of the chemical groups from which the nitro-compounds are formed, and, in doing so, volunteers the statement that "the nitro-explosives belong to the so-called High Explosives." This, however, depends very much on whether these explosives are intended to be used as disruptive agents for producing local effect, or as propelling agents. In other words, taking Hess's definition, a high explosive is one which requires the use of a detonator to develop its full value, as with guncotton or dynamite; a low explosive, as gunpowder, does not require a detonator, but will exert its full power by simple ignition. Here again, however, we require to make some qualification as, although all the nitro-explosives are high explosives in one sense, it depends on whether they can, or cannot, be detonated in order that we may define them as high explosives pure and simple, or as explosives of high energy. Practically speaking, only the latter are suitable for propelling or ballistic purposes, while the former class should be used as blasting agents only. An explosive which can be detonated by a detonator, can also, by suitably confining it, be often exploded by a simple ignition in such a manner that its explosion really becomes a detonation, or partakes of the nature of a detonation, *i.e.* very high local pressures are developed. It is, therefore, a matter of considerable importance to definitely ascertain that explosives to be used as ballistic agents cannot be detonated.

The chief value of the book depends on those portions dealing with the manufacture of nitro-glycerine, dynamite, and guncotton, and the testing of the raw and finished material. The descriptions relating to these explosives show very evidently that the author has personally participated in their manufacture, and his remarks, which are generally to the point, are consequently of considerable value to chemists and others engaged in similar operations. Mr. Sanford very properly lays much stress on the testing of the materials used in all the stages of manufacture, and it will be found that nearly as much space has been devoted, in different parts of the book, to testing and analysis as to the actual manufacture of the explosives. Unfortunately, the reader is credited with being already more or less familiar with the appliances connected with the manufacture of explosives, and therefore the author apparently considers that a brief notice is all that is necessary. Nitro-glycerine and nitro-cellulose have, however, become so important in connection with civil and military undertakings, that those who employ such explosives are glad to be able to read an interesting account which is trustworthy without being exhaustive, and which does not make too great a demand on the pocket. To such this book is especially recommended, as these substances receive the greatest share of attention, and they form the basis of the more powerful and popular blasting materials, and also of practically all the smokeless powders used in small arms or artillery; but, besides these uses, nitro-cellulose (collodion-cotton) is employed to a very large extent in the production of that most useful material called celluloid, xylonite, or imitation ivory, of which so many articles of every-day life are made, such as knife-handles, buttons, photographic dishes, and billiard balls. The manufacture of this substance forms one of the most interesting portions of the book, and, although not properly coming under the category of an explosive, it finds a fitting place in this work.

It must not, however, be forgotten by those who make use of celluloid that it becomes, under certain conditions, a powerful explosive. Celluloid shavings also should never be allowed to accumulate, as they take fire easily at a comparatively low temperature, and, in this state, burn with surprising rapidity.

In the analysis and testing of explosives, to which, as we have stated above, due prominence has been given, the various operations are briefly but concisely explained. They are evidently written for the use of practical chemists, and will, no doubt, be duly appreciated by them. With regard to the heat or stability test which is applied to most explosives before they are passed for service, it has lately been put beyond doubt that the sun's rays have a marked effect on some explosive substances, thereby shortening very materially the length of time they are able to stand the test, without, however, undergoing any other suspicious change; indeed, if they be subsequently allowed to stand for a time in a cool place out of the reach of white light, they recover their apparently lost property, and stand the heat test as well as ever.

The effect of sunlight on both guncotton and nitroglycerine has long been known, but it is only lately that this important point has received much consideration in Government and private factories. Care is now taken to screen off direct sunlight, or even white light, by some non-actinic material placed over the windows.

We feel constrained to make a few remarks on one other point, viz. the author, in detailing the various advantages claimed for a certain smokeless powder, states that it gives *lessened recoil* and *high velocity*. Now these are very common advertising phrases of no practical value, as the recoil of a gun is nearly proportional to the velocity of the projectile, by a well-known law of dynamics. Taking the figures given—38 grains of the particular powder referred to was necessary to obtain the same velocity (about 2000 f.s.) as the service charge of cordite, 31 grains in the Lee-Metford rifle with a 215 grain bullet. Now

$$\text{Velocity of recoil} \times \text{weight of gun}$$
$$= \text{velocity of bullet} \times (\text{weight of bullet} + m \text{ weight of charge}),$$

m being a factor, which is found by experiment to be practically constant.

It will be seen at once that, other conditions being equal, the heavier charge must give the greatest recoil.

H.

THE PRACTICE OF MASSAGE.

The Practice of Massage; its Physiological Effects and Therapeutic Uses. By A. Symons Eccles, M.B. Aberd. Pp. 377. (London: Macmillan and Co., 1895.)

THE rubbing and kneading of the surface of the body, and various modifications of such processes for the relief of pain, have been in vogue from time immemorial in many countries, both civilised and uncivilised. It is well known, indeed, that the natives of India have always largely employed such measures, and that even among the aboriginal tribes of America something of the kind has been practised. Mechanical frictions and rubbings were included by Hippocrates and Galen in their systems of therapeutics, and in some form or shape they have ever since been in use in the older spas and baths of Europe. But although the practice is so ancient and so widespread, its admission into modern medicine as a recognised means of treating disease only dates from the present century, and the literature of the subject—now comparatively large—may be said to have had little or no existence fifty years ago. The Scotch and French physicians seem to have been the first in modern times to investigate the subject scientifically; and it is to the latter, in particular, that we owe the systematic ways of application of the various manipulations now in use, as well as the nomenclature which is now practically universally adopted by practitioners in all civilised countries. Within the last few decades a considerable number of valuable observations on the uses and effects of massage have been published, as well as several comprehensive text-books on the subject. Among these latter, the work now before us is likely to take an important position; for not only is it the outcome of a lengthy and extensive practical experience on the part of the author, but it is written in a scientific spirit, and, indeed, constitutes a very able *résumé* of the whole subject.

Dr. Eccles commences by describing the different manipulations and the methods of applying massage in general, as well as to particular parts of the body. In the second chapter, he treats of the physiological effects of massage; and it is in this department that we naturally feel most interest. As might be expected, the effects vary with the kind of manipulation; thus gentle "effleurage," or skin stroking, will give rise, first, to a pilo-motor reflex, or condition of "goose-skin," and if firmer friction be employed, a dilatation of the superficial cutaneous vessels is produced, followed by increased activity of the sweat glands. The direction of the stroking being centripetal, the contents of the superficial veins and lymphatics are forced along, and the rapidity of the cutaneous circulation increased. Among the important results of effleurage, the author mentions a general soothing effect on the nervous system, and an acceleration of the heart-beat. With the process of "pétrissage," or the kneading, rolling, and squeezing of the integuments and underlying tissues, it is shown that the circulation of the skin and contiguous muscles is still more accelerated, the absorption of waste products promoted, and the general nutrition of the parts improved. Muscle-kneading thus serves as a substitute for muscular exercise, and also as a restorative of fatigued muscle. The experiments of Lauder Brunton and Tunnicliffe on the effects of massage on blood-pressure are here alluded to, as well as the author's interesting observations on the results of muscle-kneading on the temperature of the body.

"Tapotement," or the delivery of a rapid succession of blows, produces its principal effect through the direct stimulation of the nerve trunks; localised muscular contractions are induced; and if applied over a molar nerve, the muscles supplied by that nerve are profoundly affected. The author observes, moreover, that stimulation of the sensory nerves by this "muscle-hacking" while producing increased temperature and vascularisation of the part so treated, may also give rise to symmetrical reflex secretion. The various movements classed under the head of "vibrations," are also designed to act mechanically on the subjacent nerves, and thereby to produce reflex effects of a sedative character. The author has frequently, for instance, observed relief following nerve-vibration in non-inflammatory abdominal pain. The so-called "massage à friction," especially used for the manipulation of joints, is a combination of rubbing and kneading, having for its purpose the dissipation and squeezing out of waste products from the tissues in which they have accumulated; and in this connection von Mosengeil's experiments are quoted, which show conclusively that artificial injections in a joint can be removed by massage, and forced into the ascending lymphatics.

The succeeding chapters of the book treat of the therapeutical uses of massage in affections of the skin, of the muscles, in rheumatism, sprains, dislocations and fractures, disorders of digestion, anæmia, obesity, nervous affections, insomnia, heart diseases, and in many other maladies in which mechanical manipulations, intelligently and skilfully employed, have been proved to be efficacious after other means of treatment have failed.

The author gives, throughout his work, succinct and practical directions, which will prove of the greatest use to those practitioners who have had no experience of a treatment which is now generally accepted in the medical profession as one of the most useful in therapeutics.

OUR BOOK SHELF.

Catalogue of the Fossil Bryozoa in the Department of Geology, British Museum (Natural History). The Jurassic Bryozoa. By J. W. Gregory, D.Sc., F.G.S., F.Z.S. Pp. 239; pl. xi. (London: 1896.)

THIS catalogue is a valuable addition to the twenty-two monographs which have already been devoted to the various groups of fossils preserved in the Geological Department of the Natural History Museum. The Trustees of the British Museum have earned the gratitude of palæontologists, and of naturalists generally, by bringing together such a wealth of information upon the fine collections under Dr. Henry Woodward's care.

In an introduction, Dr. Gregory discusses the problem of tubular fossils, the affinities, and the structure of Bryozoa, the terminology of the shells of the Cyclostomata and Trepostomata, and the value of generic divisions in the latter order. In this section, the differences of opinion between those who attribute generic value to trivial differences, and those who prefer to restrict the number of genera, are described. The discussion of transitions traced in groups of Cyclostomata, leads to the examination of the question whether there are really genera and species among Cyclostomatous Bryozoa. Taking the genera *Diastopora* and *Berenicea* as exemplifying the real value of zoarial characters in the order, they seem to support the admission that "there are no true genera among Cyclostomata, but only certain convenient, but artificial, groups of species. . . . I therefore accept the terms *Stomatopora*, *Proboscina*, &c., as names for convenient groups, which are not altogether artificial, but which are not genera in the sense in which that term can be used among Echinoidea and Mammals. They could be better described as circuli than as genera."

From the subject of generic divisions, Dr. Gregory passes to specific groups and individual variations. The comparison of the forms of Bryozoa that lived in successive geological periods, appear not to lend support to Mr. Bateson's views as to discontinuous variation. "The general evidence of the fossil specimens," says Dr. Gregory, "and the great difference of opinion as to the range of specific variation between those who multiply species indefinitely, and those who place Silurian and recent individuals in the same species—tend to show that most of the forms of Cyclostomata have arisen by slow, imperceptible, continuous variation."

With the exception of two species (both members of the order Cheilostomata), all the Jurassic Bryozoa belong to the order Cyclostomata. This order is classified by Dr. Gregory into four sub-orders, viz.: I. Articulata; II. Tubulata; III. Dactylethrata; IV. Cancellata. The first of these groups is not represented in the Jurassic, and species of the fourth group do not appear until the Cretaceous period. The names of the second, third, and fourth groups are based upon zooecial structure, while the subdivisions of the groups depend upon zoarial characters.

From the foregoing outline of the teachings of Dr. Gregory's examination of the Bryozoa of Jurassic times, it will be concluded that the catalogue furnishes facts of distinct value in working out the evolution of the class. Eleven plates, containing many admirable drawings of the species described, have been prepared for the catalogue by Miss G. M. Woodward. These, with the careful determinations and critical introduction, make the catalogue not only most acceptable to all palæontologists, but also of the greatest interest to systematic zoologists.

Water Supply (considered principally from a Sanitary Standpoint). By Wm. P. Mason. Pp. 504. (New York: John Wiley and Sons. London: Chapman and Hall, Ltd., 1896.)

THIS is an unusually interesting treatise on a technical subject, about which so much has been already written, and the author is to be congratulated on the large amount of new information which he has succeeded in compressing into a comparatively small volume without rendering it heavy and unreadable. The book is full of facts gathered from the most varied sources, so that even the expert in this department of knowledge will find it a convenient work of reference, whilst it may also be perused with great profit by that large and ever-increasing body of laymen who, as medical men, members of local boards, landlords, and the like, are supposed to have some acquaintance with this subject, and whose responsibilities in this connection are generally out of all proportion to their knowledge. Prof. Mason has collected the results of the principal investigations bearing on the sanitary aspects of water supply, made both in Europe and America, and European readers should be specially grateful to him for the lucid and concise manner in which he has summarised and abstracted the important trans-atlantic labours in this direction, and the original description of which is only to be found in comparatively inaccessible and exceptionally voluminous writings of an official character. There are many points in connection with the sanitary aspects of water supply, on which, as is well known, the most conflicting opinions are prevalent amongst experts, and not the least commendable feature in this work is the impartiality and fairness with which the author has marshalled and reviewed the evidence adduced by the contending parties.

Botany for Beginners. By Henry Edmonds, B.Sc. Pp. 117. (Longmans, Green, and Co., 1896.)

THE author hopes that this little botany primer "may be the means of exciting an interest in the subject in the minds of the young." He is a teacher, and should therefore know that a multitude of new names is the reverse of exciting to young students, yet this is how the definitions are crowded in on page 3: "They [certain leaves] are spoken of as **radical** leaves (Latin, *radix*, a root). Others are attached to the stem, and are described as **cauline** (Latin, *caulis*, a stem). The radical and lower cauline leaves possess a stalk, or, as it is called, a **petiole**. This attaches the flattened part, or **blade**, to the stem. The upper cauline leaves have no such stalk, the blade being immediately attached to the stem, or **sessile**." And again on page 5: "Each of these is called a **carpel**, while the group of carpels is termed the **pistil**. Each carpel consists of a swollen portion, the **ovary**; on top of this there is a little head, the **stigma**." This is all very well, and the language of botany must, of course, be learned at some stage or other; but, at the same time, the designations follow one another so closely, that the pupils who use the volume as a reading-book will get bewildered.

The book is not, however, without its good points. It is liberally illustrated, the descriptions refer to common British flowers, and a few simple experiments are introduced to exemplify the functions of the different organs of plants. A good teacher may make the lessons in the book interesting, but of themselves they are not very inspiring.

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.*]

Utility of Specific Characters.

PROF. LANKESTER'S lucid statement in NATURE for August 20, shows that a part of his objection to my position is due to my own want of skill in stating clearly what I mean.

I am far from wishing to reject the method of imaginative hypothesis and subsequent experiment or observation. I respect that method as sincerely as Prof. Lankester himself, and although I cannot pretend to his measure of skill in using it, yet, so far as I can see, I have, in my work on the frontal breadth of crabs, employed this very method to the best of my ability. The hypothesis with which I started was, that if natural selection acted upon the frontal breadth of crabs at all, there ought to be a demonstrable difference between the percentage of abnormal frontal breadth in young crabs, and the percentage of the same abnormalities in older crabs; and I proceeded to test this hypothesis by measurement of crabs of different sizes. The result showed that a change in the frequency of abnormal frontal breadth could, in fact, be observed. The effort of imagination was here small enough, but, such as it was, it served to guide my first step; and, having made this first step, I had to formulate a second hypothesis. A diminution in the frequency of abnormal frontal breadth, with increasing size of crabs, might be due either to a selective destruction of abnormal crabs during growth, or to a modification of these crabs, by which abnormal individuals lose their abnormality as they grow. In order to decide which of these imaginative hypotheses should be adopted, I have spent a great part of the last two years in ascertaining the law of growth of crabs, so far as their frontal breadth is concerned. Setting the question of skill on one side, the only difference I can perceive between the method of this whole investigation and that of any research conducted by Prof. Lankester, is a difference in the tools employed in verification of hypotheses. The only tool which I have used has been some kind of measuring scale; and, although this kind of tool is more unpleasant to work with than those used by more fortunate persons, it does not imply any difference in the method of work.

Further, assuming the law of growth to yield evidence of selective destruction, so that change in frontal breadth is correlated with change in death-rate, I heartily agree with Prof. Lankester that a further hypothesis ought to be formulated as to the whole process connecting change in frontal breadth (and the whole group of characters correlated with it) with change in death-rate. The only step taken by Prof. Lankester, which I cannot follow, is the admission of hypotheses in which some of the factors of the problem are neglected. I should like to explain what I mean by this.

In *Carcinus mænas* I have shown that change of frontal breadth is correlated with change in several other dimensions of the exoskeleton; and I have no doubt that it is correlated also with change in the size and shape of several internal organs, such as the brain, liver, kidneys, and others. I have not measured such an oxyrhynchous crab as *Stenorhynchus*; but it is probable that the changes among internal organs correlated with change in frontal breadth, will prove to be very different in such a crab as *Stenorhynchus* from the corresponding changes in *Carcinus*.

Let us suppose, therefore, that the liver is shown to vary when the frontal breadth of *Carcinus* varies, but not when the frontal breadth of *Stenorhynchus* varies; and suppose, further, that an hypothesis is submitted as to the process by which change in the liver of *Carcinus* leads to change in the death-rate. It seems to me that, unless one of the steps in this process involves a change in frontal breadth, the hypothesis must be rejected, because one of the properties of the liver of *Carcinus* is not accounted for. The hypothesis submitted may be true of *Stenorhynchus*; but, since it neglects one of the differences between that animal and *Carcinus*, it cannot be true of both.

