THURSDAY, SEPTEMBER 1, 1892.

## EPIDEMICS, PLAGUES, AND FEVERS.

*Epidemics, Plagues and Fevers: their Causes and Prevention.* By the Hon. Rollo Russell. (London: Edward Stanford, 1892.)

IN this handbook the author has aimed at collecting together the main facts concerning preventable diseases and presenting them in a convenient form for the use of those interested in the promotion of public health. The work is in the main a compilation of extracts from the most varied sources, and references are given which enable the original authorities to be consulted. It is difficult to speak too highly of the care and industry with which Mr. Russell has fulfilled this task, and of the completeness with which the work has been brought up to date.

In an introductory chapter on the nature of spreading diseases in plants and animals the analogy is traced between such processes as dry-rot and yeast fermentation, and the action of disease germs upon the animal organism; a short account is given also of various epizoötic diseases.

Passing to the main subject of the book, the author deals *seriatim* with the different human diseases of microparasitic origin. A long chapter is devoted to cholera. Accepting provisionally Koch's comma-bacillus as its cause, Mr. Russell exhibits in a mass of evidence the conditions of filth and water pollution which enable the disease to maintain itself in its native home, India, and to spread thence in epidemic visitations to other parts of the world. In many parts of India much has been done by sanitary measures, such as drainage and improved water supply, to reduce the incidence of cholera: in a later part of the book stress is justly laid on the responsibility which rests on England in the matter of the sanitation of India. The measures by which cholera may be arrested are set forth in full, the most important being personal cleanliness, a pure water supply, and the disinfection of dejecta and soiled linen. No adequate account is given of the measures of notification and supervision which in this country replace strict quarantine.

Another important section of the book is devoted to consumption, which it is a pleasure to find included amongst preventable diseases. Nothing is more lamentable than the carelessness with which a phthisical patient is allowed to spread infection broadcast by the sputum, and though public opinion is not yet ripe for the question of seclusion of cases of consumption, much might yet be done by educating patients to disinfect the sputum and use reasonable precautions against the infection of members of their families. The diffusion of tubercle by means of domestic animals and especially by milk is enforced by Mr. Russell, and attention is drawn to the general sanitary measures such as drainage and ventilation which have already reduced its mortality in this country.

In the chapter on diphtheria mention is made of the recent researches of Klein and others showing the connection of this disease with a certain disease in cows and in cats. The author has drawn also on Dr. Thorne Thorne's recent Milroy lectures, but he has hardly laid sufficient emphasis on the aggregation of children in schools as the main cause of the late increase of urban, as compared with rural diphtheria mortality, a point to which Dr. Thorne draws especial attention.

The section on influenza is based on the most recent observations, and even contains in a note some account of Pfeiffer's and Canon's influenza bacillus. Exception must be taken to the statement that this organism is present in immense numbers in the blood. In the sputum it is extremely abundant, but in the blood, as a rule, only in the scantiest numbers.

Scarlet fever and small-pox have each a comparatively short chapter devoted to them. That on scarlet fever contains mention of the so-called "Hendon disease" in cows, to which the extensive outbreak in the north-west of London in 1885 was traced, and a good practical epitome of the precautions to be observed in the sick room. In the section on small-pox vaccination statistics are given, but we find no reference to the elaborate Local Government Report by Dr. Barry on the late Sheffield epidemic, which contains a mine of information on the most serious outbreak of small-pox in England in recent years, and should certainly have been noticed. The spread of the disease by aërial diffusion from small-pox hospitals is clearly illustrated.

Typhoid fever receives long and thorough consideration. Mr. Russell accepts the "typhoid bacillus" of Eberth, Klebs, and Gaffky as the true virus of the disease —a conclusion which is far from settled in the minds of many, inasmuch as the true lesions of the disease have not been reproduced by it. But this does not affect the questions at issue. The ordinary method by which the disease spreads, viz., excremental pollution of drinking water, is abundantly illustrated by numerous examples, and the contamination of milk is likewise mentioned. The thorough disinfection of typhoid dejecta is clearly a matter of the first importance, and a sound practical method of accomplishing this is much to be desired; at present it must be admitted that no adequate means has been devised.

Amongst the numerous other diseases which Mr. Russell has treated of, we are glad to notice that pneumonia finds a place; it is undoubted that some forms at least of inflammation of the lungs are infectious and preventable in the same manner as other specific fevers. The claims of rheumatic fever, which has also been included, to a similar position, are to say the least doubtful.

In the concluding chapters of the book, Mr. Russell deals with more general problems, such as susceptibility, immunity, the distribution of microbes, the origins of epidemics, and so forth. Gathering his evidence from various sources, he deals with these matters in a very impartial way. Thus in discussing immunity, while accepting provisionally the doctrine of phagocytosis, he by no means regards it as the only means by which microorganisms are eliminated from the body. The germicidal powers of the fluids of the body receive due consideration as at least an equally important defensive agency. The scheme of a National Health Service is discussed in an appendix.

Mr. Russell is to be congratulated on the service which he has done to Public Health by the collection of this mass of information on its more important topics. It is only natural that a work which is essentially a compilation, should be of a somewhat patchwork character; but it is to be regretted that in some of the sections the different paragraphs do not offer more coherent reading. It would further have been an advantage to the general public, whose education in these matters is so essential an element in the further progress of public health, if so many technical terms had not been used without explanation. Occasional looseness of expression is to be noticed. As when we read of "Bacterium termo, the microbe of impure water," or, "the Zeiss system magnifies three to four thousand times." But to those for whom the book is specially written, those interested or officially concerned in the promotion of health, it will prove a valuable work of reference.

## *THE PHYSIOLOGY OF THE INVERTEBRATA.*

*The Physiology of the Invertebrata.* By A. B. Griffiths, Ph.D., F.R.S. (Edin.), F.C.S. (London: L. Reeve and Co., 1892.)

STUDENTS of biology, and especially of physiology, have long wanted a book treating of the physiological problems of the invertebrate animals. It is true that what is sometimes called human physiology is in great measure the physiology of the lower animals. Physiologists, however, generally select for experiment animals which are as much as possible like themselves; it is comparatively seldom that they invade the invertebrate branches of animal life. There are vast fields there for exploration which are almost untouched from the physiological standpoint, and one can hardly doubt that great treasures in the way of fact and reasoning could be unearthed, which would throw light on the functions not only of these lower creatures themselves, but on the life problems of the higher animals also. The present book by Dr. Griffiths will therefore be welcomed as a first attempt to fill this gap. He is well known as one of the few who have carried the method of physiology down to the invertebrates, and his researches have been marked by great industry and patience.

In treating of invertebrate physiology, it is obvious that there are two courses open to a descriptive writer: one is to take the various sub-kingdoms as the main headings, and to treat of the different functions of each before proceeding to the next; the other method is to head the chapters with the functions—circulation, respiration, and the like—and to describe each of these in the various branches of the invertebrata. No doubt there is much to be said for each course. The latter, which is the one adopted in the present volume, appears, however, to have these disadvantages, that it involves a good deal of repetition, and that each chapter is split up into a number of small paragraphs, and there is thus but little continuous narrative. This is increased by the habit the author has of making extensive quotations, so that there is little uniformity of style; half a page will be given in the flowing style of Huxley, and the next half in the less fluent English of other writers. It appears to us it would have been better if Dr. Griffiths had given the results of other investigators in his own language. This, however, is a minor point. Passing to more important matters, we may proceed to enquire if the book really meets the want which has been stated to exist; and the answer to such an enquiry must depend on whether the good in it outweighs the bad, or the reverse. The features in the book which appear to be excellent, are, first, the evidence that a vast amount of pains has been expended in its compilation; and on those subjects to which the author has devoted research-work—the excretions, the blood gases and salts, and digestion—he is distinctly good, and men of science will be glad to have all Dr. Griffiths' experimental work in a handy form, instead of having to hunt it out from journals. Then the whole is exceedingly interesting, and will no doubt stimulate others to prosecute new work on the subject.

There is, however, much that must come in for adverse criticism, and the first point to which attention may be called is not so much the fault as the misfortune of the author in having to deal with a portion of biological science which is in an embryonic condition. Where little is known little can be said, and some of the chapters are little more than anatomy, with physiological excerpts from anatomical works. Again, on certain subjects such as muscular contraction and blood coagulation, the author is evidently not acquainted with the literature of his subject, and in other cases again there is internal evidence to show that Dr. Griffiths has not consulted original memoirs, but abstracts of them that have appeared elsewhere.

The main objection, however, that physiologists will feel about the work, is the conclusion to which they can hardly help coming, that Dr. Griffiths has not the advantage of being a physiologist; there is no wide grasp of the facts and hypotheses with which he has to deal, and the hand of the amateur is continually to be seen. Take as an instance the following sentences: "Urea is a product of *more or less* complete oxidation of *organic substances*, and is *formed in muscular tissues* by the *disintegration of the anatomical elements.* Uric acid on the other hand is the result of an incomplete oxidation, and is produced for the most part *in the blood*, or its equivalent when such fluid is *surcharged with peptones* which the tissues are unable to assimilate." (The italics are our own.) Again, in the chapter on the physiology of the sense organs, the difference between the tactile sense and general sensibility has not been apparently grasped; and even on subjects which the author has himself investigated, very often elementary facts have escaped him. Thus it appears that uric acid is the most constant of the nitrogenous metabolites in the invertebrata, but we are not in the majority of instances told how this insoluble substance is held in solution in an aqueous liquid. We also read that after starch has been digested with the secretion of the hepato-pancreas, it gives a precipitate of cuprous oxide with Trommer's test, and this is regarded as sufficient evidence of the formation of glucose. No reference is made to the fact that anylolytic ferments in the vertebrata produce maltose and not glucose from starch. Again, one would judge from Dr. Griffiths' words, that he regards the formation of leucine and tyrosine as the chief functions of a proteolytic ferment, or from the omission of hæmocyanin from the chapter on respiration that it was not a respiratory pigment, though this would be corrected by reference to the chapter on the blood.

Taking a general survey of the whole, we see that the book is far from perfect. Few books are when they first appear, and much that is faulty can be corrected in subsequent editions. We must, however, congratulate Dr. Griffiths on being the first to break new ground by producing a work on the subject, as well as on the good points that the book exhibits, and to which allusion has already been made.

W. D. H.

## *THE DESIGN OF RETAINING WALLS AND RESERVOIR DAMS.*

*A Text-Book on Retaining Walls and Masonry Dams.* By Prof. Mansfield Merriman. (New York: John Wiley and Sons, 1892.)

BEFORE entering upon the investigation of retaining walls and their design, the author devotes two chapters to the consideration of earthwork slopes and the lateral pressure of earth. Owing to the changeable condition of earth under the influence of moisture, and the variable nature of any stratum, it is impossible to obtain strictly exact expressions for the forms of slopes of cuttings and embankments, or definitely accurate values for the lateral pressure of earth; but, nevertheless, the formulæ deduced by the author from general principles are useful in serving as a guide to correctness of design. It is indicated that theoretically an earthwork slope should be curved, becoming flatter towards the base; and though a straight slope is always adopted for cuttings and embankments, the curved form left by slips is somewhat in accord with this theory. The inclination of slopes must indeed depend on the nature of the soil, and must be flatter in made ground than in cuttings; whilst efficient drainage and protection of the surface of the slopes from the weather are equally important for ensuring stability.

The pressure of earth is the basis of all theoretical principles relating to retaining walls, and it has formed the subject of numerous experimental investigations in England and on the Continent which might have been advantageously referred to in this book. The author adopts the view that the pressure is normal to the back of the wall; but as this theory is not universally accepted, he has also obtained a formula for inclined pressure. A retaining wall may fail by sliding or rotation, and the masonry is assumed to be laid dry, owing to the uncertain amount of cohesion in mortar joints. In practice, however, retaining walls of any height are built with cement mortar; and sliding occurs at the base, or even sometimes on detached slippery surfaces of clay below the base; whilst rotation is due to excessive pressure on yielding foundations at the front of the wall. Stability largely depends upon the nature of the foundation and the backing behind the wall. A clay foundation is far less trustworthy than gravel, and sliding is most effectually prevented in slippery soils by carrying down the foundations well below the surface; whilst careless backing up with bad materials, not brought up in their layers, may push over the wall. Efficient drainage, moreover, at the back of the wall, and outlets for water at intervals through the wall to prevent its accumulation behind, are almost as important considerations as the design of the wall. A wall leaning over backwards is shown to be the most economical; but though this form might be adopted for building against an embankment, it would not be convenient for a wall built in a timbered trench to retain the side of a cutting. The four chapters relating to earthwork and retaining walls, which comprise the main portion of the book, will be very useful for practical engineers who desire to extend their theoretical knowledge on these subjects; but students should bear in mind that an almost exclusive treatment of the theoretical aspect of these questions must be supplemented in actual design by practical experience.