To put the matter in another form: suppose I wish to obtain hydrogen from sulphuric acid, I can do so by adding to the sulphuric acid a certain quantity of zinc. From a known quantity of sulphuric acid I can obtain a definite quantity of hydrogen, and I shall, in so doing, dissolve a definite quantity of zinc with the formation of a definite quantity of zinc sulphate. If, instead of dissolving zinc, I dissolve iron in my sulphuric acid, I can still obtain from it the same quantity of hydrogen, but the quantity of iron required will not be the same as the quantity of zinc used in the previous experiment, and the resulting sulphate will be different. It is, of course, impossible to form an exact hypothesis of what occurs in either of these cases, if I pay attention only to the evolution of hydrogen, and regard the formation of sulphate as an unimportant concomitant. I must in each case form a theory of the behaviour of the metal, the hydrogen, and the acid radicle; and, so far as it fails to account for any fact concerning any one of these bodies, my theory is imperfect.

In precisely the same way, it seems to me that we ought not to rest content with any theory of an animal structure which does not account for all the phenomena associated with it; so that a theory of the function of frontal breadth in a crab should, I think, involve every organ correlated with it. It may be said that such a theory is unattainable because of its complexity; and this is certainly at present true; but the habit of regarding one or other of the properties of an organ as unimportant, would for ever prevent the formation of such a theory even if it were otherwise possible.

It is this sense of the necessary complication of such hypotheses which makes me glad to assert that they are unnecessary to a knowledge of the factors of evolution. It is possible to know that change in frontal breadth in a *Carcinus*, for example, is associated with change in death-rate under the conditions of Plymouth Sound; so that those crabs in which the frontal breadth has a particular magnitude, can be known to have a greater chance of living and breeding than those of different frontal breadth. A complete knowledge of the processes associated with this relation between frontal breadth and death-rate is a thing of very great interest, and I believe, as firmly as Prof. Lankester, that every effort should be made to attain to it; but, desirable as it is, it is still not necessary in order to know that a crab's chance of living and breeding may be known by measuring its frontal breadth. It is not necessary in order that the change in mean frontal breadth may be measured from generation to generation, and the direction and rate of evolution by this means ascertained.

W. F. R. WELDON.

Marine Biological Laboratory, Plymouth, August 26.

The Death of Lilienthal.

I HAVE received this authentic report of Mr. O. Lilienthal's death. If you think the letter worth publishing in NATURE, it is at your service.

C. RUNGE.

Hannover, Technische Hochschule.

YOU are right in presuming that I can give you details referring to Otto Lilienthal's death, authentic as far as they can be obtained.

As early as the beginning of last spring, Lilienthal's experiments had taken a new departure. He had gradually come to the conclusion that the surfaces employed by him were not sufficient.

With a surface of twelve to fourteen square metres he could take sufficiently long flights to serve his purpose of observation and practice in strong, gusty wind, but he very rightly considered experimenting in a strong wind to be too dangerous, and with a light breeze about twenty square metres were found necessary. This enormous surface, however, could not be handled with the same certainty and exactness as the older wings, and as his system of steering consisted in shifting his weight within the surface upon which it was suspended, he had hit upon the simple expedient of placing two surfaces one above the other.

This system promised from the beginning to be a very marked advance. In former days Lilienthal had tried, over and over again, to make small paper models that would soar like birds, and had always been disappointed. Now this problem seemed to be solved. These two-story models, which resembled beetles rather than birds, soared in the most astonishing manner. He would let them off from the top of the artificial cone which he had erected at Lichterfelde, and they would take long and sometimes circuitous flights into the surrounding fields, and never showed the slightest tendency to take "headers"—a peculiarity very frequently hitherto observed in soaring models.

These experiments, therefore, seemed to prove that not only would a two-story surface be more easily steered, because a definite shifting of the centre of gravity to one side would have a more marked effect (since the lateral extension of the whole structure was little more than half of that formerly used), but would also show a greater stability, a result all the more to be expected, as the centre of gravity of the system was placed more than a metre below the upper surface.

Experiments, which were begun without loss of time, seemed to bear out this conclusion. Lilienthal appeared to have suddenly gained in power and in the faculty of shaping his motion at will. It seemed to be only a question of time or opportunity that the great step would succeed of describing a complete circle in the air (which always appeared to us to be the key to a definite, if not complete success), when the disastrous accident occurred which has cost the bold experimenter his life.

The following is, as nearly as I can remember it, the report of the mechanic who used to build Lilienthal's wings, and to help him with his experiments.

On Sunday, August 9, Lilienthal had gone out to the village Rhinow, where he used to practise on the bare sand-hills in the neighbourhood. Nobody was with him except his mechanic. The weather was exceptionally favourable, a light wind blowing from the east with a velocity of about 5—6 m. per second.

Lilienthal had selected one of these new two-story surfaces, which, in a considerable number of trials from the artificial cone in Lichterfelde, had shown itself to be especially successful. He took one flight, by way of warming to his work, and then prepared himself for a second, and gave the word to his man to look at his watch and note the duration of the flight. The man saw him soar down until he was nearly above the foot of the hill, then suddenly a gust of wind set in, lifted him up to a height of 30 m. above the ground—according to his man's estimate—and there he stood apparently motionless in the air.

This was a frequent occurrence, and gave no cause for alarm at first; but now the man saw how Lilienthal gradually lowered the fore-edge of his wings more and more, without obtaining the desired effect of getting way forward and downward. The man felt uneasy at this, pocketed his watch, and began to run towards the spot where his master was hanging suspended in mid-air. Suddenly he saw the apparatus heeling over forward still more, and then Lilienthal came down with it with great force head foremost, rolled over once or twice after striking the ground, and remained motionless.

When the man reached the spot, he found the apparatus much shattered, but Mr. Lilienthal apparently uninjured though without consciousness. The local physician was instantly summoned, and at first declared that nothing serious had happened. Lilienthal was brought to the neighbouring inn, and within two hours recovered his senses. He seems to have felt no pain, because he immediately declared he would soon get up and continue practising. However, his arms and legs were lamed. It appears that his spine was fractured.

The man left him to the care of the physician, and took the next train to town to fetch his brother. When the brother came, he found that he had swooned again; and he did not recover his consciousness until death set in, which occurred the same night.

By publishing these lines the editor of NATURE will, I think, fulfil a duty he owes the scientific world, as well as the memory of a man who, throughout his toilsome life, applied his rare energy, courage, and ability to the solving of a problem which has hitherto baffled the ingenuity of all modern engineering.

Lilienthal, who was a successful engineer and manufacturer, has not lived to see his forty-eighth birthday. He leaves a widow and three children. A. DU BOIS-REYMOND.

Berlin, August 24.

Laboratory Use of Acetylene.

NOW that acetylene has come so much into prominence, an instance of its use in a laboratory which possesses no gas supply may be an encouragement to any one similarly situated. Long doomed to the use of spirit-lamps, "benzoline roarers," and the like, the cheap production of acetylene has come as a great boon to us, and is now in regular use for blow-pipe work. The apparatus in use consists of an aspirator holding about fifteen litres, permanently connected with a water supply, and possessing a ¼-inch aperture exit tap (the water flows in from below to minimise absorption); at the top a three-hole rubber cork carries an upright pipe passing through the table, which serves for filling the aspirator with gas, or using the gas on the table, a second pipe goes to the blow-pipe, and a third carries an open mercury manometer. For filling the jar, the calcium carbide is placed in a four-ounce bottle closed by a cork carrying a small separating funnel from which the water drops; the gas passes to the aspirator through a wide glass tube which acts as a reversed condenser, returning most of the water vapour to the bottle. With the large exit to the aspirator the gas can always be collected under a reduced pressure of several cms. of mercury, which quite provides against any sudden rushes of gas; the operation takes some ten minutes, and requires practically no attention.

In using the gas the water is turned on with all taps closed for a few seconds, to correct any reduced pressure caused by absorption, as shown by the gauge (this is very slight indeed), and then the gas-tap fully opened and the flame regulated entirely by the water entrance. To bring the gas into use takes hardly any longer than with an ordinary gas blow-pipe. A good fusion on platinum foil (*e.g.* $BaSO_4 + Na_2CO_3$) may be effected by using about one litre of the gas. We have used the apparatus for about two months, and I recently discovered that some of my junior workers did not know what acetylene smelt like, which speaks well for it if not for them. I am hoping to introduce the gas on to the benches if the difficulty of the enormous quantity of air required to produce a non-luminous flame can be overcome. A. E. MUNBY.

The Laboratory, Felsted School.

Coal-dust.—A Question of Priority.

IN the report of a lecture given *in extenso* at page 64, *et seq.*, in the *Colliery Guardian*, for July 10, on "Coal-dust and Explosives," by Mr. H. Richardson Hewitt, of Derby, H.M. Inspector of Mines, the following remarkable statements occur:—

"It was but a few years ago that the Messrs. Atkinson first drew attention to their idea that coal-dust was a dangerous element in mines where blasting operations were carried on . . ."

"After Messrs. Atkinson first drew attention to the subject, Prof. Galloway took it up and made some rough experiments by placing gunpowder cartridges in heaps of coal-dust and firing them in the dark."

Although these statements were obviously uttered in ignorance of the nature of my experiments, they raise a distinct and palpable issue as to priority.

The facts are as follows:—

My first experiments with coal-dust were made on July 3, 1875. I then discovered that a mixture of air and fire-damp, which is not inflammable at ordinary pressure and temperature, on account of the smallness of the proportion of fire-damp present in it, becomes inflammable when coal-dust is added to it, and can be ignited by means of a comparatively small flame.

On December 22, 1875, I gave evidence in the capacity of Assistant Inspector of Mines at the Coroner's inquest on Llan Colliery Explosion (South Wales District), when I attributed that explosion principally to the influence of coal-dust. My evidence was discountenanced by the Chief Inspector of Mines for the district, and was not embodied in the Reports of the Inspectors of Mines, but it was reported *verbatim* in the two local newspapers (*Western Mail* and *South Wales Daily News*) of December 23, 1875.

On March 2, 1876, I read my first paper, entitled "On the Influence of Coal-dust in Colliery Explosions," before the Royal Society. In that paper I announced the coal-dust theory.

In 1878 I published a large number of articles in *Iron*, under the title of "Coal-dust Explosions." In these articles, amongst many other things, I quoted and commented upon what Faraday and Lyell had written about coal-dust upwards of twenty years previously, and I gave complete translations of the papers that had been published in France, having a bearing upon the subject.

Besides contributing a number of other articles and papers on the same subject to various societies and periodicals, I read altogether five papers "On the Influence of Coal-dust in Colliery Explosions" before the Royal Society, viz.: March 2, 1876, already referred to; February 27, 1879: May 30, 1881;

December 29, 1881; May 8, 1884; and one on "A Coal-dust Explosion," February 17, 1887.

During the ten years ending in 1885, I was engaged from time to time in carrying out experiments with coal-dust: first, with apparatus provided by the Glamorgan Coal Company, Limited, and erected at their Llwynypia Colliery; secondly, with apparatus purchased by means of Government grants obtained through the Royal Society; and, thirdly, with apparatus belonging to the Royal Commission on Accidents in Mines.

Before the accounts of my earlier investigations, and the conclusions founded upon them had appeared, the Inspectors of Mines and other mining experts were practically unanimous in attributing the cause of every great colliery explosion to the sudden outburst of a large volume of fire-damp which was supposed to have flooded the workings, become mixed with the air, and, on being ignited in one way or another, produced the various phenomena subsequently observed. This explanation was accepted everywhere as the only one possible; it was recorded in the official reports of the Inspectors of Mines, and they, as well as the experts of that generation, were irretrievably committed to it.

There was not, figuratively speaking, a ripple of dissent from this mode of explanation upon the placid surface of mining opinion at the moment the coal-dust theory was launched upon it.

At first the new theory was ignored; then it was scouted; then it was subjected to scathing criticism; then it was taken up in a tentative manner by some of the younger and bolder men; and, lastly, when it was found to be making serious headway, one of the more adventurous spirits suddenly discovered that it was not new after all, for had not Faraday and Lyell and certain French engineers been its real authors?

Following my lead, first a joint paper, by Messrs. Hall and Clark, was contributed to the North of England Institute, in May 1876, then another by Messrs. Marrecco and Morrison, in 1878, all of whom, with the exception of Mr. Clark, had previously corresponded with me on the subject of explosions; finally, in the year 1879, after the publication of my articles on "Coal-dust Explosions" in *Iron*, and during the next few years afterwards, a very great army of investigators, headed by Government Commissions in England, France, Prussia, Austria and Saxony, and including the Messrs. Atkinson, entered the field.

Some of these investigators contented themselves with criticism pure and simple; others, of whom many had neither aptitude nor training for the work, made experiments with small and imperfect apparatus, and, as a consequence, obtained only negative results; still others were carried away by the side issues; and only a few, such as the Prussian and Austrian Commissions, and Messrs. Hall and Atkinson, H.M. Inspectors of Mines, did really good and substantial work of an enduring kind.

The facts and conclusions recorded in my earlier papers were freely drawn upon: by some they were generously acknowledged; by others they were first denounced and then assimilated; by others they were adopted without acknowledgment; while some of my experiments, and notably my investigations into the nature of the Fire-damp Cap (*Proc. Roy. Soc.*, March 2, 1876), were repeated with some variations and described as if they were original.

A flood of literature was now poured upon the mining world from every side, embodying opinions of the most conflicting and mystifying character, such as—a mixture of coal-dust and air may take fire but it cannot explode; coal-dust can only carry flame from one accumulation of fire-damp to another; a coal-dust flame cannot extend throughout the workings of a mine in the entire absence of fire-damp; a small proportion of fire-damp must always be present in the air when an explosion takes place; some kinds of coal-dust are more inflammable than others—and so on, so that amid the din and hurlyburly of the strife the main question of how to put an end to great explosions was almost lost sight of.

But the scene of each successive explosion when viewed under the new light served gradually to dispel the illusions which had fascinated the majority of the investigators for years; and thus it has come to pass that the new generation of Inspectors of Mines, and those who have been associated with them in investigating the phenomena of explosions, have become convinced, I believe almost to a man, of the soundness of the coal-dust theory; and that the struggle of contending factions, which was at its height ten or twelve years ago, has gradually subsided, leaving us face to face with a work which still remains to be done, namely, to render the occurrence of a great colliery explosion impossible in the future.

Into the consideration of that problem I do not propose to enter on the present occasion, as I have lately done so in considerable detail in the pages of the *Daily Chronicle* of June 24 of the present year.

W. GALLOWAY.

Cardiff, July 17.

THE AUGUST METEOR SHOWER, 1896.

THE moon being absent from the nocturnal sky during the recent return of the Perseids, encouraged the hope that the shower would be somewhat brilliant; but the weather is an element of great importance in such observations, and it was by no means favourable during the late display. In the south of England several nights were partly clear near the important time, and on August 10 the firmament at Bristol was almost free from dark cloud; but the sky was hazy and the stars dim, so that only the brighter meteors were observed.

On August 6, during an hour's watch before 10h. 50m., I counted twelve meteors, of which seven were Perseids, with a radiant at $42° + 56°$. The shower was evidently pretty active, and the meteors fairly bright, but clouds overspread the sky before 11h., and prevented further observation.

On August 7, in an hour's watch preceding 11h., nine meteors were seen, including about six Perseids, but clouds were very prevalent during the whole time, and effectually obliterated the stars at a later period of the night.

On August 10 the weather was fine, but the atmosphere was not transparent enough to be considered favourable for meteoric work. Haze was spread over the sky, and the fainter stars were obscured. Near the horizon nothing could be discerned. I began watching for meteors at about 9h. 50m. and continued until 14h. 15m. During this interval of 4h. 25m. I saw ninety-eight shooting-stars, of which sixty-nine were Perseids, and twenty-nine belonged to the minor, contemporary showers of the period. I registered the apparent paths of a considerable number of the meteors seen, and while engaged in doing this, must have missed many others which appeared while my attention was diverted from the sky. It is probable that fully one hundred and fifty meteors would have been counted by an observer watching the sky uninterruptedly during the period mentioned. Nearly all the Perseids left streaks, but the meteors generally were not very bright. The radiant point was tolerably well defined, but it was certainly not so definitely marked as I have sometimes seen it. I determined it at different times of the night as follows:—

h. m.		h. m.		° °
9 50	to	11 0	... ...	43 + 57
11 0	to	11 30	... ...	44 + 57
11 30	to	13 0	... ...	46 + 57
13 0	to	13 45	... ...	45 + 59
13 45	to	14 15	... ...	46 + 57

The mean of the five positions being at $45° + 57°$, which coincides with the usual place of the radiant on August 10.

On August 11 the heavens were overcast, but on August 12 a beautifully clear sky enabled me to resume observations. I saw fourteen meteors in about an hour and a quarter before 11h. 15m., and of these seven belonged to the Perseid shower. The radiant was at $46° + 57°$, but it was imperfectly defined.

On August 14 the firmament was again clear, and I saw nine meteors in three-quarters of an hour before

11h. 10m., of which one only was a Perseid. The shower had evidently become nearly exhausted.

The following conspicuous meteors were recorded on the several nights of observation, and I give their paths in the hope that they have been observed elsewhere.

1896.	Time.	Mag.	Path From	Path To	Length.	Radiant.
Aug. 4	9 46	1	343° +31°	335° +10°	27°	42°+56°
6	10 6	2	340 +31	337 +58	27	342−12
6	10 6	1	343 +32	328 +10	26	42+56
10	9 54	1	103 +86	202 +79	13	43+57
10	10 39	2	27 +48	355 +39	24	60+48
10	11 24	1	15 +47	9 +43	6	44+57
10	11 39	♃	66 +84	210 +81	15	46+57
10	12 6	2	42 +45	44 +39½	6	28+72
10	12 10	2	44½+35	53½+31½	8	23+40
10	12 15	>1	28 +24	24 + 4	20	46+57
10	12 19	2	60½+31½	66 +26½	7	47+42
10	12 46	1	8 +12½	1 − 3	17	46+57
10	13 8	♃	633 +63	25 +66	5	45+59
10	13 19	1	23½+20	20½+12½	8	45+59
10	13 22	1	359 +69½	334 +68	9½	45+59
10	14 14	>1	57 +76	225 +77	27	51+31
12	9 24	♃	195 +24	199 + 9	15	46+57
12	10 41	2	26 +43½	30 +38	6	331+70
14	9 24	1	265 +22	240½+19	23	356+ 5

On the whole, I regard the display as one much inferior to many observed in past years. Both as regards the number and brilliancy of the meteors there was nothing striking to record. Had the sky proved clearer on August 10, many small meteors would have been visible, which, under the conditions prevailing, were enabled to escape detection; but making every allowance for this, there is no doubt the shower was not a conspicuous one.

As to the displacement of the radiant, which takes place on successive nights, this was indicated from my results on August 6, which gave 42° + 56° for the position, while on August 10 it was 45° + 57°, and on August 12, 46° + 57°. But my observations this year have not been sufficiently extensive for the full and proper re-investigation of this feature, nor is it required, for no good end is served by the frequent re-observation of a fact already well determined.

The usual minor showers were visible; indeed, there appears to be very little doubt that the great majority of meteor radiants are manifested annually without any great change in their visible strength. Certain showers vary more than others, but many of the differences observed are due to the alteration in the conditions under which they are presented from year to year. In 1893 there was a strong shower of Cygnids observed contemporaneously with the Perseids, but the former was but slightly seen this year, for I recorded only two of its meteors. I registered meteors from radiants at 31° + 20°, 28° + 72°, 60° + 48°, 331° + 70°, 356° + 5°, which have been noticed in preceding years, and are among the best assured positions of the August epoch. Feeble showers of this character are extremely numerous, and require long watches before an observer can satisfactorily determine their radiants. Some of them fall so near together that they cannot be disassociated unless the observations are very numerous and accurate.

I observed no fireballs during the recent return of Perseids; but Mr. Blakeley, of Dewsbury, reports that he saw meteors as brilliant as Venus on August 10, at 11.40 and 12.16, both Perseids.

The Rev. S. J. Johnson, of Bridport, writes me that he observed a good many bright meteors this year. One of the finest appeared on August 10, 9h. 50m., travelling from ϵ Cassiopeiæ to a point 7° west of β in the same constellation. Two second magnitude meteors were seen within fifteen seconds of each other at about 10h. 6½m. on the same night, which were also observed at Bristol. Their heights at beginning were 64 and 65 miles, and at ending 46 and 52 miles respectively. They were both Perseids.

Mr. Blakeley, of Dewsbury, saw about thirty-five Perseids between 11h. and 12h. 30m. on August 10, and the paths seemed to give a sharply-defined radiant at the usual maximum position.

Mr. S. H. R. Salmon, of Croydon, saw, on August 10, 20 meteors (15 Perseids) between 9h. 10m. and 10h., and 18 meteors (16 Perseids) between 10h. 10m. and 11h. The sky was perfectly clear.

Mr. D. Booth, of Leeds, on August 11, saw eighteen meteors in the forty-five minutes from 10h. to 10h. 45m., and found the Perseid radiant at 47½° + 58½°.

W. F. DENNING.

THE LIVERPOOL MEETING OF THE BRITISH ASSOCIATION.

III.

IT is possible now to forecast to some considerable extent the work of the various Sections from the information already received from presidents, recorders, and authors.

In Section A (Physics), Prof. J. J. Thomson's opening address will deal, we believe, with (1) the teaching of physics; (2) the kathode and Röntgen rays; (3) the passage of electricity through a gas; and (4) the movement of the ether. Friday will be devoted in this Section chiefly to phenomena connected with the Röntgen rays; and on Saturday the Section will divide into the two departments of mathematical physics and meteorology.

In Section B (Chemistry) the address of the President (Dr. Ludwig Mond) will deal with the development of the industrial manufacture of chlorine. Technical papers will probably occupy a large portion of Friday's sitting, including a report, by Prof. Bedson, on the composition of coal. On Monday, Prof. Ramsay will read a paper on helium, and there will be a number of other communications on helium and argon. On the same day, a paper will be read on the synthesis of the elements. It is hoped that this will lead to a discussion, to which several have promised to contribute. Other matters of interest will be an exhibition of photographs of explosions in various gaseous mixtures, by Prof. Dixon, and the report of the Committee on science teaching in elementary schools, which will be followed by a paper on science teaching in girls' schools, from Miss Walters.

It is hoped that the numerous chemical works in the neighbourhood may prove attractive to the members of the Section, and arrangements are being made for members of the Section to visit several of the most interesting works on special afternoons.

Mr. Marr's address to Section C (Geology) will be devoted to recent advance in stratigraphical geology. He will notice at some length the imperfection of the geological record, especially in the earliest times. He will advocate the continuance of that work in detail which has been the cause of our best discoveries in the past. Doubt will be thrown upon the advantage of too rigid an adherence to uniformitarianism. Lastly, he will discuss the advantage of geology as an instrument of education. In the work of the Section, more prominence than usual will be given to the reports of the research committees, several of which are likely to lead to considerable discussion. The excavations at Hoxne have been successful in proving the relation of Palæolithic man to the glacial epoch, besides yielding new evidence as to alternations of climate during the Pleistocene period. Sir William Dawson will deal with pre-Cambrian fossils, and a number of papers are promised on local geology.

In Section D (Zoology), the President (Prof. Poulton) will take as his subject a naturalist's contribution to the discussion on the age of the earth. His object is to show that the appearance in time, and succession, of the various groups of animals in every way supports evolution, but an evolution which took its rise in a very much more distant past than the Cambrian or Laurentian. The general result will be to strongly support the geologists against certain of the physicists. The other arrangements in Section D are: On Friday forenoon a debate on Neo-Lamarckian theories, probably introduced by Prof. Lloyd Morgan; and in the afternoon, a report and discussion on the fauna and flora of the Irish Sea; on Saturday, a report on the migration of birds, and then a dredging and trawling expedition in Liverpool Bay; on Monday forenoon, a debate on the ancestry of vertebrates, introduced by Dr. Gaskell; on Tuesday forenoon, a joint meeting with the Botanical Section for a discussion on the cell theory; while Wednesday and the remaining afternoons will be occupied by papers which have been announced by Prof. Minot and Messrs. Macbride, Newstead, Benham, Traquair, Hartog, and others. Sir William Dawson brings some fresh evidence in regard to *Eozoon*, and Dr. Traquair will give the latest information in regard to *Palæospondylus*, illustrated by recently acquired specimens and an enlarged model.

In Section E (Geography), the address by the President (Major L. Darwin) will deal largely with African railways. Papers have been promised by a number of travellers and others, including Mr. Moir (climate of Nyassaland), Mr. Heawood (African geography), Rev. C. H. Robinson (Hausaland), Mr. Fletcher (journey in Tibet, with Mr. Littledale), Mr. J. Coles (photographic surveying), Mr. Vaughan Cornish (sand-dunes), Mr. H. N. Dixon (marine research in North Atlantic), Mr. E. A. Fitzgerald (the New Zealand Alps), Mr. A. W. Andrews (geography and history in schools), Mr. A. J. Herbertson (geographical teaching), Prof. J. Milne (Japan and its earthquakes), Dr. H. R. Mill (local geography of England), Mr. Harry Lake (the Gambia and Senegal). It is hoped that papers will also be offered by Count Pfeil, Mr. Lewin, Mr. Howard, Colonel Woodthorpe, the Archduke Ludwig Salvator, Captain Vandeleur, Colonel Trotter, Mr. Hull, and Mr. Fowler. There will also be reports on African climatology and on geographical education.

In Section G (Mechanical Science), the President's address, on Thursday morning, will be followed by a report of the Committee on Tides, and after that comes a paper by Mr. G. F. Lyster on the Dock development of Liverpool. There will be other papers on local engineering works, the Atlantic steamships, the overhead railway, and the Liverpool waterworks. Papers are also announced by Mr. Wolf Barry on the Tower bridge, by Prof. Mengarini on the electric light and tramway systems of Rome, and by Mr. A. R. Sennett on horseless carriages—a number of which, it is expected, will be shown in operation.

In Section H (Anthropology), following the precedent which proved so successful at Ipswich last year, it is proposed to group the proceedings of the Section round a limited number of large questions which seem more particularly ripe for discussion at this time. The fact that the President, Mr. A. J. Evans, the Keeper of the Ashmolean Museum at Oxford, has taken a leading part in recent exploration and discovery among the remains of early civilisation in the Levant, and that a public lecture by Prof. Flinders Petrie, last year's Sectional President, is announced on a kindred subject, suggested the early history of mankind in the Mediterranean as an appropriate subject for discussion.

The President's address, which will be delivered late in the morning of Thursday, may be expected to deal, in part at least, with this department of anthropology, and will be followed by lantern demonstrations of recent Palæolithic discoveries in North-east Africa and elsewhere. Friday will be devoted to physical anthropology, and the opportunity will be taken of commemorating the centenary of the birth of Dr. Retzius, the celebrated Swedish anthropologist, whose son, himself a distinguished observer, has signified his intention of probably being present. Dr. Dubois will discuss *Pithecanthropus*, and Dr. Brinton and Dr. Sergi the physical aspect of Mediterranean and, especially, of North African races. Dr. Topinard is expected to be present, and a communication is promised on the pygmies of Central Africa. Saturday is assigned to reports and discussions on the collection and registration of ethnographic data, and a resolution in favour of an Imperial Bureau of Ethnology will be brought forward by Mr. C. H. Read, of the British Museum. Folk-lore and descriptive anthropology will also be represented on this day. Monday opens with papers on the early distribution of copper and of iron in Europe and the Mediterranean; followed by a general discussion of the modes of the transference of culture, and illustrated by an exhibition of the early ornament of North-west Europe. On Tuesday, a general discussion of early Mediterranean civilisation has been arranged. Communications are expected from the President, Dr. Montelius, Mr. Salomon Reinach, Dr. Naue, Dr. Stolpe, Prof. Ridgway, and others. On Wednesday, Prof. Flinders Petrie's proposal of a national ethnographic storehouse comes up for discussion, and a number of separate communications will be presented. It is hoped that it may be possible to announce somewhat in detail the probable course of each day's discussion during the meeting.

In Section I, the President (Dr. Gaskell) will give his address and a paper on the origin of Vertebrates on Monday morning, and after that a joint discussion with the Zoological Section will take place. Other discussions have been arranged within the Physiological Section: (1) on the organisation and correlation of bacteriological work, to be opened by Dr. Sims Woodhead; and (2) on the presence, and effect, of bacteria in various food matters, by Dr. Kanthack. Profs. Boyce and Herdman will bring forward a report on oysters and typhoid; and various other papers are announced dealing with excitability in muscle and nerve, metabolism, gas exchange, &c.

In Section K, the President (Dr. D. H. Scott) will deal in his address with the present position of morphological botany, discussing modern work bearing on the origin and affinities of the main groups of plants with reference to fossil as well as to recent forms. The chief features, after the address, will be (1) an afternoon lecture on the geographical distribution of plants, by Mr. W. Thiselton-Dyer, Director of the Royal Gardens, Kew; (2) the joint discussion with Section D on cell and nuclear structures, to be opened by Prof. Farmer; and (3) a discussion on the ascent of sap, to be opened by Mr. Francis Darwin of Cambridge.

We understand that Prof. Flinders Petrie's aim in his evening discourse, entitled "Man before Writing," is to bring forward the character of civilisation in different countries just before the introduction of writing, to show what man is and does before the great change produced by unalterable record and transmissible message; also to point to the methods of research where no written record remains. This period covers what is now the main field of interest in European history, and also the culture of the new race in Egypt. Dr. Francis Elgar's lecture will be on "safety in ships," and Prof. Fleming's lecture to the operatives will be on "the earth a great magnet."

W. A. HERDMAN.

THE TOTAL ECLIPSE OF THE SUN.[1]

II.

KIÖ ISLAND, *August* 8.

A LOVELY morning. The sun remained unclouded till long after eclipse time, giving thereby an additional proof of the advantage to us of the short nights. There is no time either for any considerable reduction of temperature or for the accumulation of any great amount of moisture in the air; hence unclouded sunrises, and the sun strikes hot soon after rising.

The beautiful harbour in which the *Volage* is lying looks its best in early morning, as the face of the nearly vertical cliff, which swarms with bird life, lies nearly west and south, facing eastwards.

I am glad to say that the last adjustments have been made, the last demonstrations given; numerous rehearsals have landed us in the perfection of drill; the parties all know their stations, and all necessary forms have been written out. We are going then to-day to "stand easy," and take some rest in preparation for the fateful to-morrow.

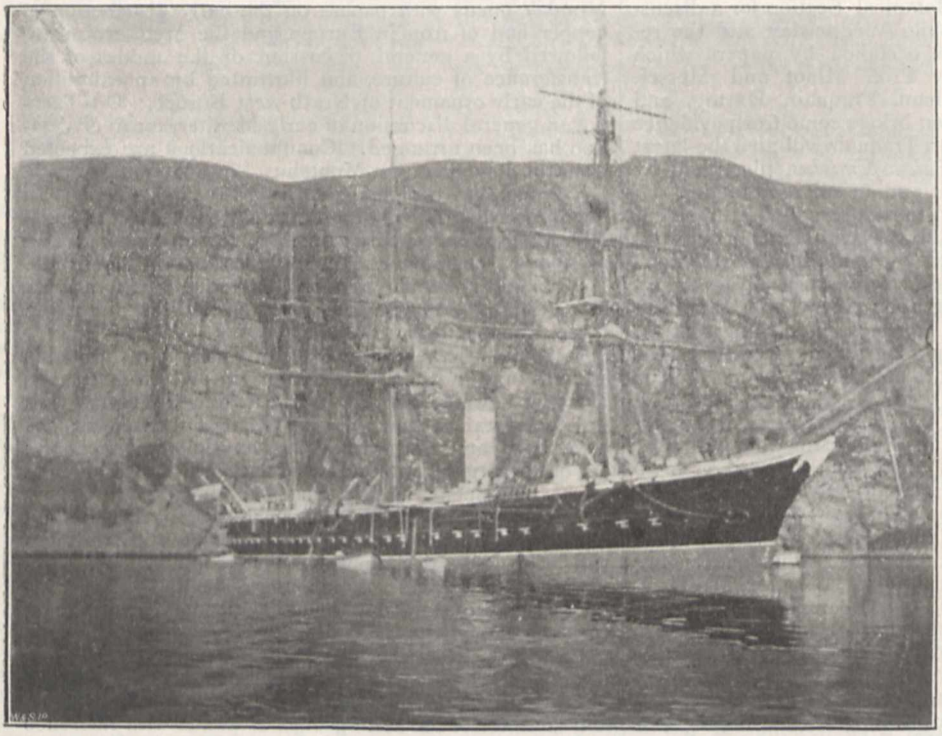


FIG. 5.—The *Volage* at anchor.

I take advantage of the pause to continue my notes. I confess I am keenly interested in our now tremendous eclipse party. I will first of all, then, deal with its progress, and especially with the final arrangements made for the larger instruments.

The *personnel* of each fixed instrument is as follows. Mr. Fowler has charge of the 6-inch prismatic camera, and he receives the following assistance.

As timekeeper Sub-Lieut. Beal offered his services, and his duty is to give Mr. Fowler warning some seconds before the commencement of totality, and to record the times of exposure of the fifty plates intended to be used. Roberts, an A.B., acts as exposer, taking off the cap from the prism at given signals. To economise the greatest amount of time, two marines stand to Mr. Fowler's right and left, to hand and receive the slides as they are inserted in and drawn out of the camera. The exposures to be made are generally very short, in fact they are all snap-shots with the exception of only two, one of them extending to half a minute.

The plate-holders are ten in number; each is capable of holding five plates, which are exposed by slipping them in turn into the focal image; this operation is controlled by a catch. The hut in which this instrument is housed is one brought out from home; the framework is covered with waterproof canvas so arranged that the roof can be removed at any time for observation. A dark room for photographic work is also attached.

The instrument under the charge of Dr. W. Lockyer is also a prismatic camera, but of 9 inches aperture, and rather differently mounted. The tube carrying the camera, prism and lens is fixed horizontally, and the light is thrown on to the prism by means of a siderostat. The work intended to be done is to obtain ten photographs in all; two snap-shots, seven with different times of exposure, the greatest amounting to thirty seconds, and lastly, a "dropping" plate. This last-named is intended to be exposed as near as possible ten seconds before the end of totality, and carried through until fifteen seconds after, the plate being moved slowly in the direction at right angles to the length of the spectrum. The object of this motion is to obtain an unbroken record of the changes in the spectrum during this interval of time.

As timekeeper for this instrument Midshipman Bruce has been selected, his duty being to keep Dr. W. Lockyer informed of the time a few seconds previous to totality, and also to note the times and lengths of the exposures made during totality. One of the ship's carpenters, Sullivan, operates with the cap in front of the prism, acting on instructions given to him by the observer. Two bluejackets are also employed in handing and replacing the dark slides as they are required.