The theory of the strains on masonry dams, considered in the concluding chapter, is more precise, owing to the exactness of our knowledge of the laws of water pressure as compared with the uncertain and variable pressure of earth. The well-known condition of stability, that the lines of resultant pressures, with the reservoir empty and full, should fall within the middle third of the cross section, is explained, as well as the uncertainty which exists as to the actual distribution of the pressures throughout the dam. The lines of resultant pressures for any given section are easily obtained graphically, for the line of pressure with the reservoir empty is the locus of the centres of gravity of the sections above a series of base lines taken down the dam, and the actual pressure is the weight of these successive sections; whilst the line of pressure with the reservoir full is the modification produced in the former line by the addition of the water pressure at the successive depths. The theoretical section given on page 110 resembles the section of the Furens dam in France, the highest masonry dam hitherto erected, the form of which was determined by elaborate analytical calculations. The principles laid down concerning masonry dams require to be supplemented by two practical considerations, namely, that high masonry dams must be founded on solid rock to secure them against undermining and settlement, which would be fatal to their stability; and that their inner face should be coated with an inpervious material, to prevent the infiltration which otherwise takes place through their joints at great depths. In taking the pressure due to waves on the top three or four feet of the dam below the water as equivalent to the greatest observed pressure exerted by waves on the sea-coast, the author far exceeds the probable limit; for ocean waves, owing to the great extent of the exposure and the depth, are impelled with a much greater force than the waves of a comparatively small and sheltered reservoir. The additional strength given to a dam by arching it towards the reservoir is very properly neglected in the calculation of its stability, for besides being difficult to estimate precisely, this increase in strength is inappreciable in a long dam, and even in the short Furens dam the arched form was merely regarded as an extra safeguard.

The book is clearly and concisely written; it is illustrated by numerous diagrams in the text; and problems to be worked out are given at the end of most of the articles, each of which deals with a subject under a special heading.

## OUR BOOK SHELF.

*Directions for Collecting and Preserving Insects.* By C. V. Riley. (Washington: Government Printing Office, 1892.)

DURING the last few years there has been in America a considerable increase of the number of persons interested in entomology. This may be due mainly to the fact that farmers have very practical reasons for studying insects, but no doubt it springs in part from a growing appreciation of the scientific aspects of the subject. However the increased interest is to be explained, one of its results is a constant demand, especially from correspondents of the U.S. Museum and the Department of Agriculture, for information as to how to collect, preserve, and mount insects. In the present work Mr. Riley undertakes to meet this demand. He also brings together a number of directions on points connected with such matters as the proper packing of insects for transmission through the mails or otherwise; labelling; methods of rearing; boxes and cabinets; and text-books. The work was prepared as a part of a Bulletin of the National Museum, but is also issued separately; and we need scarcely say that it is likely to be of great service to the class for whose benefit it was originally planned. Mr. Riley knows his subject so thoroughly that he is able to explain it simply and clearly, and the value of the text is enhanced by a large number of suitable illustrations. We may note that, in a paragraph on the scope and importance of entomology, he refers to various estimates of the number of insects in the world. Linnæus knew nearly 3000 species. In 1853 Dr. John Day thought there might be 250,000 species on the globe. Dr. Sharp's estimate thirty years later was between 500,000 and 1,000,000. In 1889 the estimate formed by Sharp and Walsingham reached nearly 2,000,000. Mr. Riley thinks even this estimate too low. Considering that species have been best worked up in the more temperate portions of the globe, that in the more tropical portions a vast number of species still remain to be characterized and named, that many portions of the globe are entomologically unexplored, and that even in the best worked-up regions by far the larger portion of the Micro-Hymenoptera and Micro-Diptera remain absolutely undescribed in our collections, and have been but very partially collected, he is of opinion that to say there are 10,000,000 species of insects in the world would be "a moderate estimate."

## 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.*]

### Science and the State.

IN last week's NATURE I find the statement that I was allowed to leave the public service "without the slightest recognition" by the State.

However distasteful it may be to me to have anything to say on this subject, I feel bound, in justice both to Lord Salisbury's and to Mr. Gladstone's former Governments, to point out that it is incorrect. Very substantial recognition was awarded me by both; and the late Lord Iddesleigh, in offering to recommend me for a Civil List pension, expressly put it as an honour.

The distinction which the Queen has recently been pleased to confer upon me must therefore, I am afraid, be placed in the category of "unearned increments." T. H. HUXLEY.

Barmouth, Wales, August 30, 1892.

[We did not refer to such recognition as is implied in the granting of pensions. What we meant was that the State ought to have marked its appreciation of Prof. Huxley's great services by conferring on him some national distinction of the kind he has now received.—ED.]

### An International Zoological Record.

ON this subject Mr. Minchin (NATURE, August 18, p. 367) writes as a Recorder, and he writes feelingly. Those who use Records can write with feeling too. The absurd waste of labour involved, even in the production of a single Record, by the present system is hardly to be excused by the consideration that the labour is voluntary. I say "voluntary" advisedly, for some three or four pounds is no pay for a month's hard work. And yet, for all this toil, the result, when, after a year or so of delay, we are presented with it, is notoriously unsatisfactory. It is indeed impossible for a single individual—often very far from acquainted with the subject he is recording—to work through all the scientific literature of the whole world for the preceding year, in search of some scattered references. Actually impossible, for the literature of one year never comes completely to hand before the end of the next, and perhaps not then; and this the Recorders seem to know, for many of them postpone their work till the autumn, though it should have already been published in the spring. The acceptance of Mr. Minchin's admirable suggestions would do away with the ridiculous decimiplication of labour, but it would neither make the Record complete nor hasten its publication. The public are probably more anxious for the latter results than they are for the relief of the Recorders.

Almost absolute completeness, a higher standard of work, and greater expedition, would probably be attained by some such organization as the following:—In each country a Bibliographer, possessing an all-round acquaintance with the subjects to be recorded; this bibliographer simply to record, on separate slips, titles and places of publication of papers issued in *his own* country (and therefore probably in his own language), and to mark by some symbol the groups of animals or facts alluded to in those papers. An Editor-in-chief, situated in some convenient postal and printing centre, *e.g.*, Naples, London, New York, Berlin, Paris, or Washington; this editor to govern the general plan of the Record, at present somewhat anarchic, to sort and distribute to specialists the slips which he receives from the bibliographers, and to edit the work. Lastly, for each group or division of a group, a Specialist, who, on receipt of the title-slips from the editor, should prepare the lists of new species, the abstracts of the papers, and a general review of advance in the subject. It may be pointed out that, by means of carbon-paper, title-slips can be easily written in duplicate or even triplicate; thus, by one writing of the bibliographer, slips can be prepared for the information of two or three specialists.

Such a scheme has the following advantages:—The literature is only gone through twice, instead of perhaps a dozen times. There is a possibility of completeness without much effort. Dates of publication can be ascertained with greater certitude. The quality of the work is improved by the employment of those specialists who will never consent to the colossal drudgery of the present system. Promptness of publication is possible. Thus, all slips for Europe and America could easily be sent to the editor within the first fortnight of the New Year, and by him transferred to specialists before the end of January. Literature from a greater distance would have to be sorted later on. Any specialist worthy of the name would already have seen most of the papers, and, with the help of abstracts from authors, could be ready with his manuscript before March, by which time the literature from the most distant parts would have come in and might be incorporated. The Record should go to press in separate divisions, so that the Birds need not be kept waiting because the Worms were not early; and the whole might well be issued in April or May.

The financial question must not be overlooked. As an International affair the sources of revenue of such a Record would be greatly increased. Not only Zoological and Royal, but also Geological Societies of all nations should be invited to contribute towards its expenses. The printer and the editor would have to be paid as now, the editor perhaps a trifle more. The postage would be a larger item, but postage is now so cheap that it really makes little difference. The bibliographers would of course have to be paid; but then the work of a bibliographer, even for the most prolific country, would be far less than the present work of the Recorder of, say, the Brachiopoda, who, I believe, gets about 30s. Some specialists would wish to be paid, but others would probably be satisfied by receiving the information from bibliographers and the abstracts and separate copies from authors. These latter, it is presumed, would gladly send single copies of their works for the use of a well-known specialist, but it is rather hard to have to distribute them to a dozen different Records, as one is requested to at present. The sale of such a work would be greater than that of the present incomplete and tardy publications. Besides, the promoters would doubtless be prepared to sell the various sections separately—an urgent reform that has long been clamoured for in vain; this alone would materially increase the receipts.

Having thought much of this subject during the last five years, and having talked it over with many Recorders and bibliographers, I venture to take this opportunity of putting forward the crude outlines of an undeveloped scheme. There is no wish to offend those unselfish toilers who have done and are doing so much for us, or the corporate bodies that support them. But this is a question that must be approached from a cosmopolitan standpoint. Men of science all the world over should support it with purse and person. All petty considerations of nationality, even of language, should be sunk. The aim of the work should be the advancement of science; only if it is truly International, can it possibly be realized out of Utopia. F. A. BATHER.

British Museum (Nat. Hist.), August 19.

---

PERHAPS you will kindly allow me, as the author of a certain pamphlet on "The Organization of Science," to say a few words on Mr. Minchin's letter (NATURE, August 18), which naturally had an especial interest for me. I am sorrowfully pleased to find the principles advocated in my pamphlet illustrated so well by concrete instance, and, needless to say, I heartily wish Mr. Minchin success in his endeavour to introduce order into at least one province of the scientific class, seeing that the text of my pamphlet may be exactly summed up in his remark—"A great need . . . is the intelligent *organization* of scientific research."

One point in Mr. Minchin's letter was of especial interest to me, for he invites the Royal Society to take in hand this work of organization, instead of leaving private individuals to execute at a great sacrifice the work which this wealthy corporation systematically neglects. Now a reference to my pamphlet (pp. 11-14) will show that this was a main thesis sustained there. Whether Mr. Minchin has done me the honour to read my pamphlet and is already preaching my crusade for me, or whether the similarity between our views is a simple coincidence of opinion, I know not, but whichever be the case, it is peculiarly gratifying to me to receive practically an endorsement from one whose experience renders him so especially qualified to speak with authority. A FREE LANCE.

London, August 23.

---

### "The Limits of Animal Intelligence."

MR. DIXON has not, I think, quite grasped the main tendency of my paper read before the International Congress of Experimental Psychology. Nor is this to be wondered at. He quotes from a brief summary of what was itself but an abstract of a portion of a work on Comparative Psychology on which I am engaged. I am in agreement with nearly all that Mr. Dixon says, except where he misunderstands my position, and except in the opinion he expresses in the last sentence. When Mr. Dixon says, "Of course it is true that my knowledge of *my own* psychology does differ in kind from my knowledge of that of animals, but it differs in exactly the same way from that of all other men," he is expressing the views which I, in common with most men who have seriously studied the question, hold. And when he says, "If in no case is 'an animal activity to be interpreted as the outcome of the exercise of a higher psychical faculty if it can be fairly interpreted as the outcome of one which stands lower in the psychological scale,' the same rule should be applied to the (scientific) interpretation of human activities," I can only say that I heartily agree with him. Since, therefore, we have so much in common, I do not propose to occupy valuable space in discussing the outstanding points of difference between us. I may perhaps be allowed, however, to take advantage of the courtesy of the Editor of NATURE, and to say a few words in elucidation of the thesis I very imperfectly set forth in my paper, a thesis based entirely on observation and induction.