The whole work of using the integrating spectroscope is left to members of the ship's company. Lieut. Martin has been selected as director, and he has as his assistants Midshipman Woodbridge as "exposer," Midshipman Brendon as timekeeper, and Midshipman Silvertop to keep the sun's image on a small screen for the purpose of correct orientation.

The instrument is set up on a board inclined at the angle representing the altitude of the sun at the time of eclipse, and movable in azimuth by means of a milled-head-driving screw turned by hand. By this means the collimator can be directly pointed towards the sun, which does away with the necessity of using a second siderostat, and this is all the more important because we have not a

[1] Continued from page 400.

second siderostat. The intention is to make three exposures with this instrument.

The whole apparatus is housed in a tent made by the carpenter out of ship's material, spare spars and a sail. The peculiar appearance of the hut has resulted in its being named by the sailors Porcupine Cottage. The hut for the 6-inch, which adjoins it, is called the Town Hall.

With regard to the other branches of work, in some of which the numbers assisting are large, the senior volunteer in each has been made responsible for the preparation and subsequent signing of forms, and representative in general of the party. The Chaplain, the Rev. E. J. Vaughan, whose interest has been unflagging throughout, has been good enough to act as intermediary between these representatives and myself, so that the closest touch has been kept. It was thought desirable that in addition to acting on the general instructions, each party should know the special points on which information is desired. A request for detailed answers to certain questions has been therefore placed in the hands of the head of each section.

I have said that this morning was lovely; yesterday—the 7th—was not by any means a pleasant and bright day, but the rain managed to keep away and allow work to be carried on in the camp, in which the preparation and the rehearsals have been vigorously continued. The first boat leaves the ship at about five each morning, so as to secure drill at eclipse time, and from this time onwards there is a continual passage of boats from ship to camp and back again, as the various observers are released from their work, which goes on incessantly, not only on board among the guns and masts, but in the fjord, in the shape of firing and boat parties, the firing being strongly objected to by the inhabitants of the "loomery," which is hard by.

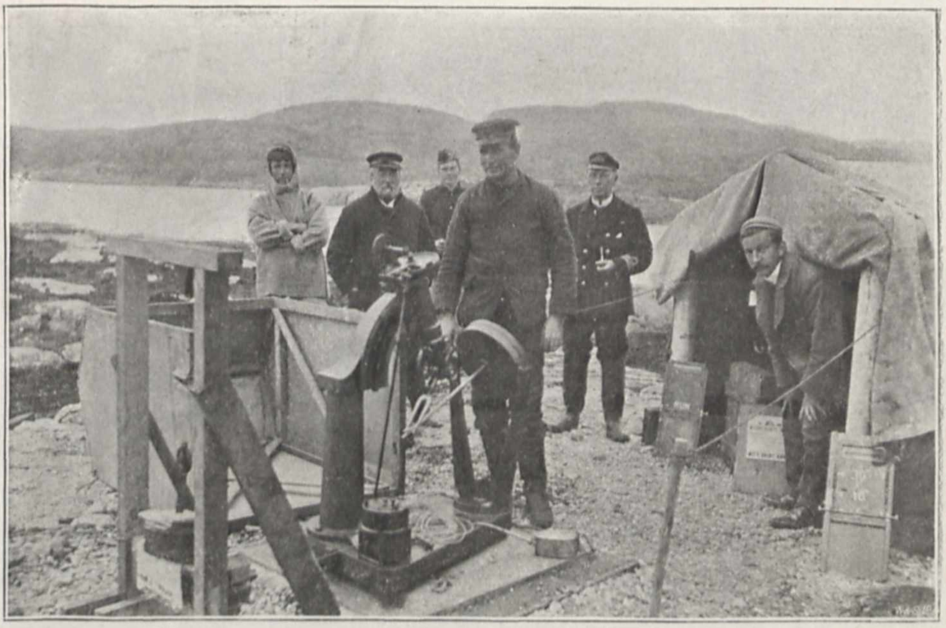


FIG. 6.—The Siderostat and the 9-inch Hut.

The birds, which in our stay we have become acquainted with, are of several kinds. Foremost among these is the white seagull, which has its home on the crags and ledges of the cliff to the west of the *Volage*. These birds literally swarm here, but apparently seem to be divided into distinct societies; indeed, on the cliff there are three or four separate "loomeries," and the birds in each of them always keep together and seldom, if ever, intermix with those in others. At apparently fixed times they fly down from their ledges and form a teeming, hurrying, clamorous throng, eddying in front of the face of the cliff. The young birds at the time are just beginning to fly, so the noise is perhaps greater than usual. After we had been here a few days they all became very tame, and swam around the ship. On Starvation Island several young ones were found; these could be easily located by paying attention to the utterances of the parent birds flying overhead, which became louder and louder the nearer the right spot was approached.

The young birds were found always in small pools between the rocks, generally lying under small bushes of grass overhanging them. The bluejackets, when ashore, caught many in this way, and it was amusing to see these birds walking about the forecastle as if owners of all they surveyed. An amusing incident occured on the evening the *Volage* arrived from Vadsö. Lieut. Martin and Sub-Lieut. Beal, on going on board the sailing cutter, found a dead gull in the bottom of the boat; on further examination, no less than 20 to 25 more were found stowed away in the stern. On making inquiries of the bluejackets as to their presence, they replied that they had collected them for supper in case the ship did not arrive that night, as provisions were rather short. The ship, however, did arrive, so that fried gull was not indulged in.

The shag, or green cormorant, abounds also in great numbers. These birds are far from beautiful, and were disliked by everybody. Many of them were too fat to fly properly, and when disturbed they managed to make themselves scarce by flopping over the surface of the water. The reverse was the case with the prettily marked oyster-catchers; these were always watched with interest, and there were five which greeted the party daily as it landed on Kiö Island. These birds are noted for being very self-possessed, cautious, and deliberate; and any event out of the ordinary arouses their curiosity, and incites them to make closer examination. Of the other birds seen, some were quick-moving sea-swallows, and a few ducks skimming occasionally along the fjord.

On our island, Kiö, there are several Lapps who continually watch our movements. In the small bay on the western shore there is one small hut in which about five, including one woman, live; while generally some of the others encamp in small curiously-looking huts near by; or either sleep in their boats or on skins ashore. In the bay to our south-east, on the other side of the fjord, there is quite a large Lapp encampment, and it is from this that most of our visitors come. The accompanying group shows many of these. This photograph was taken instantaneously, and without any preparation as regards grouping, and shows them as they sat watching us erecting the huts and instruments. At this time of the year they are generally occupied in fishing, and they sometimes bring up very fine selections of fish to our camp, which are generally bought by the steward for the ship's mess. The peat also on the island had been cut and stacked, so that this also formed at an earlier period of the year part of their daily work.

We are quite out of the world here, and till yesterday had no information as to what the other parties were doing at Vadsö. We knew that the remaining ships of the Training Squadron had arrived on Wednesday, and the booming of salutes from time to time informed us that other men-of-war had arrived. We could get no information concerning the astronomical parties, and no observer could be spared to make inquiries.

But late on Tuesday, when we had finished sketching drill, and were experiencing our only fog, a syren and the quick reply of the ship's bell told us that some vessel was approaching. Shortly afterwards we made out one of the small steamboats which ply from Vadsö to the fjords on the south side; she subsequently came alongside. We saw that Dr. Common and Sir R. Ball were on board, and I hailed them from the poop. Captain King Hall hospitably invited them on board, but the invitation was declined owing to the weather conditions, which were not improving, and the lateness of the hour. They had still to run twelve miles to reach Vadsö.

Captain King Hall invited Dr. Common, Sir R. Ball, and Mr. Downing to come over from Vadsö yesterday to lunch and see our camp. Dr. Common was too busy in setting up and adjusting his instruments, but Sir Robert Ball and a small party paid the ship a visit. We had previously arranged that the final dress rehearsals should take place in the afternoon, so our visitors were just in time to see the drill gone through. All timekeepers, chronometer, stop-watches, and deck-watches were ready. Each man was at his appointed post; the sketchers stood to the west of the camp on the higher ground; the disc observers were blindfolded and in their places, while each of the other instruments was attended by its full staff. These rehearsals must appear very curious to those unacquainted with eclipse work, and certainly our visitors saw the very perfection of drill. The routine gone through was exactly the same as if the eclipse was taking place, with the exception that no plates were actually exposed. After these general rehearsals the observers at each special instrument were put through their facings. Our visitors seemed to be rather astonished at the great amount of work that will be done if the weather only proves favourable to-morrow.

We gathered from Sir R. Ball that all the arrangements at Vadsö were nearly complete, and that Dr. Copeland's 40-foot tube was already in position.

The time arrangements have to be somewhat complicated, for the reason that it is desirable to begin the exposures with the prismatic cameras ten seconds before totality. We have then, if possible, to make a correction should the *Nautical Almanac* times be slightly out. The Admiralty authorities were good enough to put on board at Portsmouth a first-rate chronometer for our special use, and Lieut. Martin and Sub-Lieut. Beal have been unremitting in their endeavours, by taking sights and noting rates, to give us G.M.T. within a small fraction of a second.

FIG. 7.—The Integrating Spectroscopic Camera.

Before totality we have two chances of checking the *Nautical Almanac* times; by observing the first contact spectroscopically, and, failing this and more doubtfully, by observing the crescent when it covers an arc of 180°; this, it has been calculated, should occur 7m. 10s. before totality. It has been arranged that after the first contact the true G.M.T. will be called out from time to time as required, and also each minute before totality, corrected, if necessary, in the way I have already stated. In this way the special timekeepers of the prismatic cameras will be able to begin their work at the right moment before the general signal for totality, "Go," is given.

I am sorry to say that the eclipse-clock has broken down; the ship's armourer has vastly improved its going, but it has received some damage, so that I cannot rely on it. It is not good for a clock to be used only once in five years or so! So we fall back on stop-watches; and here I must state my obligations to Mr. Tripplin for the loan of a fine chronograph, which makes our stock complete, and enables us to feel certain that at one station or another the exact duration of totality will be caught.

My intention is before totality, in case we miss the first contact, to set one of the stop-watches going when the crescent covers as near as may be 180° of arc; this will give us time to correct the *Nautical Almanac* if necessary. Another will be handed to our two excellent timekeepers to replace the eclipse clock.

Two things have been strongly impressed upon me in my eclipse experience. The first is always to arrange the work so that everybody can have 30 seconds in which to observe the phenomena of the eclipse with the naked eye; the second, to take out no case which weighs more than 50 or 60 lb.

The importance of the first was forced upon me in 1871, when Captain Bailey, who travelled 400 miles to our camp to help us, and volunteered to act as timekeeper, turned his back resolutely on the eclipse and saw absolutely nothing of it, because in the preliminary drills he found he had a difficulty in picking up the time again when once he looked away from the face of his chronometer.

This time then we have a relay of timekeepers, one replacing the other at "60 seconds more"; this signal is given by both. The one who gives the time has his back to the sun, the other will see what he can. At my signal, "Go," depending upon the final disappearance of the photosphere as seen in a $3\frac{3}{4}$ with neutral tinted glass, the timekeeper first on duty is to sing out "105 seconds" and give the time every 5 seconds, "100 seconds," "95 seconds more," and so on.

The question of lamps during the eclipse is settled in the following way. If the sky be quite clear, some will certainly be wanted for the timekeepers in the huts, and for reading the fine graduations of the delicate chemical thermometers which I have brought with me. But if the sky be not clear, then others may be wanted too. So Captain King Hall has arranged to have ten lamps, each in charge of a bluejacket, in reserve, in the middle of the camp, so that anybody who wants one has only to say so to be immediately supplied.

A guard of five marines has remained permanently at the camp during our stay. They are generally dressed in most arctic-looking costumes known as "lammy suits." These are nothing more than a pair of trousers and jacket (with a hood), made out of ship's blankets, worn over the ordinary dress; they were invented, I believe, by the sailors when they made a long stay at Spitzbergen. They seem to be grand clothes for a camp, and in fact one of the marines seems to be seldom out of his—he appears to revel in the warmth it gives. Besides acting as guard to the camp, the marines are useful in many other respects; for instance, in addition to signalling for us, they are very good cooks, and all our cocoa, soups, meat, &c., brought from the ship, only needs to be handed over to them to be served up in our tent in a very appetising condition.

Since the eclipse begins so early on the morrow, arrangements have been made that a few of us should sleep in the camp to-night, and thus come under their special care; the ship's company will come over in the morning.

J. NORMAN LOCKYER.

(*To be continued.*)

FIG. 8.—Our Lapp Visitors.

PROFESSOR A. H. GREEN, F.R.S.

GEOLOGICAL science has sustained a very serious loss in the death of Alexander Henry Green, Professor of Geology in the University of Oxford. He was born at Maidstone on October 10, 1832, and after receiving his early education at the grammar school at Ashby-de-la-Zouch, he entered Gonville and Caius College, Cambridge. There he gained the place of sixth wrangler in 1855, and was elected a fellow of his college. Although mathematics had gained for him his high position in the University examination, yet geology had taken some hold of him. His interest in the subject had been awakened in Leicestershire, and the eloquent teachings of Sedgwick had further attracted him to the science.

In 1861 he obtained the appointment of Assistant Geologist on the Geological Survey of Great Britain, and was engaged for some years in mapping portions of the midland counties, near Aylesbury, Buckingham, and to the east of Banbury. Three years later his memoir on the geology of the country around Banbury was published; and although since then some modifications have been made in the grouping of the oolites, his careful statement of facts rendered the work of permanent value. Leaving these regions of lias and oolites and glacial drifts, he was transferred to the carboniferous districts of Derbyshire and South Yorkshire. Here he laboured for a number of years, practically superintending the survey of the great coal-field, and training several junior geologists to assist in the work. In the end he produced, with the aid of his colleagues, the large and exhaustive memoir on the Yorkshire coal-field, published by the Geological Survey. In 1875 he resigned his post on this survey on being appointed Professor of Geology in the Yorkshire College at Leeds. Ultimately he became also Professor of Mathematics at the same college. Although by no means a voluminous writer, he contributed occasional papers to the Geological Society and to the *Geological Magazine* on the carboniferous rocks of the north of England, on sub-aërial denudation, on the geology of Donegal, the Malvern Hills, &c. His practical knowledge of geology, his clear head, and sound judgment rendered his advice on matters of engineering geology of great service. Consequently he was engaged here and there in many important undertakings, more especially in reference to coal-mining, water-supply, &c. This work, perhaps unfortunately, was needful, for it exhausted those energies that might have been more advantageously directed to the advancement of knowledge. Professorships of geology are not, however, lavishly endowed. Visiting portions of South Africa in the course of practical work, he was able to obtain a considerable insight into the geology, and brought his results before the Geological Society. Not the least important of his labours was his manual of Physical Geology, admittedly the best English work on this branch of the science, and one which reached a third edition in 1882. The companion volume on Stratigraphical Geology was never completed, and indeed other publications perhaps rendered it unnecessary.

After the resignation of Prof. Prestwich in 1888, he was chosen to succeed him in the chair of Geology in the University of Oxford. Here he found abundance of work to do in the arrangement of the geological museum, in his lectures and class excursions. A large task, indeed, still remains to be done in the examination of many treasured specimens that have never yet been exhibited. Prof. Green took great interest in this work, and in the acquisition of new specimens. Only recently he spent some time in selecting a series of fossils from the valuable collection of the late Thomas Beesley, of Banbury, which had been presented to the Oxford Museum by Mrs. Beesley.

Prof. Green was elected a Fellow of the Royal Society in 1886, and he served on the Council during the years 1894–95. For many years he gave lectures on geology at the Military School at Chatham; he was an examiner in geology for the University of London; and had been President of the Geological Section of the British Association at Leeds in 1890.

Early in August he was afflicted with a stroke of paralysis, and a second attack terminated his busy and useful life on the 19th of the month. Eminently genial and kind-hearted, he will long be missed by his many friends. H. B. W.

NOTES.

AT the Leyden International Zoological Congress, held last year, it was decided that the next meeting of the kind should take place in England, in September 1898, and that Sir William Flower, Director of the British Museum (Natural History), should be its President. We now learn, through the *Times*, that it has been determined that the 1898 Congress, the fourth of the series, shall meet at Cambridge, under the auspices of the University, simultaneously with the International Physiological Congress, which has arranged to go there in that year. London and Edinburgh were named as places of meeting in connection with the Zoological Congress, but it was felt that there were certain advantages in holding an international meeting of this character in a University town within easy distance of London, rather than in London itself. The organising and reception Committee consists of Prof. Alfred Newton, President; Mr. Adam Sedgwick, Vice-President; Messrs. J. W. Clarke and Sydney J. Hickson, Treasurers; and Messrs. S. F. Harmer and Arthur E. Shipley, Secretaries. With reference to the two prizes which will be awarded at the Congress for the best zoological papers, the Paris members of the permanent Committee suggest that the subject for the Tsar Alexander III. prize, which will be given for the first time, shall be "The Study of the Ruminant Mammalia of Central Asia, from a Zoological and Geographical Standpoint"; and that for the Tsar Nicholas II. prize, which was awarded last year at Leyden for the first time, the paper shall be "An Anatomical and Zoological Monograph of a Group of Marine Invertebrates." These subjects are, however, in the nature of proposals which may be modified, since the Paris Committee will be glad to receive counter-suggestions and to learn the views of zoologists before making public the detailed programme of the prizes.

THE annual conference of the Iron and Steel Institute opened at Bilbao on Tuesday, under the presidency of Sir David Dale. Various papers were read, and in the evening a grand reception was given by the municipal authorities in honour of the Institute.