In the first place the study of my own mental processes, and of the nature and sequence of my own states of consciousness, has led me to the conclusion that there is a great difference between the mere feeling or awareness of certain relationships and the clear cognizing of these or other relationships. When I am bicycling, or playing tennis, or when I am living the practical life of naïve perception, I am aware of, and shape my actions in accordance with, a feeling of the relations which the objects of the external world bear to me and to each other. The greater part of my practical skill in action and of such intelligence as I show in meeting the emergencies that occur in my active life, are the outcome of this awareness of relations. But when I begin to attempt to *explain* phenomena, and to formulate my knowledge of the world, I find I am forced to pay special attention to these relationships *as such*, and to clearly and precisely cognize them. This conclusion, I repeat, is the outcome of observation, and is not, so far as I am aware, the result of any *a priori* considerations.

Looking back upon my own past, and collating the results with those reached by other observers, I find that the mere feeling or awareness of relations is prior in development to the clear and precise cognition of them. The awareness of relations seems to be, in fact, the undifferentiated germ from which their clear cognition has been developed; it is not knowledge, properly so called, but it is the raw material from which knowledge and the products of the intellect are shaped. Hence I conclude that the order of development or evolution in man is—first, the practical awareness of relations among phenomena, and then subsequently the cognition and clear knowledge (in the full sense of the word) of these relations as such.

Now, passing to the psychology of animals, such as the higher mammalia, the hypothesis suggests itself that they are still in the stage of mere awareness, and have not reached the stage of clear cognition, which, as I showed in my paper, involves reflection and introspection. This is put forward as an hypothesis; one based on observation and the doctrine of evolution; and one to be treated in the same spirit and on the same methods as other scientific hypotheses. It must be submitted to the touchstone of verification. The question is:—Are the activities of animals explicable on the supposition that the agents are merely aware of the relations; or must we suppose that they fully cognize them? I feel sure that my own practical activities are in the main based on awareness, and this leads me to suspect that the practical activities of animals are also of like psychological implication. The matter must, however, so far as is possible, be put to the test of experiment and observation. I have conducted from time to time experiments with the object of ascertaining how far there is evidence in the dog of true cognition—of causation for example. I am inclined to believe as the result of my observations that there is nothing beyond a simple awareness of the causal nexus. But I am far from wishing to dogmatize in the matter. I am chiefly concerned that the phenomena should be carefully observed, and that experiments should be conducted on definite scientific lines.

In conclusion I must be allowed to say that the phrases "difference in kind" and "difference of degree" savour somewhat of mere academic discussion, and may perhaps be left for those who deal with the matter on *a priori* lines and not from the standpoint of evolution. I for one do not for a moment question that the mental processes of man and of animals are alike products of evolution. The power of cognizing relations, reflection and introspection, appear to me to mark a new departure in evolution. But whether, as I am at present disposed to hold, the departure took place through the aid of language coincident with, or subsequent to, the human phase of evolution; or whether, as other observers and thinkers believe, it took place, or is now taking place, in the lower mammalia or in other animals, is a matter for calm, temperate, and impartial discussion founded on accurate, and, as far as possible, crucial experiment and observation. C. LLOYD MORGAN.

---

### Rules of Nomenclature.

In your review of Mr. Massee's monograph of the Myxogastres (NATURE, p. 365) I notice the sentence, "Under the generally accepted rules of nomenclature, this leads to Massee standing as the authority for many species, transferred by him, in reality, to another genus." I take this to mean that, for example, a species of which the trivial name is, say, *abii*, and which was originally described by an author Xyz, and referred (erroneously) by him to the genus *Cdia*, has been transferred now to another (the correct, according to present knowledge) genus *Efia*, and the name is now printed in this work not as *Efia abii*, Xyz, but as *Efia abii*, Massee. I am aware that this course is frequently adopted, but surely not "under the generally accepted rules of nomenclature." There is no copy of the British Association "Rules" within reach here, but my recollection is that they prescribe a different course, viz., to retain as authority for a species the name of the original describer, and that is the course adopted in, I think, most of the *Challenger* reports, and by very many zoologists. I may state briefly as an example the first case that occurs to me—I have no systematic books here to refer to. (1) About 1870 Cunningham described a new Ascidian as *Cynthia gigantea*. (2) About 1880 Herdman transferred that species to the genus *Molgula*. (3) In the *Challenger* report this species figures as *Molgula gigantea*, Cunningham; and I would submit that that, rather than the course indicated in the review, is "under the generally accepted rules of nomenclature." W. A. HERDMAN.

Tarbert, Loch Fyne, August 23.

### An Earthquake Investigation Committee.

IT may perhaps interest you and your readers to hear that by the Imperial ordinance of June 25 a committee has been established for the investigation of the earthquake phenomena, with the view of finding methods of predicting earthquakes, if possible, and of ascertaining the nature of construction, building, and otherwise, best calculated to resist the effect of the shocks. President Kato, of the Imperial University, has been nominated the president, and myself the secretary. Other members of the Committee are Furnichi (Director and Professor of Civil Engineering, Engineering College, and Head of the Engineering Bureau of the Department of the Interior), Tatonno (Professor of Architecture, Engineering College), Tanabe (Professor of Civil Engineering, Engineering College), Tanakadate (F.R.S.E., and Professor of Physics, Science College), and Nagaoka (Assistant Professor of Physics, Science College), Koto (Professor of Geology, Science College), and Kochibe (of the Geological Survey), Sekiya and Omori (Seismologists), Nakamura (of the Meteorological Bureau), and a foreign member, Prof. J. Milne Other members will be nominated by and by. The Parliament has granted 42,000 yen for this year, chiefly for the purchase of various instruments. The committee will be glad to receive any communication or suggestion on the subject. Address: Earthquake Investigation Committee, care of the Department of Education, Japan. D. KIKUCHI.

Imperial University, Tokyo, July 21.

### Prehistoric Epochs.

I DO not think that the English authors who have written on prehistoric times have divided the Pleistocene in *epochs*, as Prof. G. de Mortillet has done in France. Would it be possible to use in England subdivisions similar, or almost similar, to those used in France, and almost generally adopted, although that classification is often subject to criticism?

According to Prof. G. de Mortillet, Palæolithic silex have been found in England that could be respectively related (1) to the type of Chelles or *Chelléen* (Hoxne, Biddenham); (2) to the type of the Moustier or *Mousterien* (Creswell, High Lodge); (3) to the type of Solutré or *Solutréen* (Creswell); (4) and to the type of La Madeleine or *Magdalénien* (Creswell, Kent's Hole). The same author says that at Creswell (Derbyshire) Palæolithic silex belonging to the *Moustérien*, *Solutréen*, and *Magdalénien* divisions have been found *in situ*, superposed as in the French stations, and according to him his classification could be adopted for the English prehistoric stations. Is that the opinion of the English authors who have most recently written on the matter, and is it possible to make a classification founded on the objects of the human prehistoric industry, parallel to the palæontological and stratigraphical classifications?

EDMOND BORDAGE.

Muséum d'Histoire Naturelle de Paris, August 2.

### At Portrush.

BEING on holiday (at Portrush) in the second week of August, I discovered growing on the sand dunes there the following species, bearing beautiful pure white blossoms. I found several patches of each:—

*Thymus Serpyllum* (wild thyme); *Prunella vulgaris* (self-heal); *Gentiana campestris* (field gentian); *Erica Tetralix* (cross-leaved heath).

Also the wild strawberry, bearing abundantly white fruit. Are these cases of reversion or of adaptability? Moths were very plentiful all over the dunes. JAMES RIGG.

18, Wilton Drive, Glasgow, Aug. 18.

### Origin of Idea that Snakes Sting.

WILL you kindly inform me as to the origin of the idea that snakes sting? Froude, in "The English in Ireland," page 356, vol. i., writes: "The clergy started as if stung by a snake." Archdeacon Farrar, in "Darkness and Dawn," uses the metaphor of snakes stinging. Sir T. Browne ("Vulgar Errors") says "That snakes and vipers sting," &c., &c., "is not easily to be justified. It is not fair to bring in Shakespeare as to a matter of natural history. CYRIL FRAMPTON.

July 29.

## *ON THE RELATIVE CONTAMINATION OF THE WATER-SURFACE BY EQUAL QUANTITIES OF DIFFERENT SUBSTANCES.*

THE experiments of Lord Rayleigh and Prof. Roentgen on the thickness of the invisible films of oil on contaminated water-surfaces led me to repeat these measurements by a somewhat different method, which may perhaps be worth describing, and at the same time to compare the contaminating effect of various substances.

In order to divide very small masses exactly I chose the course of Lord Rayleigh[1] of transferring the contaminating substance to the water-surface by means of a volatile solvent. But instead of ether I used *benzine*, and let the drops of the solution evaporate *directly from the water* instead of vaporizing them on a metal plate and then immersing this, as Lord Rayleigh did.

As a fixed condition of the water-surface Lord Rayleigh chose the tension when the movements of camphor fragments are stopped. Still more suitable for my purpose, however, I found another smaller degree of contamination, which is always to be fixed with great exactness. I mean *that degree at which the tension just begins to sink*. As I have already explained (NATURE, vol. xliii. No. 1115, p. 437) the sinking of tension does not begin gradually from the very commencement of contamination, but *abruptly*, when the latter has arrived at a certain value, and then the falling of tension takes place very rapidly. The state of constant tension I have called the normal and that of variable tension the anomalous condition.

My task was therefore to examine how much of a substance is required to make a surface of a given size enter the anomalous state or to find the area of a surface made anomalous by a given mass of the substance. The latter method was generally preferred, for it was more convenient to me.

The observations were made with the adjustable trough and balance[2] described in NATURE, March 12, 1891, p. 437, and were as follows:—

Of the substance to be tried 13 mg. were dissolved in 300 ccm. of benzol. Then the trough being filled with water and the surface made as clean as possible by sliding the partition all over the length of it several times, the solution was transferred to the surface in drops, each of which had a volume of 31 cmm. or about 1/9600 of the whole solution and thus contained 0·001354 mg. Four drops were introduced each time in order to equalize accidental irregularities of size. When the evaporation of the benzol was finished I diminished the length of the surface till it became anomalous, and this length was noted. Then immediately other four drops were introduced, again measured, and so on. After two or more observations the surface was cleaned anew, but generally the first length was observed to be a little too large on account of the imperfect purity of the surface.

A sufficient number of observations having been thus made, the original contamination of four drops of the

[1] Proc. of the Royal Society, 1890, vol. xlviii., No. 293, p. 127.

[2] For the purpose of actual measurements of surface-tension, I have constructed another instrument of larger dimensions; but to indicate only a slight variation of tension, any sensible balance with an adhering disc or wire-ring of any shape and size may be employed.

benzol used was measured in the same way; by subtracting this from the contaminating effect of the solution I got the effect of the oil or other substance purposely dissolved.

Thus with three solutions of Provence oil of equal concentration I got the length of the surface rendered anomalous by the oil contained in four drops:—

Solution I., 8·3cm.; Sol. II., 7·8cm.; Sol. III., 7·7cm.

For the sake of verification the other method, viz., counting the drops required for making the whole surface of the trough anomalous, was also employed. By this course the effect of four drops was obtained as follows:—

Solution I., 8·0cm.; Sol. II., 7·9cm.; Sol. III., 7·7cm.

The close agreement of the two methods proves that the strip of plate, simply laid across the trough, is sufficient to separate normal surfaces.

Another trial with an *ethereal* solution of olive-oil gave 7·1cm., if the somewhat different size of the drops be regarded; but I preferred benzine, because its original contamination was in most cases only between 1·3cm. and 2·5cm., whilst that of ether amounted to 4 to 6cm.

The mean of the lengths got by the three solutions was 7·9cm., and by this combined with the width of the trough = 5·8cm., we obtain the area of the surface made anomalous by 1mg. of Provence oil:

$$\frac{7{\cdot}9.\ 5{\cdot}8}{4.0{\cdot}001354} = 8460 \text{ qcm.}$$

or a density of 0·000118mg. per qmm. at the beginning of the anomalous state.

In the following table are collected the results obtained with different substances:—

| Substance. | qcm. per mg. | mg. per qcm. |
|---|---|---|
| Provence oil ... ... | 8460 ... | 0·000118 |
| Ordinary olive oil ... | 8565 ... | 0·000117 |
| Oleine [1] ... ... ... | 8137 ... | 0·000123 |
| Rape-seed oil ... ... | 7388 ... | 0·000135 |
| Poppy oil ... ... | 8994 ... | 0·000111 |
| Tallow ... ... ... | 9636 . | 0·000104 |
| Spermaceti ... ... | 5568 ... | 0·000179 |
| Stearic acid ... ... | 4711 ... | 0·000212 |
| Resin (colophony) ... | 8105 ... | 0·000123 |
| Turpentine oil (clear) .. | 107 ... | 0·009346 |
| Turpentine oil (older) ... | 2944 ... | 0·000339 |

The table shows next that the mass required for lowering the tension is not the same with different substances, and on the other hand it affords an interesting comparison between fluid and solid bodies. If the cause of the lowered tension be a film of greasy fluid spread over the surface, the contaminating effect of solid bodies can only be explained by small quantities of such fluids present on the surface or in the interior of the solid. This may be so in many cases, but the effect of stearic acid and spermaceti is such as if more than half their weight consisted of oil. The strong effect of colophony, although this did not dissolve entirely in benzine, and the result that tallow acts more strongly than an equal weight of oleine, its fluid component, also appear to me very remarkable.

After this it seems to me very probable that the contaminating substances *are not spread in coherent films at all*, but rather in a state of very fine distribution between the superficial water-molecules, that must be named either *emulsion* or *solution*.

However, only certain organic substances seem to be capable of forming surface-solutions of this kind, whilst the effect of metals and salts, formerly observed by me, was due to incomplete cleanness of the bodies, as later researches have proven.

Finally I will add some remarks on the thickness of the hypothetical oil-films. The thickness calculated from my observations with olive oil is at the beginning of the anomalous state 1·3 $\mu\mu$. In order to derive from this number the thickness at any other condition of the surface, it needs only to be multiplied with the relative contamination corresponding to that condition, that is, with the ratio of the surfaces. So we get at the smallest relative contamination measurable in my apparatus = $\frac{1}{35}$ a thickness of the film = $37.10^{-3}$ $\mu\mu$.

For measuring the relative contamination in the anomalous state, a special mode of procedure was required on account of the imperfect separation of surfaces by the partition. For that purpose I put on the surface that is to be contracted a [-shaped swimming wire, a little shorter than the width of the trough, and by the situation of this mark, following exactly every movement of the surface, I measured the relative length of the latter, instead of reading it from the partition itself.

The ratio in which the surface must be contracted in order to arrive at the tension at which camphor comes to rest, was very different with various substances, for an instance with stearic acid = $\frac{5}{3}$, oleine = $\frac{18}{11}$, ordinary olive oil = 5, and with Provence oil the tension in question could not be reached at all, except when the oil was standing on the water in visible drops or films. The calculated thickness of the film at the stopping of camphor movements would be with olëin = 2·13 $\mu\mu$, ordinary olive oil = 6·5 $\mu\mu$, and with Provence oil still greater, if this liquid were spread equally. A very precise specification of the sort of oil used therefore appears to be necessary, if observations concerning this point are to be compared.

AGNES POCKELS.

[1] A brown-looking liquid sold under this name in the drug stores.

## NOTES.

THE Federated Institution of Mining Engineers will hold its annual general meeting in North Staffordshire on Wednesday, September 7, in the large hall of the First Shropshire and Staffordshire Artillery Volunteers, Shelton. Both on that and on the following day visits will be made to various works and places of interest.

THE Committee appointed to consider whether a national aquarium should be established in Sydney have presented a full and interesting report to Mr. F. B. Sutton, the New South Wales Minister for Public Instruction. They strongly recommend that "a commodious building of a substantial and not unsightly character" should be erected, to contain a large series of tanks constituting the public aquarium, with experimental tanks for researches on fish-breeding, &c., in connection with the fisheries of the colony, and laboratories for scientific investigation. It is calculated that the "initial cost" would be about £10,000, and that an annual amount of about £1200 would be needed for salaries and for purchases, repairs, and other incidental expenses.

IN response to an invitation from President G. Stanley Hall, of Clark University, a number of psychologists met from various institutions at that University, Worcester, Massachusetts, on July 8, for the purpose of forming an American Psychological Association. Prof. G. S. Fullerton, of the University of Pennsylvania, presided. After some general discussion on the form of organization the entire matter was referred to a committee. Sessions were held in the afternoon and evening, at which papers were read by Profs. Jastrow, Sanford, and Bryan, and Doctors Nichols, Krohn, and Gilman. It was decided in response to an invitation from Prof. Fullerton to hold the next meeting of the Association in Philadelphia, at the University of Pennsylvania, on Tuesday, December 27. Prof. Jastrow was appointed secretary to provide a programme for that meeting. He asked the co-operation of all members of the Association for the section of psychology at the Chicago Exhibition, and invited correspondence on the subject.

DR. VON LENDENFELD, at one time assistant to Prof. Lankester at University College, Gower Street, has been appointed to the chair of zoology at the University of Czernowitz, rendered vacant by the death of Prof. V. Graber.

PROF. DR. CHARLES BERG has become director of the National Museum at Buenos Ayres, in the place of Prof. Dr. Hermann Burmeister.

THE Council of the Institution of Civil Engineers has issued a list of subjects on which it invites original communications. The list, it is explained, is to be taken merely as suggestive, not in any sense as exhaustive. The Council points out that it has power to award to the authors of papers premiums arising out of special funds bequeathed for the purpose. No award will be made unless a communication of adequate merit is received, but more than one premium will be given if there are several deserving memoirs on the same subject.

THE twenty-third session of the German Anthropological Congress, which was held at Ulm early in August, was in every way most successful. At the first meeting one of the most prominent speakers was Prof. Ranke, who spoke of the need for a German National Museum. He recognized the value of the museums at Mainz and Nürnberg, but urged that a genuinely national institution ought to be established, and that the proper place for it is Berlin. At this meeting an interesting discussion on the so-called Kannstadt race was opened by Dr. von Hölder. The opinion of the meeting was that the characteristics of the famous Kannstadt skull are found in some persons of the present day, and that the skull is not one that has come down to us from prehistoric times. Prof. Virchow, who took part in the discussion, uttered a general warning as to the necessity for caution in attributing high antiquity to human remains. On the following day a paper on the anthropological position of the Jews was read by Dr. von Luschau. His main points were that the Jews are a mixed race, and that in some of their physical peculiarities (such as the form of the nose) they resemble the Armenians more closely than any people of purely Semitic origin. Prof. Kollmann dealt with the question of the origin of the European peoples, and Prof. Virchow spoke of the fact that the traveller Vaughan Stevens has found in the interior of Malacca a genuine Negrito stock, and has sent skulls and specimens of hair. At the third meeting one of the best papers was by Dr. Boas, on the organization of anthropological research in North America. It was decided at this meeting that the next session of the Congress would be held at Hanover in 1893. Scientific excursions were made to Blaubeuren and Schussenried, where traces of lake dwellings have been discovered, and to Sigmaringen and Schaffhausen.

THE causes of the St. Gervais disaster are being gradually elucidated. A very interesting paper describing a visit to the small Tête-Rousse Glacier is contributed to *La Nature* (August 20) by M. Vallot, director of the new Mont Blanc Observatory. At the end of the glacier, on a steep face of rock, he and M. Delebuque found an enormous arching cavity, filled recently (it would appear) with ice which had been shot out by some internal force. They entered the cavern, and observed traces of an interior lake. A passage, strewn and overhung with blocks of ice, led up to an open space, a sort of huge crater, with walls of white ice, absolutely vertical. It was about 270 feet long, and 133 feet broad and deep. M. Vallot and his friend returned by the way they entered, and examined this crater from above. Their opinion is that a lake had been formed at the bottom of the glacier, and the crater, gradually accumulating through obstruction of the orifice of outflow, had undermined the ice-crust over the upper cavity. This at length collapsed, exerting enormous pressure on the water, which pressure, transmitted to the lower grotto, burst the glacier, throwing out the anterior part on the steep rocky slope. Thus is explained the enormous quantity of water precipitated into the valley, carrying in its passage the soil of the banks, and forming a torrent of liquid mud mixed with ice blocks and rocks. M. Vallot estimates that about 100,000 cubic metres of water and 90,000 of ice issued from the glacier. On reaching the Baths the torrent may have been 300,000 cubic metres. He supposes that the sub-glacial lake may form again, and the remedy would be to blast the rocky bottom so as to provide an escape for the water; a work which should be done speedily to be of use.

THE weather has been very unsettled during the past week, several low-pressure systems having passed over our islands from the westward, accompanied by very heavy rain, especially in the southern, northern, and western parts of the country. Between mid-day of Saturday and Sunday 1¾ inches fell in the south, being about three-fourths of the average fall for the month of August, and another heavy downpour occurred in the north and west on Monday night, two inches being measured in the west of Scotland, and 1½ inches at Holyhead. The temperature has fallen considerably since the previous week, the daily maxima rarely exceeding 70° in the southern parts of the country, while in the north and west it has been considerably lower. The wind has reached the force of a gale on the coasts on more than one occasion during the week, and on Tuesday the centre of a rather deep depression lay over Ireland, while the sea was rough on nearly all coasts, the conditions being very threatening, with a prospect of further heavy rains. In southwest England the amount of rainfall from the beginning of the year up the week ending August 27th, was still more than eight inches below the average, and the only district where the amount just exceeded the average was the northern part of Ireland.

THE New England Meteorological Society has issued a volume of Investigations for the year 1890 (reprinted from the Annals of Harvard College Observatory, Vol. xxxi. pt. I., 1892) containing a summary of the observations made at the Society's stations; reports were received from 172 observers during the year, also five-year tables of temperature and precipitation, by J. Warren Smith, with an introduction by W. M. Davis, Director of the Society. The title scarcely explains the real amount of work done, for at some stations there are many periods of five years, *e.g.*, at New Bedford (Mass.) the observations extend over 15 pentades (1816–1890). It has not been possible to keep to the same years in all cases, nor has any attempt yet been made to discuss the data.—The tornado at St. Lawrence (Mass.), of July 26, 1890, by Helen Clayton. This storm caused considerable loss of life and property. The distances between the points where destruction was reported seem to indicate that the destructive winds descended at times to the earth's surface at certain points, and after a short track rose again. Prof. Davis has written a preface to this paper, in which he discusses fully the characteristics of tornados.

THE Annual Report on the Royal Botanic Gardens, Trinidad, for 1891, contains a table showing the monthly and yearly rainfall values for thirty years ending 1891. The average yearly fall for that period was 65·91 inches. Mr. F. H. Hart points out that the rainfall shows a decrease at a seriously rapid rate, for, dividing the period into decades, the first decade shows a total of 7·12 inches more than the second, and the third shows another decrease of 9·56 inches on the second, or 16·68 inches on the first decade. This is a subject of the utmost importance to questions of forestry and water supply. He also points out that the rainfall is not so much affected as is generally supposed by the contiguity of Trinidad to the mainland, but more particularly to the course of the trade-winds which blow towards the continent of South America. It is a curious fact that it always rains at Trinidad with a high barometer. On June 25 last the observer states that it was not daylight until long past the proper hour, the readings at 9h. a.m. having to be taken by candle-light. The rain was heavy and continuous, and was accompanied by the *highest* barometer readings for the year.

"FIFTY Years of York Meteorology, 1841–1890," a paper contributed to the report of the Yorkshire Philosophical Society for 1891, by Mr. J. Edmund Clark, has been issued in pamphlet form.

SOME of the effects of the absence of light upon animal life were strikingly revealed, not long ago, on the reopening of an old mine near Bangor, Cal. In a dry slope connecting two shafts, one of the explorers was astonished to find a number of flies that were perfectly white, except the eyes, which were red; and directly afterwards he killed a pure white rattlesnake. The animals had lived in the dry passages, where they had been supplied with air but not with light. It is supposed that the flies were the offspring of some that had been imprisoned by the partial filling of the mine with water about thirty years ago, and that the snake, when quite young, had been washed down in a rain. A few of the flies were exposed to light in a glass case, and resumed the colours of ordinary house flies within a week.