INFORMATION has been received through Reuter's agency of the finding of an extensive gold-bearing quartz reef at Cape Broyle, Newfoundland. The analysis shows nearly three ounces of gold to the ton of quartz, and over one ounce of silver. The barrels of quartz sent for analysis were taken at random.

DR. E. S. HOLDEN announces in *Science* the following gifts to the Lick Observatory:—By Miss Caroline W. Bruce, of New York City, a sum of money to procure a large comet-seeker, and to provide photometers for visual use with the thirty-six-inch equatorial; by Mr. Walter W. Law, of Scarboro'-on-Hudson, a liberal gift towards providing for the publication of the Observatory Atlas of the Moon, mentioned in the *Publications*, vol. viii. p. 187.

THE forty-first annual exhibition of the Royal Photographic Society is in course of preparation, and will be opened to the public on Monday, September 28. On Saturday, September 26, there will be a private view, followed in the evening by a conversazione, at which the President and Council will receive the fellows, members, and their friends. The judges this year in the technical section are Captain Abney and Messrs. Chapman Jones and Andrew Pringle. Exhibits must be delivered at the Society's rooms, at 12 Hanover Square, not later than the morning of September 10.

PARTICULARS of the International Horticultural Exhibition to be held in Hamburg, from May to September next, have now come to hand. The Committee proposes: (1) a Permanent Exhibition, out-of-doors and under cover, from the beginning of May 1897, to the end of September, 1897; (2) a Spring Exhibition, from May 1 until May 7, 1897; (3) a Special Exhibition of plants, flowers, and vegetables, from May 30 until June 3, 1897; (4) a Special Exhibition of plants, flowers, and shrubs, from July 2 until July 6, 1897; (5) a Special Exhibition of plants, flowers, and fruits of the season, from July 30 until August 3, 1897; (6) a general Autumn Exhibition from August 27 until September 5, 1897; (7) a general Fruit Exhibition, from September 17 until September 30, 1897.

THE seventh annual general meeting of the Federated Institution of Mining Engineers is announced to take place at Cardiff on September 15, 16, and 17. Some thirteen papers are on the agenda, and many excursions have been arranged. An invitation has been given to the Federated Institution, among others, by the Canadian Mining Institute, to hold a meeting in Montreal at about the date of the meeting of the British Association in Toronto next year; but before replying, the Secretary of the Institution is anxious to learn the names of those who may be expected to be present on the occasion.

KIEF has been selected as the place of meeting of the tenth conference of Russian Naturalists and Physicians. The conference will last from August 21 to August 30, 1897. A grant of over £400 has been contributed by the University of St. Vladimar in Kief towards the expenses.

GOOD progress is being made by the Russian National Health Society in the matter of the Jenner Commemoration of October next. The centenary work, containing a life of Jenner and translations of all his works, as well as an historical notice of the development of vaccination in Russia and other European countries, is likely to be a volume of much interest and value. It will be illustrated by over a hundred figures, including many reproductions of Jenner's original drawings, portraits of Jenner, and views of the Berkeley neighbourhood. The Society, under whose auspices the commemoration is to take place, is already in receipt of a large number of loans and gifts for the exhibition which it is proposed to hold in connection with the celebration, and these have come from well-nigh every part of the world. England, it is said, is not too well represented by exhibits.

NEWS comes from Russia of another medical society having received the, in that country, necessary Imperial approval of foundation. It is to be known as "The Society for Combating Infectious Diseases," and will be under the patronage of the Princess of Oldenburg. The society will resemble the Russian National Health Society, in that it will admit both lay and medical members.

ACCORDING to *Science*, an observatory for terrestrial magnetism has been established in connection with the astronomical observatory at Munich, and Dr. Franz von Schwarz has been appointed director. *Science* also states that the Observatory of the School of Technology at Karlsruhe is to be removed to Heidelberg. The Director of the Observatory, Dr. Valentiner, has been made a Professor in the University of Heidelberg.

A MAGNETIC survey of Maryland is being made by Dr. Bauer, the editor of *Terrestrial Magnetism*, under the auspices of the State Geological Survey.

THE *Engineer* states that Colonel Home, C.S.I., Royal Engineers, has been engaged by the New South Wales Government as an expert to advise on the subject of water conservation.

THE *British Medical Journal* learns from Amoy, China, that Dr. Yersin has been experimenting with his plague serum. Up to date he is reported to have cured more than twenty plague patients. The cures are reported to be marvellous, as many of the patients were in high fever, the buboes fully developed, and the sufferers in a comatose state. In Canton Dr. Yersin, on July 1, 1896, according to Bishop Chausse, effected a remarkable cure on a very unmistakable and severe case of plague. After showing the Amoy doctor his methods of injection, he returned to Saigon. It is stated in the newspapers in China that it takes six months to prepare the serum; that Dr. Yersin first inoculates rats and then horses, from which sources he obtains his fluid.

THE subject of the Baumgartner Prize for 1899, awarded by the Vienna Academy of Science, is "the extension of our knowledge of ultra-violet rays."

THE Leopolinisch-Carolinische Academie of Halle is, it is stated, about to publish Cuvier's first work, which is on the edible crabs of the French coast. It dates from the year 1788. A number of letters of Cuvier are in the possession of the Academy, and these also it is intended to publish.

THE University of Moscow has been presented with a portion of the collection of butterflies of the late Prof. A. M. Butljero, and the Museum of Natural History, Berlin, has had bequeathed to it, by the late Julius Flohr, that gentleman's collection of Mexican insects.

SOME one once rather unkindly said that one half of the British population was always endeavouring to shut up the other half in asylums of one kind or another. Though this remark may be a trifle exaggerated, it may be applied with some truth if societies or associations be read for asylums. The latest association which has appealed for our support is for the Harmonious Development of Faculties. The Association aims at bringing about a clearer apprehension of the co-relationships of physical, moral and intellectual faculties. Anything that contributes to the harmonious development of these is good; anything that hinders this development is evil; these are briefly the ethical rules of the Association. The Committee believe that they are spreading a philosophical truth which will have an elevating influence over men's minds. They therefore wish us to draw attention to the existence of the Association, and this we have now done, leaving to our readers the contemplation of the doctrine to which we have referred. The Hon. Secretary of the Association is Prof. M. Deshumbert, Camberley, Surrey.

DR. W. L. ABBOTT, of Philadelphia, has been well employed during the past eight years in exploring various parts of the Old World, and sending his collections to the National Museum at Washington. Mount Kilima-njaro and the adjoining districts of East Africa were the scenes of his first investigations, after which he visited the Seychelles, and the neighbouring islands of the Indian Ocean. He then proceeded to Northern India, and passed two years in Cashmere, Ladak, and Turkestan. From all these localities numerous collections of natural history and ethnology have been transmitted to Washington, where the members of the staff of the National Museum are busy in working out the results. Two of their reports on the birds collected by Dr. Abbott have just reached us. One of them, by Mr. Ridgway, describes the specimens obtained in the Seychelles, Amirantes, Gloriosa, Aldabra, and other adjacent islands, many of which had not been previously visited by a naturalist. In Aldabra, generally known as the home of gigantic tortoises, Dr. Abbott met with forty-five species of birds, several of which are representative forms peculiar to that island. In a second memoir Mr. Richmond gives us an account of 746 "well-prepared specimens" which Dr. Abbott has accumulated in Kashmir, Ladak, and Baltistan, and refers them to 188 species. Most of these are, of course, well known to Indian ornithologists, but Mr. Richmond ventures to describe as new a Blue-throat from Ladak, under the name *Cyanecula abbotti*.

DR. NICOLA TERRACCIANO has contributed to the Transactions of the R. Accademia delle Scienze fisiche e matematiche, of Naples, an important memoir on the flora of Monte Pollino and the surrounding district. This group of mountains, situated between Calabria and the Basilicate, has for some time attracted the attention of Neapolitan botanists, and the number of species in its flora now amounts to 1468, exclusive of varieties. Dr. Terracciano notes as new to the Italian flora, *Gagea minima* and *G. amplyopetala*, and he describes four altogether new species, namely *Fritillaria pollinensis*, *F. intermedia*, *Ornithogalum ambiguum* and *Narcissus pollinensis*, together with many other forms which he considers varietal.

THE estimation in which certain gramineous species are held varies much in different countries. For instance, *Holcus lanatus*, which in Britain is universally regarded as a weed, though it intrudes abundantly upon many of our pastures, is deliberately sown in mixtures of meadow-grass seeds in France. The *Agricultural Gazette of New South Wales* (vii. 5) cites another example in the tufted hair grass (*Deschampsia cæspitosa*, Beauv., or *Aira cæspitosa*, Linn.). This species is locally known in England as tussock grass, and as "bull faces" or "bull pates," and efforts are constantly made to extirpate it from our permanent pastures. In Australia, however, "it affords a fair pasturage if periodically burnt down." Graziers on and near the Australian Alps have been asked to send notes of their observations of this species, as it is regarded as quite possible that the Australian plants differ in forage value from those of the northern hemisphere. The culms are sufficiently tough to permit of door-mats being made from the hay.

WHAT is known as the "shade-tree insect problem," in the Eastern United States, forms the subject of an illustrated bulletin of the Department of Agriculture at Washington. The great abundance of insects which attack shade-trees was a noteworthy feature in many of the cities in the summer of 1895. In almost every low-lying town from Charlotte, N.C., north to Albany, N.Y., the elm-leaf beetle *Galerucella luteola* defoliated the English elms, and often the American elms. The bagworm (*Thyridopteryx ephemeræformis*), the white-marked tussock moth (*Orgyia leucostigma*)), and the fall webworm (*Hyphantria cunea*) are conspicuous amongst the depredators. Some species of trees suffer much more than others, the beeches, hornbeams, and alders appearing to have few insect enemies. Spraying and banding of trees and other checks are being employed, and one of the Washington newspapers has advocated the formation of a tree protection league amongst the citizens.

A CORRESPONDENT in the *Grahamstown Journal* tells how he cleared his garden of a pest of locusts. A number of diseased insects were obtained and ground into a fine powder, which was then placed in a bucket of water. Some of the mixture was poured on a few locusts of a fairly good-sized swarm, and before many days had elapsed numbers of the locusts were found dead, and eventually the garden was quite clear of the pest.

ON account of the great success of the botanical models made by the firm, Herrn. R. Brendel, in Berlin, the same firm is now constructing zoological models out of papier-mâché, some of which are exhibited in the Berlin Exhibition this summer. For instance, there is a model of the ordinary house-fly (*Musca domestica*) thirty times life-size; it is very accurately made, and all its parts are beautifully worked and distinct, making it unnecessary to take it to pieces. By means of a small piece of mechanism the spreading of the wings can be demonstrated. There is also exhibited, in a series of eight models, a plaster representation of the development of the frog, each being ten times life-size; they are all so arranged that they can be lifted off their supports and examined more minutely. With the help of such useful models as these, students of zoology will be more easily able to grasp some points which cannot always be obtained from pictures or diagrams. These models should also be found most useful in schools where the pupils do not often come in contact with museums.

IN Italy, almost the only instruments used for the study of earthquake-pulsations are long and heavy pendulums. The greater the length the more steady is the bob during movements of the ground, and the heavier the bob the more readily is the friction of the recording pens overcome. In the last number of the *Bollettino* of the Italian Seismological Society (vol. ii., 1896, pp. 62-65), Dr. A. Cancani describes the latest form of seismometrograph constructed under his superintendence. Two instruments have been made, one for the geodynamic observatory at Rocca di Papa, and the other for that at Catania. The former is 15 metres long and 200 kg. in mass, the latter is 26 metres in length and has a mass of 300 kg.; in other respects they are almost identical. The suspending wire of the pendulum passes at its lower end through slits in the short arms of two horizontal levers. The slits are at right angles to one another, but the levers are bent at an angle of 45° in opposite directions, so that the pens at the free ends of the long arms write their component records side by side on the same moving band of paper. The paper is driven at the rate of 60 cm. an hour, a velocity great enough to allow the individual undulations to be examined, and the times of the different phases to be determined with considerable accuracy.

THE restlessness or alarm shown by birds and animals before the occurrence of an earthquake sensible to man is now well known, and is probably due to the very small tremors which precede the larger vibrations. In an interesting paper (*Boll. Soc. Sismol. Ital.*, ii., 1896, pp. 66-74), Dr. A. Cancani has collected a large number of examples observed in Italy. He points out besides the important fact that, while most animals are disturbed during and after an earthquake, it is only at some distance from the epicentre that they exhibit any signs before the shock is perceptible to man. The explanation Dr. Cancani gives is that the tremors move with a greater velocity than the large vibrations, but that a considerable space must be traversed before they have outraced the latter by several seconds.

IN the *Bulletin* of the Constantinople Observatory for January 1896, Dr. Agamennone concludes his summary of the earthquakes felt in Turkey during the year 1895 (see NATURE, vol. liv. p. 373). The number of recorded shocks amounts to 400, and these are found to belong to thirty-one seismic centres, the principal of which are near Paramythia, Imam Keuy (Aïdin), and Pergama. In the neighbourhood of Constantinople at least ten earthquakes had their origin, showing that the seismic activity provoked by the great shock of July 1894 has not yet ceased.

WE have received from Prof. G. Vicentini a new and valuable contribution to our knowledge of earthquake-pulsations, consisting of a list of the disturbances registered by his two-component microseismograph at Padua from February to September 1895. Many of these can be referred to known shocks, occurring either in Italy or in neighbouring countries. On three occasions (March 6, June 15, and July 5) the origin of the pulsations is unknown, but the diagrams are similar to those that are produced by earthquakes taking place at a very great distance. Copies of the diagrams corresponding to twenty-two earthquakes are reproduced on a scale two-thirds of the original.

IN the current number of the *Journal* of the Anthropological Institute of Great Britain and Ireland (vol. xxvi. No. 1) Mr. Robert M. W. Swan gives some very interesting notes on ruined temples in Mashonaland. These temples are of the Zimbabwe style; *i.e.* they seem to take the form of circular arcs, if not complete circles. Practically only one he describes—that of the temple at Lundi River—attains to anything like a circular shape, and this is very complete, being only pierced by two openings. The others scarcely reach 180°, and these seem always to be pierced by a doorway. The temple at Lundi River stands on a little knoll about half a mile south of the waggon road, and 300 yards towards the east of the river. It is built of small rectangular, naturally-shaped blocks of granite, laid in very regular level courses. From the fact that the inside finely-built wall supports, to some extent, many of the stones of the outside wall, it is suggested that it is probable both were built at the same time. Mr. Swan took measurements of the different parts of the building. The circumference of the temple was 169 feet $6\frac{1}{2}$ inches, or 17·17 feet × π^2 (10 cubits × π^2). At no point did the foundations of the temple diverge more than a few inches from a true circle. The two doorways into the building were 60 feet $8\frac{1}{4}$

inches distant from one another, the angles between the doors subtending an angle of 128° 51′ at the centre. One of the doors formed with the centre of the temple a north and south line, so that it is supposed that the wall between these two doors was intended to face the sun when rising at the summer solstice. Many other interesting points of this temple are referred to by Mr. Swan. To give some idea of the great number, he says: "From what I have said it will be seen that, along the 250 miles or so of road between the Lobsani and Lundi rivers, I have visited about twenty temples, or other remains of the people who built Zimbabwe . . . but admitting that I have seen all within a mile on both sides of the road, and that the strip of country traversed is a fair sample, as regards ruins, of this part of Africa, it is evident that the number of ruins of this class in the whole country between the Zambesi and Limpopo rivers must be enormous." Further on he says: "On a hill further on, I found four temples of the same sort, and one little crescent of rough stones carefully oriented to the sun rising at the northern solstice. In fact these temples are so numerous in this part of the country, that one might safely undertake to find a hundred of them within ten miles of Salisbury." Mr. Swan, in a postscript to his paper, suggests that these temples are not temples in the ordinary meaning of the word, but simply religious symbols, analogous, as he says, to our crosses and wayside shrines. The article contains several other points of interest, too long, however, to be dealt with here.

AN extraordinary incident is reported in *Engineering*, from Terre Haute, Indiana, by the city engineer, Mr. G. H. Simpson. A street of this town was paved with brick five years ago, the joints being grouted up. The work was done partly during the winter, being finished in early spring. The foundation consisted of broken stone 8 in. thick, above which was a layer of sand 2 in. thick. At the end of last July, with the thermometer standing at about 100° F., a section of the pavement rose like an arch from its foundation, and though water was turned on to it, and openings made to let out any possible accumulation of gas beneath, it maintained its position unaffected. Men were then put to work to repair the pavement, but hardly had they removed the swollen section when, with a loud report, another section of the pavement rose in a similar manner to a height of 7 in. to 9 in.

WE have received the fourth yearly report of the Sonnblick Society, containing the results of the meteorological observations made at the summit of that mountain for the year 1895. In addition to the usual obligatory observations, the observer, at the instigation of Dr. Pernter, made a special study of the crackling or humming of the telephone, and by this means, the occurrence of thunderstorms was frequently predicted. The records of this phenomenon have been discussed by Dr. W. Trabert, who finds that in all years, during the winter season, the noise gradually decreases from 7h. a.m. until noon, and then increases until about 9h. p.m.; while in the summer season the minimum occurs about 7h. a.m., from which time the humming steadily increases until 9h. p.m. The only meteorological phenomenon with which the noise can be connected appears to be the diurnal and annual range of the amount of cloud, which it closely follows; whence Dr. Trabert concludes that although it may have some connection with earth currents, it is probably primarily due to the electricity of the clouds. The report also contains good photogravures of a cumulus cloud driven by a strong wind over the Tauris mountains, at an elevation of about 10,000 feet.