A WHALING party is being fitted out in America for the purpose of obtaining a live whale for exhibition in the Fisheries department at the World's Fair at Chicago. If captured the whale will be confined in a tank and towed to Chicago by the way of the St. Lawrence river.

IT would appear that naphtha is poisoning the Volga, doing great injury to the fishing industry. Dr. Grimm says (*Messager des Pêcheries*) that the quantity of naphtha conveyed on the river rose from some 32 million kilogrammes in 1887 to nearly 50 millions in 1889. Most of this is carried in badly-made wooden barges, and there is a great deal of leakage into the river, about 3 per cent. on an average (it is estimated). Thus in the three years, 1887 to 1890, the Volga must have absorbed some three million kilogrammes of naphtha, without reckoning petroleum, of which there is a considerable (though less) leakage. Everywhere the fish are decreasing, and they quite disappear at places where boats stop. On the other hand, various fishes—the starlet of Astrachan, *e.g.*—living in the infected water, get a flavour of naphtha, and are no longer eatable. The naphtha also kills the infusoria, insects, flies, mosquitoes, &c., which serve as food for the fishes. In its spring floods the river spreads naphtha over the meadows, destroying the larvæ of those organisms. The thin layer of naphtha on the water hinders the larvæ from breathing. Further, the naphtha injures the vegetation in the meadows. Naphtha is found in such quantities on the land as to suffice for domestic use to the natives, who collect it. Dr. Grimm urges the necessity of taking steps to prevent the ruin of the Volga fisheries.

AMONG the most interesting Echinoderms collected by the United States Fish Commission steamer *Albatross*, on her voyage from New York to San Francisco, was a stalked Crinoid, which is described in No. 2, vol. xvii., of the Memoirs of the Museum of Comparative Zoology at Harvard College (January 1892). The material, consisting of portions of three specimens, was dredged in 392 fathoms off Indefatigable Island, one of the Galapagos group. During the last dredging trip of the *Albatross* an additional specimen was obtained off Mariato Point, in 782 fathoms. When this last specimen was taken out of the water it was of a brilliant lemon colour, with a greenish tinge on the sides of the arms and along the food furrows of the ventral surface. A coloured sketch of it is given from a drawing made on the spot by Mr. Westergren. Its base of attachment came up with a fragment of stem nearly 14 inches long. At the first glance Prof. Agassiz was inclined to regard it as a modern representative of Apiocrinus, but a more careful examination showed so many points of difference that he had to establish the new genus Calamocrinus for its reception, and it stands as *C. Diomedæ*. It is most closely allied to a large group of Mesozoic Crinoids, and it assists in making clear many points in their morphology. This genus has the orals greatly reduced, much as in Bathycrinus. It also possesses heavy perisomic plates, passing gradually into still stouter so-called interradial plates, in Calamocrinus, in no wise to be distinguished from the true interradials of Palæozoic Crinoids. Another structural feature is the limitation of the articular facet to the middle of the radial. This is an eminently embryonic character, and there are traces of it in some of the forms of Millericrinus described by De Loriol in his Jurassic Crinoids, especially in *M. milleri*. After a very detailed and masterly description of the stem, calyx, and arms of the species, Prof. Agassiz discusses the subject of the "Apical System of the Echinoderms," and "Of some of the Homologies of the Echinoderms." Thirty-two plates, some coloured, accompany this Memoir, which is inscribed as follows: "From the time the Crinoids which form the subject of this Memoir came into my hands, I have been in constant correspondence with my late friend, Philip Herbert Carpenter, regarding the many points of interest suggested by their discovery. I can now only have the melancholy satisfaction of inscribing to his memory a Monograph which I had hoped to dedicate to him as an expression of my admiration for his researches in a field where we had long been fellow workers."

M. DE LAPOUGE calls attention, in *La Nature*, to an interesting object he has found in one of a number of ancient graves he has been excavating at Gignac (Hérault). It is a finely-carved head of jade, representing a type of the yellow race. It evidently formed part of a statuette of a religious character, and the style shows that it must have come either from China or Japan. M. Sindhô is of opinion that the statuette was probably made in Japan a little before the Christian era, from a Hindu or Sinhalese model of Buddha. M. de Milloué thinks the head is that of Kouan Yin, a Chinese divinity, while M. de Rosny and M. Motoyosi attribute it to Mayadêvi, the mother of the founder of Buddhism. Whatever the object may be, M. de Lapouge is inclined to believe that it hung as an amulet around the neck of a Hun or Goth, and that the graves at Gignac belong to a cemetery of a West Gothic colony.

A VALUABLE essay on the Ainos of Yezo, by Mr. Romyn Hitchcock, is included in the report of the U.S. Museum for 1890, and has just been issued separately. It is based mainly on the author's personal observations. He has much that is interesting to say on the various aspects of the life of the Ainos, and his remarks are admirably illustrated. Mr. Hitchcock notes the remarkable fact that the Ainos have been very little influenced by the civilization of the Japanese, with whom they have so long been in close contiguity. The Aino, he says, has not so much as learned to make a reputable bow and arrow. Unable to affiliate with the Japanese, the Ainos "remain distinct and apart," and for that reason, in Mr. Hitchcock's opinion, are "doomed to extinction from the face of the earth."

THE second volume of Mr. J. Walter Fewkes's "Journal of American Ethnology and Archæology," has just been issued. The most important article in the first volume was an interesting account, by Mr. Fewkes, of "a few summer ceremonials at Zuñi Pueblo." The greater part of the second volume is devoted to a description, by the same writer of "a few summer ceremonials at the Tusayan Pueblos." Mr. Fewkes and his assistant, Mr. J. G. Owens, were admitted as priests by the Tusayans, so that the paper contains many details which have not hitherto been accessible to students. Mr. Fewkes also presents a report on the present condition of a ruin in Arizona called Casa Grande, and Mr. Owens describes various natal ceremonies of the Hopi Indians.

THE new number of the *Internationales Archiv für Ethnographie* (Band V., Heft 3) opens with a paper, in French, by M. G. van Vloten, on the flags used at Teheran in connection with the festival in memory of the martyrdom of the Imâm Huçein. M. Désiré Pector contributes (also in French) some observations suggested to him by the reading of a work by M. de Montessus on Pre-Columbian Salvador. Herr F. Grabowsky writes (in German) on the theogeny of the Dayaks.

THE following are the subjects of papers in the current number of the *Mineralogical Magazine*:—Minerals from the apatite-bearing veins at Noerestad, near Risör, on the south-east coast of Norway, by R. H. Solly (with a note on their occurrence, by A. L. Collins); on the pinite of Breage in Cornwall, by J. H. Collins; danalite from Cornwall, by H. A. Miers and G. T. Prior; mineralogical notes from Torreon, State of Chihuahua, Mexico, by Henry F. Collins; note on crystals of manganite from Harzgerode, by Frank Rutley; analysis of aragonite from Shetland, by J. Stuart Thomson; orpiment, by H. A. Miers. There are also reviews and abstracts; and Mr. Miers and Mr. Prior contribute a valuable index to mineralogical and petrographical papers, 1888.

WE have received from the Geological and Natural History Survey of Canada, Part 4 of "Contributions to Canadian Micro-Palæontology." The report consists of descriptions and illustrations of thirteen new and three previously known species of Radiolaria, collected by officers of the survey from the upper cretaceous rocks of North Western Manitoba, and has been prepared for publication by Dr. D. Rüst, of Hanover. Mr. Tyrrell, geologist in charge of the explorations in Manitoba, contributes a short introduction to the report.

BULLETIN No. 11 of the Imperial University College of Agriculture, Komaba, Tōkyō, has recently been published. It consists of the report of Dr. O. Kellner on the third year's "Manuring Experiments with Paddy Rice."

AMONG the contents of the June number of *Timehri*, the Journal of the Royal Agricultural and Commercial Society of New Guinea, are papers on "Twenty Years' Improvements in Demerara Sugar Production" (Part 2), "The Bats of British Guiana," "Guiana Gold," and "Our Birds of Prey." The number also contains many short notes of an interesting nature.

MR. S. GARMAN publishes a treatise on the fishes of the families Cyclopteridæ, Liparopsidæ, and Liparididæ, in the Memoirs of the Museum of Comparative Zoology at Harvard College (Vol. xiv., No. 2, April 1892). Though several of the rarer forms of Discoboli are not represented in the collections of the Harvard Museum, yet it possesses so many duplicates of several species, in addition to rare and some undescribed types of others, that it presented great facilities for a study of the group, of which Mr. Garman has well availed himself. Prof. F. W. Putnam had at one time intended to write a history of the group, and many drawings had been some years ago prepared for it by Mr. Roetter; these drawings have been utilized in the present memoir, and the work has been made more complete by the drawings of the young stages of several of the species, contributed by Prof. A. Agassiz. After a short introduction there is a history of the distribution of the species, followed by one on the history of the genera from the times of Pliny, Gesner, and others, and then a description of the recognized genera and species, of which the following is a summary. *Cyclopterus lumpus*, Linn.; *Eumicrotremus spinosus*, Mull.; *E. orbis*, Gthr.; *Cyclopteroides gyrinops*, gen. et spec. nov. (St. Paul's Island, Alaska); *Cyclopterichthys ventricosus*, Pall.; *C. amissus*, Vaill.; *Liparops*, gen. nov. established for *Cyclopterus stelleri*, Pall.; *Liparis montagui*, Don.; *L. mucosus*, Ayr.; *L. calliodon*, Pall.; *L. liparis*, Linn.; *L. antarctica*, Put.; *L. agassizii*, Put.; *L. tunicatus*, Reinh.: *L. steineni*, Fisch.; *L. pulchellus*, Ayr.; *L. pallidus*, Vaill.; *Careproctus micropus*, Gthr.; *C. major*, Fabr.; *C. gelatinosus*, Pall., *C. reinhardi*, Kroy.; *Paraliparis rosaceus*, Gilb.; *P. bathybius*, Col.; *P. liparinus*, Goode; and *P. membranaceus* Gthr. *Careproctus longifilis*, spec. nov., and *Paraliparis fimbriatus*, spec. nov., are also indicated, but will be described at length in the forthcoming report of the "U. S. Fishery Commission."

SOME experiments have recently been made at the New York Agricultural Experiment Station upon the possible effect of long-continued applications of a copper sulphate spray used as a fungicide (Bulletin 41). Two soil mixtures were used, one containing 5 per cent. and the other 2 per cent. of copper sulphate. These quantities are comparatively so enormous that useful practical conclusions cannot yet be drawn, though some of the results have proved interesting. Seeds of plants representing widely differing natural orders were planted in these soils, and at the same time an equal number of the same kinds of seeds were planted for checks in similar soil to which no copper sulphate was added. Care was taken to select good seed, and to give the soil mixtures, and checks exactly similar conditions and treatment. In the soils containing sulphate of copper more seeds germinated in almost every case than in the soils containing no copper. The average length of time required for germination was greatest in the copper soils. The foliage of plants grown in the copper soils was of a deeper green and darker with the 5 per cent. soil mixture than with the 2 per cent. one, but although darker the leaves were smaller and the height of the plants and the yield of fruit very much less than in the case of plants grown under normal conditions. Peas grown in the 2 per cent. soil mixture seemed to be more vigorous for the first few weeks than the check plants grown in untreated soil; they also came to maturity earlier, but finally showed a dwarfed appearance, and the yield was less than with the check plants, being little more than one-half the yield under normal conditions. In the 5 per cent. soil mixture peas gave a yield only one-seventh of that from untreated soil. In the case of all plants grown in the soil mixtures the roots were very small and ill-developed. Analysis of the tops of tomatoes grown in the 5 per cent. soil showed in the air-dried substance ·06 per cent. of copper, proving conclusively that these plants can take up sulphate of copper by their roots. Analyses were made of berries and stems from vines which had been sprayed with copper compounds, and although the amount of copper found upon the stems varied, that found on the grapes was practically constant, and amounted to 1/120th of a grain per pound of grapes, this quantity being considered quite negligeable and harmless.

THE additions to the Zoological Society's Gardens during the past week include two Rhesus Monkeys ♂ ♀ (*Macacus rhesus*) from India, presented by Mr. J. Hall-Browne and Mr. Rivers respectively; four Virginian Foxes (*Canis virginianus*) from California, presented by Mr. Edward Chauvenet Holden; two Ogilby's Rat Kangaroos (*Hypsiprymnus ogilbyi*) from Australia, presented by Mr. John W. Roche; a Ruffed Lemur (*Lemur varius*) from Madagascar, deposited by Captain Marshall, F.Z.S.; three Tigers ♂ ♀ ♀ (*Felis tigris*) from India, deposited by Messrs. William Watson and Co.; a Blue and Yellow Macaw (*Ara ararauna*) from South America, presented by Mr. R. Larchin; ten Spanish Blue Magpies (*Cyanopolius cooki*), and two Ravens (*Corvus corax*) from Spain, deposited by Lord Lilford, F.Z.S.; two Fringed Chameleons (*Chamæleon tænio-bronchus*) and a Lobed Chameleon (*Chamæleon parvilobus*) from Natal, presented by Mr. Charles W. Heaton; a Black Iguana (*Metopoceros cornutus*) from West Indies, purchased; six African Scorpions (*Scorpio*, sp.inc.) from South Africa, presented by Mr. J. F. Hawtayne.

## OUR ASTRONOMICAL COLUMN.

PHOTOGRAPHIC MAGNITUDES OF NOVA AURIGÆ.—*Astronomical Journal*, No. 269, contains the results of Mr. J. M. Schaeberle's work with regard to the determination of the photographic magnitudes of stars, including also that of Nova Aurigæ. The method he has adopted differs from those used by former observers in that the photographic magnitude of a star for any exposure-time is expressed "as a function of the equivalent theoretical aperture which a standard star (Polaris in this case) would require to make the same impression on the plate in the same time." The particular form which the expression, as obtained from this investigation, assumes enables one, after having once adopted the photographic magnitude of the standard star, to determine the theoretical photographic magnitude of any other star without any reference at all to the visual magnitude. As this method had only been applied to bright stars, the appearance of Nova Aurigæ suggested a further trial for stars of less magnitude which were visible only in large instruments. On the plates, which were each night exposed, three stars in the region of the Nova, the images of which resembled somewhat that of the Nova in form, size, and density, were selected for the sake of comparison. The magnitudes of these comparison stars were then determined by direct measurement of their images on the standard positive plate, this plate being a second positive from the original negative. The resulting photographic magnitudes for the month of February showed that the light of this new star fluctuated very considerably, confirming the visual observations.

The following list gives the theoretical magnitudes as obtained in this way, the mean time at Mount Hamilton being also added. The exposures up to March 10 were all moderately short, varying from 2 to 128 seconds.

| Date 1892. | Mt. Hamilton M.T. | Mag. | Date 1892. | Mt. Hamilton M.T. | Mag. |
|---|---|---|---|---|---|
| | h. m. | | | h. m. | |
| Feb. 6 | 12 30 | 4·63 | Mar. 2 | 10 45 | 5·20 |
| 8 | 7 20 | 4·54 | 3 | 9 10 | 5·09 |
| 9 | 9 40 | 4·67 | 4 | 8 25 | 5·63 |
| 10 | 10 7 | 4·77 | 6 | 9 15 | 5·40 |
| 11 | 8 55 | 4·4 | 7 | 9 40 | 5·90 |
| 12 | 7 20 | 4·5 | 8 | 9 10 | 6·09 |
| 13 | 9 20 | 4·3 | 9 | 8 55 | 6·16 |
| 14 | 7 40 | 4·03 | 10 | 8 ± | 7·10 |
| 15 | 6 15 | 5·22 | 11 | 8 ± | 7·70 |
| 21 | 10 10 | 4·96 | 13 | 8 24 | 7·70 |
| 22 | 9 30 | 5·12 | 15 | 11 9 | 8·45 |
| 24 | 7 ± | 4·84 | 16 | 8 35 | 8·60 |
| 25 | 8 55 | 4·90 | 20 | 8 56 | 9·25 |
| 26 | 9 50 | 5·04 | 21 | 8 50 | 9·40 |
| 27 | 8 20 | 4·75 | 22 | 9 17 | 9·55 |
| 28 | 8 50 | 4·98 | 24 | 9 2 | 9·80 |
| | | | 25 | 9 10 | 10·00 |

COMPARISON STARS OF THE PLANET VICTORIA.—Dr. Gill, in *Astronomische Nachrichten*, Nos. 3107-08, communicates an article on the definite places of the stars used for comparison with the planet Victoria in the observations for parallax made in the year 1889. The positions of these stars are now, as he says, "more accurately known than those of any other group of stars in the heavens," and he suggests that they should be advantageously used for the determination of optical distortion and scale values of photographic telescopes, and for testing the various methods for the "raccordement des plaques." The positions of the thirty-seven stars are based on 3766 meridian observations of right ascension, and 3771 meridian observations of declination, together with several other observations made with the heliometers at the Cape, Yale, and Göttingen, amounting to 1867 measurements of distances, and 151 position angles. In the first tables which Dr. Gill here gives, are shown the definite places for the Victorian comparison stars computed for the Equinox 1889·90, and Epoch 1889·55. Owing to the comparatively large quantities that the probable errors of the proper motions amount to, Dr. Gill mentions that it is desirable to obtain photographs for determining scale-value distortion, &c., as soon as possible. Table 2 consists of a comparison between the distances as obtained from definite co-ordinates, and these as measured by Gill, Finlay, Jacoby, Chase, Schur, and Ambronn with the heliometer.

INTERNATIONAL TIME.—In a small pamphlet, published by Mr. Edward Stanford, a scheme for a systematic regulation of time is discussed by Major the Hon. E. Noel. The principle on which the system he proposes is based is the same as that which is at present in use on the American continent. It consists in dividing the earth's surface up into time-zones each covering fifteen degrees, so that they will differ from one another by one hour. In considering the question of the initial-time meridian, there are many points which have to be well borne in mind. In the first instance there must be a first-class observatory, on which every one could depend; secondly, the contra-meridian, *i.e.*, that half of the initial meridian in the opposite hemisphere, must fall in a convenient place, by which is meant that it must not cut through a continent or any large tract of land. Another important consideration is the arrangement of the time-zones, which must, if possible, be conveniently related to the longitude boundaries as are shown in our maps. Taking these points into account, Major Noel retains Greenwich as the initial for longitude, but selects Rome as our initial for time. On this basis he discusses this scheme with reference to each individual country. The only great country which this arrangement would not suit is France, for she, as is well known, keeps Paris time; a suggestion put forward here is that France should form a special zone, making her time exactly, instead of approximately, forty minutes after Rome. The folding diagram which accompanies this pamphlet shows a map of the world graduated on this system. From this one sees that the meridian of Rome traverses the centre of the Scandinavian Peninsula, coincides with Copenhagen, passes close to Leipzig, and between Berlin and Munich, while it cuts Italy from north to south. The western boundary of this zone, which is exactly on the fifth meridian west of Greenwich, passes between Italy and Spain, outside the western frontier of Germany, and skirts the west coast of Norway, while the eastern boundary also traverses convenient points for such a division of time. In considering the scheme as a whole, there is much to be said in its favour; but as such a question as this deals with so many nations, its development and final adoption cannot take place in a trice, but can only be brought to a head after many years' deliberation and debate.

COMET SWIFT (MARCH 6, 1892).—The ephemeris of Comet Swift is given in *Edinburgh Circular*, No. 29, and has been computed from elliptic elements supplied by Herr Berberich. This comet in large telescopes is quite a conspicuous object, while in smaller ones it is still visible. The following ephemeris we take from the above-mentioned source:—

*Ephemeris for Berlin Midnight.*

| 1892. | R.A. | Decl. | Log Δ. | Log r. | Br. |
|---|---|---|---|---|---|
| | h. m. s. | ° ′ | | | |
| Aug. 31 | 0 42 35 | +52 42·6 | | | |
| Sept. 1 | 41 24 | 38·3 | | | |
| ,, 2 | 40 10 | 33·6 | 0·2693 | 0·3922 | 0·081 |
| ,, 3 | 38 55 | 28·5 | | | |
| ,, 4 | 37 39 | 22·9 | | | |
| ,, 5 | 36 22 | 16·9 | | | |
| ,, 6 | 35 4 | 10·5 | 0·2720 | 0·4004 | 0·077 |
| ,, 7 | 0 33 46 | 52 3·7 | | | |

Taking the comet's position for September 2, we find that it will lie very nearly $3\frac{1}{2}°$ south of α Cassiopeiæ, being in the prolongation of a line joining the stars λ and ζ of the same constellation.

## GEOGRAPHICAL NOTES.

THE Berlin Geographical Society are preparing for publication one of the most valuable mementoes of the Columbus celebration, in the form of a magnificent atlas, containing amongst other early maps a series of hitherto unpublished delineations of the Atlantic of very early date. These maps have been discovered in manuscript in Italian libraries, where they were copied by a young German geographer of great artistic power. They will be published with all the brilliant colouring of the original illuminated MSS.

IN the recent risings of the Arabs against European traders and officials on the Lomami in the Congo Free State, there is too much reason to fear that the veteran M. Hodister, Director of the Katanga Company in Africa, has lost his life. This is a disaster of a much more serious kind than the mere collapse of a trading company, for M. Hodister in the course of his long service in Central Africa had acquired a remarkable knowledge of the Arabs, and great tact and success in dealing with them. In his personal character he commanded the respect of all with whom he came in contact; courage he shared with many fellow-explorers, but his calmness in danger and serious earnestness in work are not too common amongst the Congo State officials or the leaders of caravans through the territory. M. Hodister was one of the first Belgian officers appointed on the establishment of the Congo Free State, and as an official, and later as the head of the Katanga syndicate in Africa, he has spent the best years of his life in opening up the Congo Basin.

THE Sixth International Geographical Congress having been fixed to meet at London in June, 1895, an organizing committee, of which Major Leonard Darwin is President, and Mr. J. Scott Keltie Secretary, has been appointed by the Council of the Royal Geographical Society. Circulars have been sent out calling attention to the fact that the meeting is to take place, and inviting suggestions. A provisional programme of the proceedings will be drawn up in the course of next year.

AN exhaustive bibliography of Socotra has just been published as a pamphlet of forty pages by M. James Jackson, the librarian of the Paris Geographical Society. Including references to maps, there are 176 entries relating to this island; many of these papers had almost passed into oblivion, and their recovery and systematic presentation is of much value.

## SOME PROBLEMS IN THE OLD ASTRONOMY.[1]

IF a comparison were instituted between the position of the modern astronomer and that of his prototype on the plains of Chaldea, it would not be altogether to the disadvantage of the ancient student of the heavens. He stood at the gateway of the unexplored Uranian mysteries, unfettered by the dogmatic theories of a line of predecessors. From his own imagination he constructed hypotheses and theories, with no feeling of uncertainty about the priority of invention, and with little anxiety concerning the agreement of theory and observation. The modern questions that distract the astronomical world had no place among the thoughts that disturbed the tranquillity of his soul. He had not reached that critical epoch when he must choose between the "old" and the "new" astronomy; and he was free from the harassing perplexity that besets the luckless astronomer of this age who seeks to learn the mysteries of the moon's motion, or strives to formulate the cause and the law of the variation in the terrestrial latitude. The iniquitous behaviour of the astronomical clock and level, combined with the possible, but unknown, influences of temperature, were not then in league to vex his waking hours and fill his dreams with illusory solutions that ever floated just beyond his grasp. He was not obliged to search the ancient records in musty volumes and strain the limits of conjecture in the interpretation of careless observations and imperfect memoranda; in short, he was a happy man, free to work in any direction, and not liable to be called upon from time to time to amuse or to instruct his fellows, or even to weary them, with prosy discourse on his own work or a stale *résumé* of astronomical progress.