A DISCUSSION took place some time ago in our columns on "The Alleged Absoluteness of Rotation." In connection with this subject we have pleasure in calling attention to a recent paper by Dr. Benedict Friedlaender and Herr Immanuel Friedlaender, bearing the title "Absolute oder relative Bewegung?" (Berlin: Leonhard Simion), in which the *pros* and *cons* of the three different hypotheses are discussed, as well as the possibility of an experimental solution of the question.

WE have received from Prof. Ángel Gallardo, of Buenos Ayres, an interesting pamphlet on Karyokinesis. In it the author presents the physico-mechanical hypothesis of figures of cell-division and some of its consequences, founded on the views of recent writers, without, however, attempting to investigate the influence of this hypothesis on the more important questions of biology.

FOUR new volumes have been published in M. Léaute's Encyclopédie scientifique des Aide-Mémoire. In "La Distillation des Bois," M. Ernest Barillot describes the plant and processes utilised in the distillation of wood for the production of methyl alcohol, acetic acid, charcoal, tar, &c. A volume entitled "Chaleur et Energie," by M. E. Ariès, is an exposition of the principles of thermodynamics according to a method based upon the postulate that "Un système ne peut décrire un cycle ferme irréversible, à l'aide d'une seule source de chaleur, sans lui *céder de la chaleur* et sans *consommer du travail*." The work is divided into two parts, the first dealing with the general principles of the science of heat, and the second with thermodynamics. The last chapter is devoted to the description of a general method for the application of thermodynamical principles. Lieut.-Colonel Hennebert contributes to the Series a volume on "Travaux de campagne." In this book, the author reviews the means of organisation of attack and defence of an army in the field, victualling, encampments, and the construction and use of various military works. The same author is responsible for a volume on "Communications militaires." In this, roads, navigable waters, railways, and bridges are examined successively from a military point of view, means of destruction as well as construction being described.

A PROSPECTUS has reached us giving particulars of a work on "Submarine Telegraphy," by Mr. Charles Bright, which will, provided a sufficient measure of support is obtained in advance, be published by Messrs. Crosby Lockwood and Son. The book, though based upon Wünschendorff's "Traité de Télégraphie sous Marine," has been thoroughly revised and brought up-to-date, and is practically a new work. Besides being a *résume* of the science and practice of submarine telegraphy, both from an electrical and engineering aspect, the book contains a complete history of this particular application of science from its birth, practically speaking, in 1850 up to 1895, with a short sketch of that which preceded in land telegraphy, and a prelude concerning all early efforts connected with signalling of any description.

MESSRS. WHITTAKER AND CO. are about to publish an authorised translation, by Mr. Lucien Serraillier, of Mr. D. Farman's work on "Automobiles." The work will be fully illustrated, and contain constructional details of the latest developments in this branch of work.

MR. QUARITCH has sent to us his catalogue, dated August, of choice and valuable books offered for sale by him. The list contains particulars of very many rare and choice works relating to most branches of science.

MESSRS. SIMPKIN, MARSHALL, AND CO., LTD., will, on October 3, issue the first number of *The Avenue*, a monthly illustrated magazine devoted to education, association, and social progress.

THE additions to the Zoological Society's Gardens during the past week include a Squirrel Monkey (*Chrysothrix sciurea*) from Guiana, presented by Mr. A. C. Goude; a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mr. W. Stevens; three Ivory Gulls (*Pagophila eburnea*), a Richardson's Skua

(*Stercorarius crepidatus*) from Spitzbergen, presented by Mr. J. F. Studley; two Variegated Sheldrakes (*Tadorna variegata*) from New Zealand, presented by Sir Walter L. Buller, K.C.M.G.; two Streaky-headed Grosbeaks (*Poliospiza gularis*) from South Africa, presented by Miss Jessie Porter; an Oyster-catcher (*Himantopus ostralegus*), British, presented by Mr. R. Gurney; a Bordeaux Snake (*Coronella girondica*), a Common Snake (*Tropidonotus natrix*, var.) from France, presented by Mr. E. A. Minchin; a Squirrel Monkey (*Chrysothrix sciurea*) from Guiana, a Beccari's Cassowary (*Casuarius beccari*) from New Guinea, a Red Kangaroo (*Macropus rufus*, ♀) from Australia, deposited; two Otters (*Lutra vulgaris*) from Ireland, four Cayenne Lapwings (*Vanellus cayennensis*) from South America, purchased; a Chinese Mynah (*Acridotheres cristatellus*) from China, received in exchange; an African Wild Ass (*Equus tæniopus* ♀) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

DOUBLE STAR OBSERVATIONS.—In *Ast. Nach.*, No. 3370, Dr. Doberck, while discussing the elements of η Coronæ Borealis, takes the opportunity to determine the probable error that accompanies the observation of position angle and distance in the case of the better-known double star observers. Three stars have been selected for the discussion. η Coronæ, a close double, in which the probable errors are referred to a common distance of 0″·7; α Centauri, reduced to a mean distance of 10″, and, of course, including a different class of observers; and γ Virginis, with a mean distance of 2″·5. Dr. Doberck might with advantage have given the aperture of the telescope with which the observations have been made, but a glance at the list is sufficient to show that the greatest accuracy, as might have been anticipated, is on the side of the large telescopes. In the case of η Coronæ, Profs. Hall and Burnham are the only observers whose probable errors fall below 1° in position angle. In distance, their only competitor is M. Perrotin, who also has the advantage of large aperture. With γ Virginis, where the components are more widely separated, telescopes of moderate size are able to compete advantageously, and the measures of MM. Duner and Schiaparelli appear quite as trustworthy as those of Prof. Hall. The probable errors attached to observations made in the southern hemisphere are, on the whole, slightly larger than those derived from northern observers.

VARIABLE STARS.—Owing to the rapid accumulation of new material, which seems to be coming in on all sides, Dr. Chandler thinks that a new edition of his catalogue, incorporating everything up to date, is necessary. With this we entirely agree with him; for, although the system of supplements is a good one, they *can* accumulate, and when this happens the sooner they can be eliminated the better. Our readers are so familiar with these catalogues, that little need be said when it is stated that Dr. Chandler has entirely overhauled the work, and brought in all the new material. It is good, however, to hear, as he says, that the "degree of uniformity and completeness of the observation of the phenomena, and the consequent development of our knowledge with regard thereto, during the past few years is remarkable." He adds, however, further that the need for volunteers in the southern hemisphere is pressing (*Astronomical Journal*, No. 379).

VARIABLE STAR OBSERVATIONS.—Profs. Barnard and Chandler have both called attention to possible errors introduced into the observation of variable stars from physiological causes. The latter thinks that a systematic error arising from unequal sensitiveness of different portions of the retina, dependent upon different positions of the variable star with reference to those with which it is compared at different hour angles, can be traced in the case of the minimum phase of U Pegasi. Mr. A. W. Roberts, in the *Astronomical Journal*, No. 381, urges the employment of some mechanical means for the elimination of this source of error. He himself has been in the habit of using both a negative and a direct-vision eyepiece, and taking the mean of the two observations. In this way, it is asserted, the mean error of observation has fallen from 0·12 mag. to about 0·05 mag. The obvious suggestion of employing a prism mounted behind the eyepiece, and taking four observations in such a manner that the comparison star is rotated 90° about the variable, is not lost sight of; and when this arrangement is carried into effect, it is confidently anticipated that the mean error will not be greater than 0·03 mag. It is needless to point out that this implies a greater degree of accuracy than has been attained with any photometer. The probable error in the case of the Harvard photometer has been quoted as 0·075 mag., and Drs. Müller and Kempf, with the Zöllner photometer at Potsdam, have not been able to make their probable error much below 0·06 mag. Mr. Roberts' experiment will, therefore, be watched with considerable interest.

THE CAPE OBSERVATORY.—The Observatory Report for 1895 furnishes several items of general interest. The fine equatorial, presented by Mr. McClean, is in an advanced state, the only part not yet commenced being the line-of-sight spectroscope. Besides the cylindrical observatory and hemispherical dome, the donor has generously provided a rising floor of excellent design, and also an attached building containing entrance hall, study, developing room, and instrument store. The objective prism of 24 inches aperture has been completed by Sir Howard Grubb. The chief part of the year has been occupied in clearing off arrears of reduction and publication. The publications during the year included—"The Cape General Catalogue for 1885, with Appendices, &c."; "A Determination of the Solar Parallax and the Mass of the Moon from Heliometer Observations of the Minor Planets Iris, Victoria, Sappho"; the first volume of the "Cape Photographic Durchmusterung," containing the mean places of 152,000 stars for 1875, derived from Cape photographs between Declinations − 19° and − 37°; a complete account of the "Geodetic Survey of South Africa." Much actual observational work has been entirely suspended to allow of these publications being completed. It is also mentioned that an increase of staff will be required for the new astrophysical department created by the advent of the McLean telescope. With the transit instrument 2872 stars have been observed, the small number being due to the objects being chiefly slow-moving circumpolar stars. The work with the astro-photographic telescope has been satisfactory. 91 catalogue plates were taken, 55 of these being finally passed. 367 chart plates were exposed, 240 being passed. This leaves 15 catalogue and 253 chart plates yet to be done to complete the complement assigned to the Cape. A complete investigation of the réseau used here (Gautier No. 8), has been made, and will soon be published. The observations made with the zenith telescope in 1892, 1893 and 1894, for aberration and change of latitude, are completely reduced, and are being finally revised.

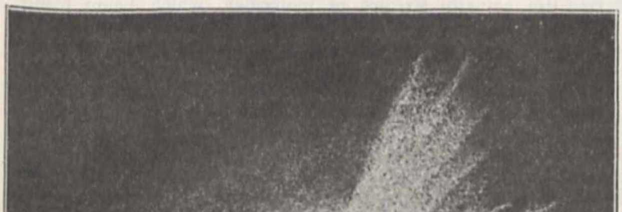
AN INVESTIGATION ON ABERRATION AND ATMOSPHERIC REFRACTION.—The latest volume of the publications of the Washburn Observatory of the University of Wisconsin (vol. ix.) contains an investigation, by Mr. George C. Comstock, on "Aberration and Atmospheric Refraction." It may be remembered that M. Lœwy pointed out the extended use of the equatorial telescope and its adaptation to new lines of research through the introduction of reflecting surfaces in front of the objective. The method adopted here, however, deviates widely from Lœwy's, for reasons given by the author in the introduction. Instead of the employment of a prism in front of the object-glass (the fundamental idea of the apparatus designed by M. Lœwy), the reflecting surfaces of which were the silvered faces of an equiangular glass prism, Mr. Comstock substituted for it three plane mirrors of rectangular cross-section. By this means he was able to overcome the great drawback, met with when using the prism, of the deformations of the prism arising from changes of temperature, and producing errors of focus which seemed to be insuperable with this type of apparatus. A detailed description of the mirrors and method of mounting, too long to be referred to here, is given. Mr. Comstock next enters on the determinations of the errors of the apparatus, and gives tables of the instrumental constants that follow, a description and investigation of the micrometer employed, and the effect of aberration and refraction upon the apparent distance between two stars respectively. Several other points are investigated, which he found were important after a preliminary trial of the method he adopted. From the discussion of 822 observations of the angular distances separating thirty-nine pairs of stars made by two observers, it appeared, as he says, "that the apparatus as employed is capable of furnishing a very considerable degree of precision, the probable error of a single observation made under normal conditions being ± 0″·30, *i.e.* less than a millionth part of the quantity measured." As mentioned before, the observations were made to determine, from the annual variations in the distance separating each pair of stars, a value of the constant of aberration, and a second part of the work was to make a comparison of the measured and computed distances, which would give the corrections to be applied to the refraction tables. A series of subsidiary investigations, the results of which are given on page 203, was also completed. The result of the whole investigation furnishes as a definite result: Constant of Aberration $= 20''\cdot443 \pm 0''\cdot010$, which differs only very slightly from the commonly accepted value obtained by Struve, and this within its own limit of probable error. The volume is accompanied by some excellent illustrations of the instrument and the novel dome which protects it. The second part of this volume contains the observations of the right ascensions of the stars observed with the prism apparatus made by Mr. Albert S. Flint.

NEW FEATURE ON MARS.—A telegram from Kiel announces the observation of a bright prominence on the terminator of the planet, by Messrs. Hussey and Holden, at the Lick Observatory on Wednesday last, August 27. The planet is well situated for observation at midnight, being at present some five or six degrees north of α Tauri.

THE ECLIPSE AT BODÖ AND NORTH FINLAND.

WE give this week a reproduction of the drawing of the corona made near Bodö, which accompanied Dr. Brester's letter in our last issue (p. 390).

Further particulars have been received concerning the doings of the Russian Expedition under Baron Kaulbars, which observed in Russian Finland. There was an unusually large development of the corona, the extensive and often oblique rays of which surrounded the dark disc of the moon. One of these rays reached a length double that of the sun's diameter. Some of the rays crossed each other, and Baron Kaulbars writes to the *St. Petersburger Zeitung* "that the remarkable proportions of the corona coincide with the opinion according to which this phenomenon is only very little developed with a *minimum* of sun-spots, for he had been able to see only very insignificant spots on the sun at rare moments during observations extending over several weeks."



Dr. Brester's drawing of the Corona.

Other expeditions to the Maritime Province of the Amur appear to have been very successful.

ON THE RÖNTGEN RAYS.[1]

WHO would have dreamt at the last annual meeting of the Victoria Institute, that before a year was out, we should be able to see on a screen, to receive on a photographic plate, which is afterwards developed, the skeleton, or a portion of the skeleton of a living man, or at least a living child? And as the modes of exciting these rays improve, we shall probably go on, step by step—indeed already, I believe, the whole body of a full grown man has been penetrated by these rays, the discovery of which we owe to Dr. Röntgen.

I feel some diffidence in bringing this subject before you, because I have never, myself, made experiments with the Röntgen rays. Nevertheless I have read a good deal about them, following what others have done, more especially where it connected itself with the subject of light, to which I have paid a good deal of attention. So I cannot but have a tolerably definite idea in my own mind as to the nature of these Röntgen rays which has been a matter in dispute and, I may say, is still in dispute, although I think opinions are generally coming round to that which I will bring before you in the end.

Now before I go to the Röntgen rays direct, I must touch on previous work which gradually led up to them.

For a very long time it has been known that an electric discharge passes more readily through tolerably rarefied air, than through air of greater density, and so with other gases. If we have a longish closed tube, provided with electrodes at the ends by means of platinum wires passing through the glass, if the air be tolerably exhausted from it, an electric discharge passes, comparatively speaking, freely through it, forming a beautiful skein of light, if I may so speak, and under certain circumstances that skein of light is divided into strata in a very remarkable manner. These strata fill the greater part of the tube from the positive electrode, or anode, as it is called, till we get nearly, but not quite, to the negative electrode, or kathode. There is a dark space separating the end of the positive discharge which, as I said, under suitable conditions and sufficiently high exhaustion, shows stratification, from a blue glow enveloping the negative electrode or part of it. The luminosity about the kathode is somewhat indefinitely bounded on the side of the stratification.

When, however, the exhaustion is carried still further, at the same time the strata become wider apart, and the luminosity recedes from the kathode and expands, forming a sort of glowing halo much more sharply defined on the inside than the outside; in that respect resembling the ordinary luminous halo—not the corona—occasionally seen round the moon. We have here, then, these two dark spaces, one outside the halo, where the luminosity gradually fades off, and another dark space on the inside, where the luminosity is more sharply defined, and which reaches to the negative electrode.

Now it is the phenomena in connection with this second dark space that I have more particularly to bring before you. As the exhaustion is rendered higher and higher, the inner dark space gets wider and wider until at a sufficiently high exhaustion it fills the whole tube or bulb. Mr. Crookes has worked more especially at this subject, and, indeed, the tubes which are now used for the production of the Röntgen rays, are generally called "Crookes tubes." I have seen in some of the foreign periodicals the word "Crookes" used to signify one of these tubes. Mr. Crookes' researches in very high vacua led him up to that most remarkable instrument, the radiometer, the nature of which led us to form clearer conceptions, than we had hitherto done, of the nature of the motion of molecules in gas; or rather, when the theory of the radiometer was made out, presented us, as I may say, with a visible exhibition of the thing in actual working.

Now these researches, which led Mr. Crookes to improve his vacuum, naturally led him to examine the electrical phenomena produced by excessively high vacua.

I have said that it was with the second or inner dark space that I had chiefly to do. When the exhaustion is sufficient, that fills the whole tube.

Now what takes place in this dark space? Suppose we interpose a screen, such as a plate of mica with a hole in it. A portion of the discharge from the negative electrode goes through that hole and continues onwards in a straight course until it reaches the wall of the tube. When it reaches the wall

[1] An extract from the Annual Address to the Victoria Institute, by Sir G. G. Stokes, F.R.S., the President.

of the tube (I will suppose the tube, as it is called, to be made of German glass) it produces a greenish yellow fluorescence, or phosphorescence of very brief duration. I need hardly say that if you do not limit what comes from the negative electrode by the screen with a hole in it, you get a broader beam which affects the glass wall over a larger space.

Now what is it that proceeds from the negative electrode towards the glass, and, when it gets there, produces this phosphorescence? Is it light, or is it matter?