Unfortunately for us, we live in an age when astronomy is no longer a simple subject, stimulating the imagination by the nightly display of stellar and planetary glories, and involving in its study only the elements of geometrical analysis. Within the last fifty years the science has been separated into many divisions; and within a few years several of these branches have assumed new phases. As a result of this continued division, the range of study and investigation has spread beyond the efficient grasp of any individual, and specialists are rising up in all directions.

It has been the custom for the presiding officer of this section to present, on the first day of the annual session, an address setting forth either the progress in general astronomy or in some branch of the science, or the history or development of some department of mathematics, each confining himself to his own special branch of scientific work.

It has seemed to me that a formal statement, to this section, of the general progress of astronomy within the last year or the last decade, would be to lay before you a mass of data with which you are already familiar. This view of the case has led me to attempt the presentation of the importance of one branch of astronomical work in which for several years I have taken a deep personal interest, and which, owing to the present tendency towards specialization, is likely to suffer from serious neglect.

It is not many years since we first heard of the distinction between the "old" and the "new" astronomy, but in the comparatively short interval since those terms were first used the scope of physics has so expanded in all directions and so adapted itself to its new surroundings that we find it, in one department at least, casting aside its former title and masquerading under the name of astronomy. That this departure has quickened the zeal of many students, stimulated the development of numerous and valuable modes of research, and resulted in grand and important discoveries, is one of the most gratifying scientific facts of this epoch. The direction of this new movement has followed rigorously the line of least resistance. Except in rare instances, that line of work which promises the quickest returns in the proper form for publication is most attractive to the young student of physics and astronomy, and the comparatively inexpensive apparatus required for the simpler astro-physical work is apt to lead him in that direction. The new and important changes that have been wrought within a few years in the methods of teaching and in the laboratory work in physics, together with the apparent ease with which an account of a few hours' labour with the spectroscope or camera may be spread attractively over several printed pages, have doubtless had their influence in leading the candidates for honours into the new fields of astro-physical research.

The advance in the development of methods of research and the improvements in apparatus are so rapid, and the field is so broad and increasing, that constant vigilance is necessary to keep even in touch with the progress of the "new" astronomy. One of the most striking examples of the achievements in this new line of work has resulted from a skilful combination of the spectroscope and the camera in the determination of stellar motion in the line of sight with a remarkable linear exactness.

The limits of this address would scarcely suffice to simply name the problems now under discussion by the more modern methods, without essaying even a cursory review of their importance or their bearing on current scientific investigation; and yet, from the true astronomical point of view, all of these questions are at least secondary to the fundamental problems of finding the true position of the solar system in the stellar universe and determining the relative positions and motions of those stars that, within the range of telescopic vision, compose that universe.

To this latter phase of our science I ask your attention for a few minutes. These problems still lie at the foundation of the "old" astronomy and cannot be relegated to the limbo of useless rubbish or to the museum of curious relics, not even to make room for the new-born astro-physics. On this foundation must rest every astronomical superstructure that hopes to stand the tests of time and of observation, and the precision of the future science depends rigorously upon the accuracy with which this groundwork is laid.

This work was begun in the sixteenth century, but, in spite of all the improvements in apparatus and in methods of analysis and research, a really satisfactory result has not yet been reached. There is no more fascinating phase of the evolution of human thought and skill in the adaptation of means to ends than is found in the development of the mathematical and instru-

[1] Address delivered before Section A of the American Association for the Advancement of Science, by Vice-President J. R. Eastman.

mental means for the determination of the positions and motions of the bodies included in the solar system. Accuracy in astronomical methods and results did not exist, even approximately, until after the revival of practical astronomy in Europe about the beginning of the sixteenth century; and, before the end of that period, the crude instruments of the early astronomers reached their highest perfection in the hands of the skilful genius of Uraniborg.

The invention of the telescope, the application of the pendulum to clocks, the invention of the micrometer, the combination of the telescope with the divided arc of a circle, the invention of the transit circle by Roemer, with many improvements in minor apparatus, distinctly stamp the seventeenth century as a remarkable period of preparation for the achievements of the next century.

From the standpoint of the modern mechanician the instruments at the Greenwich Observatory in Bradley's time were very imperfect in design and construction, and yet on the observations obtained by his skill and perseverance depends the whole structure of modern fundamental astronomy. The use of the quadrant reached its highest excellence under Bradley's management.

The next advance, the real work with divided circles, began at Greenwich in 1811, under the direction of Pond. Since that epoch, theory and observation have held a nearly even course in the friendly race toward that elusive goal perfection; and the end is not yet. A careful, but independent, determination of the relative right ascensions of the principal stars, supplemented by a rigorous adjustment of such positions with regard to the equinoctial points, and a similar determination of the relative zenith or polar distance of the same bodies, finally referred and adjusted to the equator or the pole, seem in this brief statement to be, at least, simple problems. If, however, we examine the conditions in detail the simplicity may not appear so evident; and this characteristic may prove to be one reason why this important branch of astronomical research is now so generally neglected.

In the first place, it must be understood that such an investigation cannot be completed in a few months. At least *two* and preferably *three* years' work in observing are necessary to secure good results. Skilled observers, and not more than two with the same instrument, are absolutely necessary. Such work cannot be confided to students or beginners in the art of observing, or to observers who have acquired the habit of anticipating the transit of a star. The telescope and the circles, the objective and the micrometer, the clock and the level must be of the best quality, for imperfections in any of these essentials render the best results impossible. A thoroughly good astronomical clock is the rarest instrument in the astronomer's collection. It is not sufficient that a clock should have a uniform daily rate, the rate should be uniform for any number of minor periods during the twenty-four hours. The absolute personal error in observing transits should be determined at least twice a week, and when it is not well established it should be found every day. The level error should be found every two hours, and the greatest care should be exercised in handling this important instrument. The division marks should not be etched on the level tube unless the values of the divisions are frequently examined, for, sooner or later, such tubes become deformed on account of the broken surface, and are then worthless.

In the determination of zenith distances the effect of refraction plays such an important part that no work can rightly claim to be fundamental until the local refraction has been carefully investigated, and special corrections to the standard tables, if necessary, have been deduced for each observing station. The ordinary mode of observing temperature is quite inadequate to the importance of the phenomena. These observations should be made as near as possible in the mass of air through which the objective of the telescope is moved, and also in the opening in the roof and the sides of the observing room where the outside air comes in contact with that in the building. The thermometers should all be mounted, so that they may be whirled in that portion of the air where the temperature is desired, and they should be tested at least once a year to determine the change in the position of the zero of the scale. But a complete list of the things to be done, and of the errors to be avoided, are too voluminous for this occasion, and are not necessary to show the complex character of the problem; the suggestions already made must suffice.

For many years an immense number of observations of the larger or the so-called standard stars have been made at the principal observatories, for different purposes and with varying degrees of accuracy, but it is not certain that the work of the last thirty years, with all the advantages of improved apparatus, has resulted in more exact determinations of even the relative right ascension of such stars. There can be no doubt that the chronographic registration of star transits has given more accurate results for the smaller stars, but I think it is equally true that, in the case of first and second magnitude stars at least, no improvement has been made in accuracy.

With double threads it is possible to observe the zenith distances of such stars with a fair degree of precision, because the operation is one of comparative deliberation, and the centre of the mass of light can be placed midway between the threads with little difficulty. But the attempt to note, with a chronograph key, the instant when a swiftly-moving and irregular mass of light, like α Canis Majoris or α Lyræ, is bisected by a transit-thread, is an operation that rises but little above the level of ordinary guesswork. Transits of first and second magnitude stars cannot be observed with an objective of more than four inches aperture with the desired accuracy, unless the apparent magnitude is reduced, by means of screens, to that of a fourth or fifth magnitude star. It is necessary in this connection to avoid confounding the methods employed in the observations of the bodies of the solar system with those for obtaining fundamental places of the stars. The observations of the Sun, Moon, Mercury, and Venus with a transit circle are, from the unavoidable conditions, necessarily uncertain to a degree even beyond the probable error involved in the observations of the large stars. In spite of these unfavourable conditions, however, the continued observations of these bodies at the principal observatories for many years have produced the most valuable results, even when the work on the standard stars, on which their results depend, has no claim whatever to a fundamental character.

In geographic exploration the first endeavour is to secure approximate positions of salient points from a rapid reconnoissance. This is followed by more careful work, fixing the observing stations with that degree of precision which ensures good results. Finally, the highest qualities of skill and science are combined to exhaust all available means to reach the greatest attainable accuracy. In the exploration of the heavens, the first two of these steps have already been taken, and most of the stars of the larger magnitudes have been so well observed, that the accuracy of their positions is not only far higher than is required by the greatest skill of the navigator, but it is equal to all the demands of ordinary practical work. It is the next step which challenges the skill of the mechanician, the observer, and the computor; and astronomers cannot rest at ease until all known resources have been exhausted in the attempt to reach the best results. It is not a very difficult matter to fix the position of stars within a range, in the individual observations, of three or four seconds of arc; but that degree of accuracy is not sufficient for the more exact problems of astronomy, and it falls far short of what is required in the important discussions of solar and stellar motions.

Bradley's observations furnish the data for Bessel's "Fundamenta Astronomiæ," and many astronomers have since attempted by reductions to obtain improved positions for Bradley's stars. The value of these observations in the development of modern astronomy can hardly be exaggerated. Their importance in the dermination of stellar proper motions increases with the lapse of time, and yet the accuracy of the original observations was far inferior to that obtained in ordinary routine work with modern methods and improved instruments.

Fundamental catalogues of stars have notably increased since the "Fundamenta Astronomiæ," but the demand has not yet been satisfied. The catalogues of declinations or north-polar distances are more numerous than those of right ascension, evidently because, for many reasons, independent declinations are more readily determined.

There is probably no collection of the right ascension of the large stars that has attained, or justly deserved, a higher reputation than the Pulkowa Catalogue. The observations on which this catalogue is founded were made by Schweizer, Fuss, Lindshagen, and Wagner, at the Pulkowa observatory between 1842 and 1853. The observations were reduced by the several observers, thoroughly discussed by Wagner, and published in 1869. Only one observer was employed at any period. As these results have received high praise for their accuracy, and for their freedom from systematic errors, it may be of some interest to consider briefly, and in a general way, the character of the data on which the results depend.

The objective of the transit instrument with which these observations were made, had a focal length of 8 feet and 6 inches and a diameter of 5·85 inches. It was so constructed that the ocular and the objective could be interchanged. It was also reversible, and a part of the observations were made with the clamp east and the remainder with the clamp west. This construction permitted the observations to be made under four different sets of conditions, and for that reason the observed right ascensions of each star were arranged, for facility of discussion, in four separate groups.

An examination of the results in each group discloses some interesting facts that are worth considering somewhat in detail. The whole number of stars in the catalogue that are reckoned as standard stars, and are south of 70° north declination, is 365. Of this number 70 per cent. have a range, in the individual results, in at least one of the four groups, of two-tenths, or more, of a second of time. This range is between 0·20 and 0·29 for 142 stars; between 0·30 and 0·39 for 92 stars; between 0·40 and 0·49 for 15 stars; and 0·50 or more for six stars. The mean range for the 255 stars is 0·297. In general, the accordance between the individual results is quite good, but the discordance just mentioned sometimes occurs more than once in the collected observations of the same star, and these doubtful data have been used in deducing the standard places given in the catalogue. It is not necessary to look for minor discrepancies, for enough of appreciable magnitude have been cited already to warrant the conclusion that better observing can and ought to be done with modern instruments, and that the needs of astronomical science to-day demand a more comprehensive, and a more accurate, standard catalogue of right ascensions.

These remarks must not be interpreted as unfavourable criticism of the Pulkowa Catalogue, by far the best work of its period, but they are made simply to call attention to the fact that the present state of stellar astronomy and the direction which the investigations of the immediate future are likely to take, plainly require the most accurate fundamental catalogue of the standard stars that modern instruments and appliances, modern methods and the most skilful observers can produce. All of these conditions are essential, and they must be carefully co-ordinated to obtain the desired results.