One remarkable circumstance connected with this *something* is, that you can deflect it in its course by a magnet. If you present a magnet to a ray of light it does not deflect it at all; but this *something* is easily deflected by a magnet, even by a tolerably weak magnet. Mr. Crookes found that in addition to that property, if this discharge of a something fell upon one side of a very light fan, formed of thin, split mica, and delicately mounted so as to enable it to spin readily, it sent it spinning round; and he believed that the nature of that which we have here to do with is, that it is a stream of molecules. Nobody, I suppose, denies that there is matter propelled; but there has been a considerable difference of opinion as to whether the matter propelled is of the essence of the phenomenon, or whether it is something merely accidental. Mr. Crookes held that it was of the essence of the phenomenon, and that we had here, really, a stream of molecules, and I must say, for my own part, I believe he was right. But some foreign men of science hold that the projection of matter is altogether a secondary phenomenon, and that what comes through this small hole is really only a process which goes on in the ether—something so far of the nature of light, but yet differing from ordinary light most markedly in the property of being deflected by a magnet. To illustrate what I mean by saying something secondary, Prof. Wiedemann, who holds the opinion that it is of the nature of light, or a process going on in the ether, imagines that the projection of matter has no more to do with the phenomenon than the path of a cannon ball has to do with your hearing the sound of the cannon. I think, myself, that it has a great deal more to do with it than that. However, I will leave that matter for the present, to pass on to some researches which led up to the remarkable discovery by Dr. Röntgen.

In Germany, Prof. Lenard made a very remarkable series of experiments in what the Germans call, and what we may call, the kathodic rays, and which he believed to be actual rays, and not streams of molecules sent from the kathode. In order to produce these rays, as I will call them, you want a very high vacuum. If, however, you make your vacuum too high and too nearly perfect, you cannot get the electric discharge to pass through it. A perfect vacuum appears to be a non-conductor, and if you attempted to make the electric discharge pass through it, it would go, by preference, on the outside from one electrode to the other, so that you cannot work directly with anything too nearly approaching to a perfect vacuum. But it is a very remarkable thing, though Lenard, I believe, was not the first to discover it, but Hittorff, that these kathodic rays pass or appear to pass through a plate of aluminium which is perfectly impervious to light, or even to the ultra-violet rays, which we know by their effects, though we do not see them directly; so that you may have these kathodic rays at one side and something of the same kind at the other. Lenard constructed an apparatus commencing with a Crookes tube, in which there was very high, though not too high, exhaustion, with a kathode which was either flat or cup-shaped at one end, and opposite to that, in the part where the kathodic rays would strike the glass if it were there, instead of glass it was closed by a thin plate of aluminium foil, so thin that it would support the atmospheric pressure although it was impervious to air. But as a continuation of that tube he had another tube, which was also capable of exhaustion. The two tubes had glass tubes leading from them to the same air-pump. There was communication with the air-pump and communication between the two tubes, and you could exhaust them together, and the pressure would be so far reduced that the aluminium plate was strong enough to sustain the reduced pressure. They were both exhausted together until a suitable exhaustion was produced for the production of the kathodic rays in the first tube, and then the connection between the two tubes was intercepted, and the exhaustion of the second tube, which was kept connected with the air-pump, was continued for several days, until, as near as he could get it, there was nothing at all, in the way of gas, left in it. What was the result? In the first tube the kathodic rays were produced by the electric discharge. They fell on the aluminium foil at the end, and then there was a continuation of kathodic rays in the highly exhausted tube—the vacuum tube I will call it—and these went on as if they had been rays of light. They were deflected by the magnet just like the original kathodic rays.

Now at first sight that looks very much as if you had to deal with actual rays, which passed through the aluminium foil, just as rays of light would pass through a plate of glass. But I think the real explanation of it is altogether different. I believe it to be of this nature. First I will use rather a gross illustration, in order that you may the better apprehend the nature of the other explanation that I am about to bring before you. Suppose that I have a row of ivory balls in contact, such as billiard balls, and that another similar ball strikes the first of these. The result is that the last of the balls is sent off, and the striking ball and the intermediate balls remain approximately at rest. Now it is conceivable that something analogous to that may take place as regards these so-called kathodic rays, supposing they are not rays at all, but streams of molecules. It is conceivable that the molecules proceeding from the kathode or negative electrode of the first tube, be they of residual gas, or aluminium, or platinum, might fall upon the thin aluminium plate which forms a wall between the two tubes, separating the one from the other, and that that would give rise to molecular discharge in the second space, although the actual moving molecules never passed through the wall. As I say that is a rough illustration—rather a gross and material illustration—to enable you to understand more clearly the view I have to bring before you.

I have said that the so-called kathodic rays are easily deflected by a magnet. Now we know from other experiments that if a body sufficiently charged with electricity is in rapid motion, and that motion takes place in a magnetic field, the body tends to be deflected. This looks, therefore, very much as if these kathodic rays are actually streams of molecules, which being highly charged electrically, and of almost inconceivable minuteness, would be deflected by a slight magnetic force. Now, if these highly-charged molecules come to strike on the aluminium wall which separates the two tubes (which are end to end) from one another, it may be that an electrical action goes on which resembles very much what electrolysis is supposed to be according to the views of Grotthuss. I shall not have time to enter into an explanation of that now, for it would lead me too far from the subject; but several present will no doubt understand what I mean when I refer to the views of Grotthuss. The molecules then impinge on the wall, and give rise to a projection of molecules from the second side of the wall, but the latter are not the same molecules which impinged on the first side of it. Whether the molecules projected in the second tube come from a very minute quantity of residual gas, or whether they are derived from the aluminium wall itself, from which they are torn, as it were, does not signify for my purpose. We have here, you see, a conceivable mode of emitting these so-called rays in this way, simulating the transmission of a ray of light through a plate of glass, though it is no ray at all that we are dealing with. I confess I think that that is the true view of the action which takes place. But Lenard himself believed that the kathodic rays were, as he said, processes in the ether. By means of the first tube used alone, as was done in the first instance, but closed with a "window" of somewhat thicker aluminium foil, so as to sustain the atmospheric pressure, he was able to receive the kathodic rays which came from the second surface of the aluminium foil in air, where he could examine them at pleasure, using for their detection sometimes a phosphorescent or fluorescent screen, sometimes a photographic plate. He found that under these conditions they were quickly deflected from their original direction and dispersed, so that they could not be traced far, just like rays of light in a turbid medium, such as water to which a little milk has been added; whereas in a subsequent series of experiments, to which reference has already been made, in which the kathodic rays were received into a second tube, the dispersion became less and less as the exhaustion proceeded, until at the highest attainable approach to a perfect vacuum the dispersion almost disappeared, and the rays were traced right onwards for a metre and more, and that, without being enlarged by diffraction, as would be the case with rays of light.

Lenard mentioned incidentally that these kathodic rays, as he supposed they were, were able to pass through the hand even. He missed the discovery of the X rays because he had, I may say, the kathodic rays too much in his head, and attributed the whole effect on either side of the wall to the kathodic rays. Really the effect is due in part to the kathodic rays, and in part to the Röntgen rays, the existence of which he was not aware of. They cannot be distinguished merely by their effect on a fluorescent screen or on a photographic plate, since both these recipients are affected by the rays of both kinds.

Such was the state of things when Röntgen made his remarkable discovery. According to an account which I saw in one of the newspapers (we cannot vouch for the truth of everything we see in the newspapers), the discovery was made in the first instance accidentally. I cannot give you more authentic information than that, but he had been working with a Crookes tube and he observed that a photographic plate, enclosed in the usual case in which these plates are enclosed when you want to protect them from light, showed on development certain markings an it; so he put the whole apparatus as it had been, with a photographic plate in its case in the same position as before, and the thing was repeated. That is according to the account in the newspapers. A very remarkable discovery was the result. He found that rays were capable of coming out of some part of a Crookes tube which had the remarkable property of passing through substances that are opaque to ordinary light, and opaque even to the ultra-violet with which we were previously acquainted. They pass freely through black paper, through cork, wood, or even through the flesh of the hand, though less freely through the bones, so that by simply laying his hand upon the case containing the photographic plate, he actually got a photograph of the bones of his hand.

Well, what is the nature of these rays and from whence do they come? As Röntgen said in his original paper, a slight examination shows that they have their origin in the part of the Crookes tube opposite to the kathode, and which is rendered phosphorescent by the discharge from the kathode.

The rays, however, which come from this part of the tube, and which appear to have their origin there, differ utterly in some respects from the so-called kathodic rays. If you isolate a portion of them, you find that a magnet has no action upon them; unlike the kathodic rays, they proceed onwards without deflection, just as if the magnet were not there. Like light they proceed in a straight course, but these rays are able to pass through a variety of substances that are opaque to ordinary light, while on the other hand they are stopped by other substances which let light freely through. That, however, does not prove that they are not of the nature of light. You may have, suppose, a red glass which is opaque to green rays, but lets red rays through very freely, so that as regards merely the fact of the X rays being stopped by substances transparent to light, while they pass more or less freely through other substances which are quite opaque to ordinary light, that establishes no greater distinction than exists between green and red light. Are they then of the same nature as light?

The X rays have some very remarkable properties by which they appear at first sight to differ *in toto* from ordinary light. They pass with either no refraction, or excessively small refraction, through prism-shaped bodies, which we know rays of light do not. They suffer hardly any, if any, regular reflection, unless perhaps at a grazing incidence.

Röntgen himself, in his original paper, dwelt on these peculiarities of the new rays. He formed a prism of aluminium, with which he attempted to obtain deviation of the new rays, but the experiment showed that if there were any deviation at all, at any rate the refractive index could not exceed 1·05. He speaks of the rays not being apparently capable of regular reflection, but he brought forward experiments which show that in a certain sense they appear to be capable of reflection.

A photographic plate with the sensitive surface downwards was placed in its case under a Crookes tube, and immediately under the plate, and inside the case, were placed portions of different kinds of metal, which would be capable of reflecting back the rays on to the sensitive surface, if they admitted of reflection; and it was found that the plate was much more darkened over certain of those metals than where the metal did not exist. There was very little darkening over aluminium, and a great deal of darkening comparatively over platinum. This indicated that some effect was produced, though the greater part of it is not one of regular reflection. He conceived the effect to be one of reflection such as you might have from a turbid medium.

There is, however, another mode of explanation which seems worth considering, viz. that the Röntgen rays, falling upon the metal, throw the molecules into a state of vibration, which they communicate to the ether, by a sort of phosphorescence or fluorescence of X light; so that the rays which come from the molecules, though perhaps not of exactly the same nature as the X rays that fell upon them, still have enough of the "X" quality about them, whatever that is, to enable them to get through objects which are opaque to ordinary light.

Lord Blythswood, who has worked a great deal with the Röntgen rays, has written a paper, which was communicated to the Royal Society by Lord Kelvin, in which he establishes a minute regular reflection of those rays from speculum metal at an angle of about 45°. Two plane specula were placed side by side so as to receive at that angle the X rays coming from a Crookes tube, and a duly protected photographic plate was placed in such a position as to receive the regularly reflected rays if there should be any. The developed plate appeared to show a slight indication of the junction between the mirrors; and that the appearance was not illusory was shown by Lord Kelvin, who made measurements on the image and compared the results with what they ought to be on the supposition of a regular reflection. The indication was so faint that I could not myself perceive it (I have not seen the negative, but only positive copies), but Lord Blythswood has given me some positive copies of a negative which he subsequently obtained by reflection from a concave speculum at a small angle of incidence, and which show for certain a minute regular reflection of X rays, while at the same time they prove that the quantity of X light returned by regular reflection is extremely small compared with that which comes from the mirror by some different process.

Now there is another remarkable property of these rays, or absence of property, if you like so to call it. Rays of light, as we know, admit of diffraction. If you pass light from a luminous point through a very small slit, or a small hole, the riband, or the beam of light at the other side, does not follow merely the geometrical projection of the slit or hole as seen from the source of light, but is more or less widened, and certain alternations of illumination are visible, a phenomenon referable to interferences which I have not time to go into. How do these X rays behave under such conditions? It is a very remarkable thing that they do not show these enlargements or exhibit any sign of interference.

The last number of the *Comptes rendus* contains a paper by M. Gouy in continuation of a former paper, but describing experiments carried out in a still more elaborate manner, which proves the truth of this to a very high degree of strictness. He makes out that if these X rays are periodical, the wave-length cannot well be more than the one-hundredth part of the wave-length of green light, indicating an enormously high degree of frequency.

Now, if we assume that the X rays, like rays of light, and unlike the kathodic rays, are a disturbance propagated in the ether, ponderable matter being concerned only in their origination, not in their propagation, the question arises, What is the relation between the direction of vibration and the direction of propagation? Are the vibrations normal or transversal? We know that the vibrations of the air which constitute sound take place in a to and fro direction, or are what is called normal—that is, perpendicular to the waves of sound. We have the fullest evidence that the vibrations of the ether which constitute light take place in directions perpendicular to that of propagation, or are what is called transversal. To which category do the vibrations belong which constitute the X rays?

If we could obtain polarisation, or even partial polarisation, of the X rays, that would settle the question, and prove that they are due to transversal vibrations. But most of those who have attempted to obtain indications of their polarisation have failed. This, however, does not prove that the vibrations are normal, for the peculiar properties of the X rays shut us out—or, at least, almost completely shut us out—from the ordinary means of obtaining polarisation. There is, however, one paper in the *Comptes rendus*, by Prince Galitzine and M. de Karnojitsky, in which the authors profess to have obtained by a special method undoubted indications of polarisation. No reasonable doubt can remain as to the abstract capacity of these rays for polarisation after what has been done by another physicist. I wish I had time to go into the experiments that have been made by M. H. Becquerel in the direction of polarisation; but I have already kept you too long. He had more particularly studied a very remarkable phenomenon, viz. that certain phosphorescent bodies—such as sulphide of calcium, for instance, and salts of uranium—on exposure to ordinary sunlight give out rays of some kind which pass through bodies opaque to light, and are able to affect a photographic plate beneath them. So far these agree in their properties with the X rays which are obtained from a Crookes tube, which they far more closely resemble than they do rays of ordinary light; but the rays thus obtained were found by Becquerel to admit of polarisation by means of tourmalines in a manner altogether unmistakable. I think, therefore, that we may take it as established that the Röntgen rays are due to some kind of transversal disturbance propagated in the ether.

The non-exhibition of the ordinary phenomena of diffraction and interference is explicable on the supposition that the vibrations in the X rays are of an excessively high order of frequency. I am not sure that a different sort of explanation might not, perhaps, be possible which I have in my mind, though I have not matured it; but, save the possibility of that, one is led to regard them as consisting of transverse vibrations of excessively high frequency. This opens out some points of considerable interest in the theory of light; but I am afraid it would keep you too long if I were to attempt to go further into this matter. I will merely remark that, taking the way in which these rays are most commonly produced, viz. as coming from a point where the kathodic discharge in the Crookes tube falls on the opposite wall, we may understand how it is that vibrations of excessively unusual frequency may be produced. These highly charged molecules, charged with electricity, coming suddenly against the wall, may produce vibrations of a degree of frequency which we are not at all prepared for; but I see by the clock that I must not detain you any longer on speculations.

Postscript.—This "different sort of explanation" is one between which and the supposition of periodic vibrations of excessively high frequency my mind has for a long time oscillated. In the above lecture I gave the preference to the latter; but subsequent reflection leads me strongly to incline to the former. I hope before long to develop fully these views elsewhere; meanwhile, suffice it to say that I am disposed to regard the disturbance as non-periodic, though having certain features in common with a periodic disturbance of excessively high frequency.

THE ICE VOYAGE OF THE "FRAM."

DR. NANSEN has communicated to the *Daily Chronicle*, by telegraph from Tromsö, some interesting details given by Captain Sverdrup, with reference to his voyage in the *Fram*. The marvellous way in which the *Fram* withstood the ice-pressure, and the methods employed to free the ship from the ice, is an object-lesson for future Arctic explorers. The telegram is abridged below.

On March 14, 1895, Nansen and Johansen left us. During the first month after their departure, the ice was very quiet and the drift inconsiderable. Towards the end of April the drift, however, improved, and we were carried westwards. On July 26 the *Fram* was in 84° 50′ N., and 73° E. long. There was during this time much ice-pressure, but it never reached the ship. Then we had winds from south-west and west, which during the summer drifted the *Fram* backwards towards the east and north-east. It was not before October that the favourable drift recommenced, and during the autumn and winter, and especially during January and the first part of February 1896, our drift was better than ever.

On October 16, 1895, the *Fram* had reached the highest latitude observed, viz. 85° 57′ N., and 66° E. long. In the middle of February we were on 84° 20′ N., and 23° E., but here the drift closed until May, when we were again carried southwards. On July 19 we had reached 83° 14′ N., and 14° E. long.

There we got the *Fram* out of the grasp of the ice by blasting with gun-cotton and powder, and began to force our way southwards. During the whole drift in the ice the *Fram* was exposed to constant and violent pressures. None of these were, however, so dangerous as that which we had at New Year before Nansen left us. Immediately after his departure we were occupied in removing the huge mass of ice which on that occasion was pressed against the *Fram's* sides. At the end of March, just as the last portion of this ice was being removed, the ice suddenly cracked in all directions round the ship, and a broad water-lane was formed, which came within a few feet of the *Fram's* stern. Strong pressure very soon began along this crack, and the ice was so much broken up that the *Fram* at the end of July lay close to open water. A single mine was sufficient to free the ship from the ice.

As this mine was exploded, the *Fram* glided from the ice into the water like a ship being launched from her ways, but with a noise like thunder, the crew cheering loudly as she struck the water. Having been brought into a safe harbour by warping and sawing the ice, she was again, in August, frozen in. The ice-pressures were, during this year, of no great importance in comparison with the pressures this last summer.

During one week in June this summer (1896), at the height of the spring tides, the *Fram* was regularly exposed to violent pressures caused by the changing tide-currents. She was then once or twice a day lifted 6 to 9 feet, and her bottom could be seen resting on the ice. On all these occasions the *Fram* proved to be the very ship for ice. She was quietly lifted, and not a noise or a crack was heard from her timbers. The men on board were not disturbed in their slumber, even when the pressure was at its highest, and we awoke in the morning in ignorance of what had happened during the night. It was not before we came on deck that we observed how high we were lifted above the ice.

The temperature of the air was pretty even during our whole voyage, and did not fall lower than during the first winter. The depth of the sea was during our drift about the same as we had found before Nansen's departure, viz. 1800 to 1900 fathoms. In the temperature of the sea there was also little change, but the warm layer of Gulf Stream water under the cold surface-water increased a little in body as we came westwards. Depôts of provisions, boats, kayaks, and all necessary equipment were during our whole drift kept in readiness on the ice in the neighbourhood of the *Fram*, in case of fire or other accidents.

The time passed comfortably and peacefully, much in the same way as during the first winters. An easier expedition can hardly be imagined. Our principal work was to take the regular observations, sleep, eat, and drink. Our health was perfect the whole time, and we had no sign of scurvy. When the ice began to slack a little this summer, we worked hard to loosen the *Fram* from the ice—a difficult task, owing to the huge ice, piled up by pressures, in which our ship was frozen. We succeeded, after some days' hard work, by blasting, using mines of up to 100 lb. of powder. Guncotton proved the best.

From July 19 to August 13 we forced our way southwards through 150 miles of close ice. The ice was, as a rule, very high, and the floes were so extensive that we could not see all of them, even with telescopes. It often seemed to be hopeless, and if the *Fram* had not been such a superior ship for ice-navigation it would have been quite useless to try to force our way through ice-masses of such a description. It was by steam and warping that we broke our way through foot by foot, and where the ice was too bad for this it was forced by blasting.

We came out of the ice on August 13—the same day on which Nansen and Johansen arrived at Vardö in Norway.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Lords of the Committee of Council on Education have appointed Mr. A. J. R. Trendell, C.M.G., to be Assistant-Secretary of the Department of Science and Art, in succession to Mr. G. F. Duncombe, retired. Mr. Edward Belshaw succeeds Mr. Trendell as the Chief Clerk.

THE retirement of Prof. Erismann from the chair of Hygiene in the University of Moscow, is announced.

COLONEL PENNYCUICK, late R.E., has been appointed President of the Engineering College, Cooper's Hill, in the place of General Sir Alexander Taylor, retired.

THE following announcements have been recently made:—Dr. Burney Yeo, to be Professor of Medicine, and Dr. Curnow, to be Professor of Clinical Medicine at King's College, London.

A SCHEME for a Central Technical College in Liverpool, for which the plans have already been accepted, now awaits the sanction of the City Council. The estimated cost, apart from the final equipment, amounts to £80,000.

THE syllabus of lectures at the British Institute of Preventive Medicine, for the Session 1896-97, has just been issued, and contains particulars as to the work in the following departments:—Bacteriology: (1) Bacteriology in relation to Medicine and Pathology; (2) Bacteriology in relation to Hygiene; (3) Biological Chemistry; (4) Original Research Work: Hygiene, Clinical Investigation, Bacteriology of Fermentation, Water Laboratory, and Photomicrography.

THE following appointments have recently been made at the Swansea Technical School:—Lecturer in Metallurgy, Allan Gibb, Honours Associate in Metallurgy of the Royal College of Science. Lecturer in Physics, W. Williams, B.Sc. (London), Senior Demonstrator, Physical Department, Royal College of Science. Lecturer in Engineering, T. Gilbert Jones, B.Sc. (Vict.), Wh.Sc., &c., Lecturer in Applied Mechanics and Steam, Huddersfield Technical School.

AMONG recent appointments abroad we notice the following:—Prof. Thomas A. Williams, of South Dakota, to be Assistant in the Division of Agrostology of the Department of Agriculture; Mr. F. S. Earle, to be Professor of Biology at the Alabama Polytechnic Institute; Dr. Karl Rümker, to be full Professor of Agriculture in the University of Breslau; Dr. F. W. Küster, to be Professor of Physical Chemistry in the University of Göttingen; Dr. Wm. Sandmeyer, to be Professor of Physiology in the University of Marburg; Dr. Max Fischer, to be Professor at the Agricultural Institute at Leipzig; Dr. Richard Lorenz, to be Professor of Electro-chemistry at the Polytechnic Institute at Zürich; Herr Troske, to be Professor of Engineering at the Technical High School, Hanover; Dr. J. Biehringer, to be Docent in General and Technical Chemistry at the Technical High School, Braunschweig; Dr. Benecke, to be Docent in Botany in the University of Strasburg.

THE *Calendar* of the People's Palace, East London, Technical College for the Session 1896-7, contains information concerning all the classes which are to be held next winter, and their name seems to be legion. Not only can the student of pure science receive instruction in any branch from thoroughly competent teachers, but also the person desirous of help in learning how to make artificial flowers for bonnets, or how to cut out a coat. We fancy it would be difficult to name a subject which does not come within the syllabus of this technical school. We refer the students of East London to the *Calendar* itself for information concerning scholarships, exhibitions, fees, &c.

THE City of London College, Moorfields, has issued its list of classes to be held during the forthcoming session, and a very full syllabus of lectures proposed to be given in the Engineering Laboratory of the same establishment has reached us.

PARTICULARS of the technical instruction lectures and classes organised by the British Horological Institute, Northampton Square, London, E.C., have been published for the session, which commences on September 8. They include drawing and theory classes held at the Institute on Tuesday and Thursday evenings, or instruction in theory by correspondence. Ordinary and honours theory examinations, held at the end of April in each year, are opened to all engaged in the horological trades. Certificates are issued to watch and clock repairers who satisfy the examiners of their proficiency. The certificates will be of two classes, both for watches and clocks: an ordinary and an honours certificate. Practical examinations in new work will be held annually in April, and the silver medal of the Institute will be awarded to recipients of the honours theory certificate and the practical certificate for new work, who obtain the largest aggregate number of marks in both examinations.

THE Aberdeen County Council, says *Education*, is making careful inquiry at various fishing centres as to the extent to which the County Councils in England have provided technical instruction for fishermen. The Cornwall County Council spends between £500 and £600 per annum on this branch of their work, and they have appointed a lecturer to give instruction on the curing of herring and pilchards; the natural history of crabs and lobsters, mackerel, oysters, and salmon; the making of crab-pots, splicing and net repairing, and so on; and to supervise demonstrations on oyster and lobster culture at Falmouth. Instruction is also provided in the subject of navigation, with a view to the examinations of the Board of Trade. The Essex County Council have started a marine biological station at Brightlingsea, to give practical instruction in the natural history of food fishes and other creatures. Experiments are also conducted in oyster culture, and lectures and demonstrations are given at the station. In Lancashire and Northumberland instruction has been given on the natural history of fish and navigation. At the conference, which was held last December, the proposal was put forward that a few practical fishermen should be selected from different centres in Aberdeenshire, and enabled to visit the more important fishing centres with a view to acquiring, and afterwards extending, a knowledge of the different methods of fishing, the treatment of fish after capture, preservation, and so on.

THE Department of Science and Art has issued the following lists of Scholarships and Exhibitions just awarded:—Whitworth Scholarships (tenable for three years), £125 a year each: Frederick C. Lea (24), engineer; William A. Taylor (23), engineer; Henry T. Davidge (24), engineer; John W. Hinchley (25), student (formerly engineer). Whitworth Exhibitions (tenable for one year), £50 each: William Du Bois Duddell (23), engineering student; John A. Sloan (23), engineer; Alfred J. White (20), engine-fitter apprentice; Hugh Wallace (21), engineering student; Edward A. Gere (22), student; Frank W. Arnold (23), engineering teacher; Hugh B. Phillimore (22), electrical engineer; Hanson Topham (19), mechanic; Harry E. Wimperis (19), engineer; Charles E. Handy (19), engine-fitter apprentice; Bertram J. Rouse (22), engine fitter; Frank H. Corson (19), fitter apprentice; Thomas G. Procter (20), engineering student; Harry Geldart (21), mechanic; Hector H. Garratt (20), engineer apprentice; George Wall (22), engineering student; George W. Howe (20), electrical engineer apprentice; William W. Firth (21), engineering student; Harry Grute (22), fitter; Hugh J. Williams (23), turner; Frank Mould (24), engine fitter; Frank H. Jeffree (22), engineer; Denys Walton (19), engineer apprentice; Allan J. Grant (20), engineer; William G. Hibbins (24), engineer; Joseph P. Ward (21), engineer; George L. Overton (21), student; Asa Binns (22), fitter; Albert Pidgen (23), fitter; William P. Ferguson (21), fitter.

THE list of successful candidates for Royal Exhibitions, National Scholarships, and Free Studentships (Science) is as follows:—National Scholarships for Mechanics: Ernest Larmuth (17), student; Raymond B. Smith (17), engineering student; John B. Shaw (22), engineer; Frederick J. Tyler (22), engineer apprentice. National Scholarships for Chemistry and Physics: Henry L. Heathcote (19), student; James M. McEwen (17), solicitor's clerk; Arthur Hopwood (21), hatter; Percy Hughes (18), laboratory assistant; Sydney W. Smith (18), student. National Scholarships for Biological Subjects: Herbert Wright (21), weaver; Wilfred Thomas (20), laboratory assistant. National Scholarships: Alfred J. White (20), engine-fitter apprentice; James Walker (23), engineer; John Cresswell (19), student; Ernest W. J. Edwards (17), assistant demonstrator of physics; Archie McDougall (17), laboratory assistant; Frank E. Smith (19), laboratory assistant; George J. Fenwick (17), scholar; Hugh McDougall (19), laboratory assistant; Frank W. Arnold (23), engineering science teacher; Hanson Topham (19), mechanic; Harry E. Wimperis (19), engineer. Royal Exhibitions: William Alexander (20), engineer apprentice; William Scholes (16), student; Thomas G. Madgwick (18), engineering student; William Robertson (19), laboratory assistant; Charles E. Handy (19), engine-fitter apprentice; William Pickering (22), stonemason; George A. Robertson (22), engineering student. Free Studentships: Frank Jowett (18), student; Percy Kenyon (17), student; George W. Howe (20), electrical engineer apprentice; Frank Mould (24), engine-fitter; Philip G. Gundry (18), student; Allan Macdiarmid (22), student.

SCIENTIFIC SERIAL.

American Journal of Mathematics, vol. xviii. No. 3. (Baltimore, July.)—On the multiplication and involution of semi-convergent series, by Prof. Cajori. In vol. xv. Prof. Cajori has generalised Voss's results (*Math. Ann.*, vol. xxiv. p. 42), and some further contributions of his to this difficult subject are given in the *Bulletin* of the Am. Math. Soc. (vol. i. pp. 180-183). The search, he remarks, for expeditious tests on the applicability of Cauchy's multiplication rule to powers of semi-convergent series higher than the second power, has given rise to the present investigation, which begins with alternating semi-convergent series, and ends with certain trigonometric series.—Analytic functions suitable to represent substitutions, is an interesting following-up of a theorem due to Hermite (*Comptes rendus*, vol. lvii. p. 750), by L. E. Dickson. Further generalisations are promised in a dissertation by the author.—S. Kantor contributes an elaborate memoir, "Theorie der Transformationen im R_r, welche sich aus quadratischen zusammensetzen lassen," which has as heading, "Boldness is caution in these circumstances."—Tactical Memoranda, i.-iii., by E. H. Moore, is the opening one of a series of papers which the author proposes to publish, on certain more or less closely connected topics of tactic. He starts from Cayley's division of algebra into tactic and logistic. This instalment bears upon the work of Reze (Geometrie der Lage), S. Kantor, Klein, and many others; it also gives a generalisation of the *fifteen-schoolgirls* arrangement, and considers whist tournament arrangements, which are in ultimate formulation purely tactical.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 17.—M. Marey in the chair.—On the copper mines of Sinai, worked by the ancient Egyptians, by M. Berthelot. These mines are near the coast of the Gulf of Suez, and are undoubtedly the most ancient known to history, having been worked at least 5000 years before the Christian era. They were abandoned about 3000 years ago, on account of the small amount of copper present in the ores. The reduction appears to have been carried out by methods not differing essentially from those in use at the present day, wood being used as the reducing agent, together with fusible silicates.—On the subject of a preceding communication, relating to some properties of primitive roots and secondary roots of prime numbers, by M. de Jonquières.—On an apparatus for aërial navigation, by M. Honoré.—Abstract of solar observations made at the Royal Observatory of the Roman College during the first half of 1896, by M. P. Tacchini.—Combination of argon with water, by M. P. Villard. When argon is compressed to 150 atmospheres in the presence of water cooled to 0°, local cooling at a point in the tube causes the separation of crystals, probably a hydrate, the dissociation tension of which at 0° is 105 atmospheres. Nitrogen and oxygen also combine with water under similar conditions, but at much higher pressures.—On the reticular structure of central nervous cells, by Mdlle. Wanda Sczawinska.—Contribution to the study of the coagulation of the blood, by MM. J. Athanasiu and J. Carvallo. It is concluded that in the normal state the blood and lymph contain elements, perhaps leucocytes, which supply the fibrin ferment necessary for the coagulation of these liquids, and that when these elements are prevented by any means, such as peptone, from fulfilling this function, the tissues are capable of replacing them.—Influence of certain substances upon the bactericidal properties of the blood, by M. London. The bactericidal power of the blood is markedly reduced by want of food, but increased by small repeated doses of sodium bicarbonate.—On the extraordinary refractions observed in the neighbourhood of lakes, and known under the name of *Fata Morgana*, by M. André Delebecque. The apparent enlargement of objects on the opposite bank of the lake is really due to the superposition of a number of images which, although not distinguishable by the unaided eye, are clearly separable by the aid of a telescope.—On the resolution of the general equation of the fifth degree, by M. L. Mirinny.

August 24.—M. A. Cornu in the chair.—M. Tisserand gave an account of the results of the observations made of the total eclipse of August 9. The results obtained by M. Deslandres at Yeso, and by Mdlle. Klumpke, at Vadsö, were unfavourable, but M. Backlund, of the Observatory of Pulkowa, was able to make some good observations at Novaya Zemlya.—On the transformations of the equations in dynamics, by M. Paul Painlevé.—On a proposition in mechanics, by M. F. Siacci.—On a doubly recurring series of points always homocyclic, by M. P. Serret.—On the electric convection following the lines of force produced by the Röntgen rays, by M. Aug. Righi. Experiments are described which tend to show the existence of a convection following the lines of force.—The utility in radiography of a screen coated with phosphorescent sulphide of zinc, by M. C. Henry. The zinc sulphide screen, wrapped in carbon paper, is covered with the object to be examined and exposed to the radiation of a Crookes' tube for some minutes. On removal to a darkened room the image shines for at least a quarter of an hour, so that the smallest details of the image can be made out. The light emitted by glow-worms was found to be capable of penetrating blackened paper, and affecting a sensitive plate underneath.—The quaternary beds of the Micoque, by MM. G. Chauvet and E. Rivière.—Note on magnesium sulphide, by M. N. Bignan.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—British Association, Liverpool, 1896: Handbook to Liverpool, &c. (Philip).—An Archæological Survey of the United Kingdom: Dr. D. Murray (Glasgow, MacLehose).—On the Adjustment and Testing of Telescopic Objectives, 2nd edition (York, T. Cooke).—The Principles of the Transformer: Dr. F. Bedell (Macmillan).—"Made in Germany": E. E. Williams, 3rd edition (Heinemann).—Entomological Notes for the Young Collector: W. A. Morley (E. Stock).—British Butterflies: J. W. Tutt (Gill).—Elements of Astronomy: Sir R. S. Ball, new edition (Longmans).

PAMPHLETS.—Les Applications de L'Électrolyse a la Métallurgie: M. U. Le Verrier (Paris, Gauthier-Villars).—Vierter Jahres-Bericht des Sonnblick-Vereines, 1895 (Wien).—Arithmetic for Promotion, Scheme B: Lock and Macdonald, Part 5 (Macmillan).

SERIALS.—Science Progress, August (Scientific Press).—Royal Natural History, Part 34 (Warne).—Strand Magazine, August (Newnes).—Journal of the Royal Microscopical Society, August (Williams and Norgate).—Quarterly Journal of Microscopical Science, August (Churchill).—Longman's Magazine, September (Longmans).—Good Words, September (Isbister). Sunday Magazine, September (Isbister).—Lloyd's Natural History. British Birds: Dr. R. B. Sharpe, Parts 3 and 4 (Lloyd).—Humanitarian, September (Hutchinson).—Chambers's Journal, September (Chambers).—Scribner's Magazine, September (Low).—Natural Science, September (Page).—Journal of the Royal Horticultural Society, Vol. xx. Part 1 (Victoria Street).—History of Mankind: F. Ratzel, translated, Part xi. (Macmillan).—Modern Astrology, September (Bouverie Street).

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