It must be plain to every astronomer that the needed fundamental catalogue must be deduced from new observations. The reduction and the discussion of old observations of doubtful quality is a waste of time and energy. Under existing circumstances the greatest weight must be given to the observations. Neither amount of labour nor skill in computation can derive results of the desired accuracy from careless, incomplete, or incorrect observations. An attempt on the part of the computer to apply any system of theoretical weights, either simple or complex, to such observations is almost certain to lead, at least, to self-deception; and the safe as well as reasonable rule in such case would be to use the weight zero.

One example may serve to illustrate the effect of dealing continuously with old observations. In standard star positions the four principal national ephemerides are not only not in accord with each other, but they generally do not exhibit results even from the few best modern observations. The many discrepancies of varying magnitude in these volumes present with marked emphasis the undesirable results arising from the custom of "threshing old straw."

The data on which these several ephemerides are founded are the common property of all astronomers, and no one can claim the exclusive use of any published observations; and yet national pride or national obstinacy, which is sometimes mistaken for the nobler sentiment, or some computer's pet scheme or system of combination, has led to the adoption of a variety of assumptions in the interpretation and treatment of the original data until our standard ephemerides are so complex in their structure that the exact details of their preparation are practically unknown outside their respective computing offices. The accuracy of the star positions is unchecked by any recent fundamental observations, and they lack that trustworthy character that should inhere in a system intended to serve as a basis for even good differential work.

If this character were wholly satisfactory, we should soon see the representatives of astronomy, geodesy, and geology gathering about the zenith telescope, confident of reaching some definite conclusion in regard to the variation of terrestrial latitudes by the systematic use of this simple instrument. But the accurate star positions do not exist, and under the present conditions the most feasible plan for utilizing this instrument is to so arrange the observing stations as to eliminate the effect of errors in the star places.

If it be admitted that sidereal astronomy is worthy of further and more accurate study, that the needs of astronomical research at the present time and in the immediate future demand more exact positions of the standard stars, it may be desirable to consider briefly the status of those agencies to which we must look for the successful prosecution of such an investigation.

It is not an easy task to determine the exact number of active observatories in the world. Some published lists contain the names of all observatories, from the most expensive and fully equipped Government establishments to the temporary shelter that protects a small equatorial telescope, and perhaps a chronometer, which is kept by the owner for the amusement and possibly for the instruction of himself and his friends. A fair enumeration, however, would probably give a list of about 250 observatories sufficiently equipped to do some kinds of astronomical work. Of this number more than 20 per cent. are found in North America. In the equipment of these 250 observatories are to be found about sixty transit circles with objectives ranging from nine to about three inches. The quality of about one-fourth of these instruments is such that good results may be expected from their proper employment. To the latter class of instruments we are limited when we seek for the highest class of work now under consideration. If we take account of the modern subsidiary apparatus, and of the electric methods of recording transit observations and illuminating the different parts of the instrument, it does not seem extravagant to conclude that, if one third of the best transit circles were devoted for the next four years to observations for the formation of a fundamental star catalogue of right ascensions and north-polar distances, the aggregate result would be not only the best positions ever published, but it would be of the greatest value in the discussion of current, as well as future, astronomical problems. Unfortunately, however, we do not find any such number of instruments employed in fundamental work. At the present time there is no general fundamental work in progress in any portion of the world, and within the last thirty years there have been no results of that character to take the place of the Pulkowa determinations. This statement does not refer to observations of one ordinate only, or to those cases where several observers, both trained and untrained, are accustomed to observe in turn with the same instrument and their several results are indiscriminately mingled in such a way that critical discussion is out of the question. Several observers may work together in the determination of declinations with a fair degree of success, because, to a large extent, each observer's work in a period of twelve or twenty-four hours is independent of that of his fellow's; but even this work is better when done by one skilled observer alone. Fundamental right ascensions, however, cannot be determined with the requisite accuracy, and the necessary freedom from systematic errors, if more than one or, at most, two observers work with the same instrument. If only accidental errors of observation, or such as are due to atmospheric disturbances, uncomfortable positions, or the unsteady nerves of the observer, were introduced by increasing the number of observers, then increasing the number of observations would tend to diminish the error of the result. But the personal errors of observers, and their various habits of manipulation, are of the same nature as systematic errors, and cannot be eliminated by increasing the list of observers or the number of observations.

Of the many valuable star catalogues in existence, I know of none in which the right ascensions depend upon the observations of more than one astronomer, where it is possible to know, or to eliminate, either the constant or the variable errors due to the personal equation of the observers.

In the current astronomical work of this country in which we, as members of this section, are especially interested, observations and discussions, planned solely, and properly carried out, for the determination of absolute star places, are quite unknown. The necessary instrumental outfit, with the exception in some cases of a clock of the requisite quality, exists in several observatories, and I have no doubt that trained observers of the highest character can be found to meet all demands.

With the exception of a few Government establishments, and of those built to promote a higher grade of instruction, the observatories throughout the world have been founded generally for some special purpose. Their existence depended upon some endowment or bequest originating in the real or fancied interest which the wealthy benefactor took in some popular branch of the science, and this founder, with a real enthusiasm for the stimulation of research, and a noble generosity that deserved recognition in a broader field, often unwittingly limited the scope of his foundation and restrained the usefulness of his gift. Utility or novelty, separately or in combination, were frequently the groundwork on which were based the successful claims for pecuniary assistance in founding and maintaining astronomical observatories. The working observatories founded fifty years or more ago, with scarcely an exception, were supported entirely in the belief that the results of the observations would be, directly or indirectly, beneficial to navigation and to commerce. At that time this belief rested upon a reasonable basis. This plea for the construction and support of observatories is sometimes heard even at this period in the evolution of science, in spite of the fact that, if every fixed observatory in the world were destroyed to-day, no interest of navigation or commerce would suffer for the next fifty years. The function of astronomy in promoting the development of navigation and in fostering the extension of commerce has been completed.

In the periodical struggle with wealthy patrons to secure the yearly stipend, and with corporations and legislative bodies to obtain the annual appropriations for the support of observatories, may be found perhaps an apparent, if not a sufficient, motive for selecting the class of work that is pursued in most of the American observatories at this time. The apparent conclusion of those who have sought financial support for astronomical observatories seems to have been that such aid could not be secured except for some special work or research, and that the particular branch of investigation selected must be one that promised either immediate and novel results, or such as would enable capital to win, either in material benefits or in popular reputation, some returns for the risks incurred in speculative advances. Persistence in these theories and in the consequent lines of action, has doubtless resulted in the evolution of a certain type of astronomer, and also of a corresponding type of astronomical patron, whether the latter be an individual, a corporation, or the legislative agents of millions of intelligent people. Such a result would be the obvious outcome of the forces in action.

The motives that actuate the early settlers in new countries, that guide them in the struggle with the untamed forces of nature, arise mainly from the material interests of the pioneer. As the subjugation of the land progresses and the comforts and luxuries of life are substituted for the bare necessities of existence, the higher, intellectual side of humanity asserts itself and demands, not only a hearing in the councils, but also its share in the advantages won in the campaign for material prosperity.

The progress in the development of the various stages of civilization has its parallel in the evolution of the science of modern astronomy. For many centuries the timid navigator skirted the familiar shores of his native land, or, occasionally lured by the hope of unusual gains, he rashly tempted fate by adventurous cruises along distant shores that bore no name in the traditions of his forefathers. But, however lofty his ambition, he never allowed the known or unknown peaks and headlands to sink below his horizon. To him the open ocean was a symbol of infinite space that he dared not explore until astronomy furnished the key to its uttermost recesses, and the art of navigation rose to the dignity of a science.

Greenwich Observatory was founded in 1675 to promote the interests of navigation. The royal warrant appointing the first astronomer royal also declares that his duty is "forthwith to apply himself with the most exact care and diligence to the rectifying the tables of the motions of the heavens and the places of the fixed stars, so as to find out the so much desired longitude of places for the perfecting the art of navigation." Right faithfully have the successive astronomers royal carried out the spirit of the royal mandate. For many years the success was far from uniform, nor was the progress always satisfactory, but, through adversity as well as prosperity, the original design of the foundation was always kept in view, and the results have been commensurate with the effort. If the work of all the other observatories of the world were neglected or destroyed, the data in the annual volumes of the Greenwich Observatory would be sufficient, not only to build anew the science of navigation, but to reconstruct the entire planetary and lunar theories. Surely there can be no more flattering commentary on the value of a well-planned system of observatory work closely followed, through two centuries, with true Anglo-Saxon pertinacity.

The history of Greenwich Observatory is in many respects that of nearly all the observatories, of that early epoch, that have survived to the present time, but most of the urgent needs that led to their foundation have ceased to exist, and new problems have arisen to take their place. The immediate material and commercial advantages, sought for in obedience to the demands of the original foundations, have been fully gained, and the scientific results obtained from the same researches remain a permanent benefaction to the whole world.

To this extent the science of astronomy is deprived of some, perhaps the most efficient, of the influences that commended it to public approval and support during the last two centuries; and the science has now reached a period in its development where we may with propriety consider two pertinent questions. First, what has astronomy gained for itself in the effort to present, in its results, commercial advantages or popular reputation to its patrons, in return for financial support?

Second, what shall be its future attitude when seeking aid in the foundation and endowment of new observatories or in the maintenance of those already in existence?

It may be assumed without fear of contradiction that after the revival of astronomical studies in Europe the rapid development of practical and applied astronomy and the consequent establishment of a large number of observatories was due to the stimulus derived from newly-awakened interests of navigation and commerce. Around these centres of scientific activity the astronomers of the world gathered to discuss not only the problems of practical astronomy, but the more abstruse, theoretical questions which lay at the foundation of the higher branches of the science. The work of each observatory not only furnished the means for determining the accuracy of the numerous theories then extant, but it produced original data on which new theories were constructed, to be in their turn subjected to the rigid test of observation. In the extreme interest evolved in such discussions by those who eagerly sought the key to Nature's methods in the simple form of general laws, the minor problems of practical astronomy were soon solved or passed over to clear the way for the more profound questions that involved the motions in the solar system and the structure of the stellar universe. So, indirectly at first, with a zeal superior to all obstacles, and an ambition that looked beyond the simple and practical idea underlying the original foundation, astronomers have steadily but persistently sought for Nature's general laws in the labyrinth of complex phenomena, have devoted years of intense labour to the most refined tests of methods and theories, and finally, have won for their exacting but fascinating study the foremost place among the sciences. Success in all these labours has justified the wisdom of those royal and wealthy patrons who generously gave their support when a favourable issue was by no means certain.

In its practical results astronomy has returned to mankind a thousand-fold the cost of founding and maintaining its observatories, and at the same time it has developed a science whose field of action includes not only the figure, motions, and positions of our own insignificant planet, but it reaches the uttermost limits of the universe.

If the second question be regarded as involving only a simple problem in ethics it could be readily answered by following the homely, but sometimes pertinent, injunction to "speak the truth." But in view of the complexity of interests now existing this question has a wider signification and deserves some consideration. As already stated, utility or commercial advantage can no longer be given as a reason for carrying on astronomical investigations. Novelty, combined with a desire for architectural display and an absurd ambition to secure the largest telescope and the greatest variety of astronomical instruments, has, even at the present time, a place, and sometimes a prominent one, among the reasons assigned for establishing new observatories. In view of these facts, it is surely the duty of astronomers to see to it that, for their own reputation and for the present and the ultimate welfare of their science, the true purpose of astronomical study and research, and the grounds for the existence and the support of observatories should be frankly given and courageously maintained. It is possible that pecuniary profit may sometimes indirectly arise from some branches of astronomical work or investigation; but the only sound and honest reason that can be given for such work is, that it stimulates the highest form of intellectual activity, widens the already broad field of investigation, and increases the sum of human knowledge. Whoever pleads the cause of astronomy on a lower plane discounts the intelligence of himself or of his audience. Why should the astronomer stoop to select a less noble theme, or consider it from a lower point of view? He who leads an intelligent and thoughtful life must feel himself in daily touch with those phenomena that are involved in the most important astronomical problems of the present and the immediate future. The figure and motions of the earth which he treads; the constitution and translation of the sun that invigorates his life and lights his days; the movements and structure of the moon and planets that beautify his nights; the proper motions and distances of the countless stars that nightly set before his eyes the highest types of rigorous law and of boundless space that the mind can grasp; all of these, and more, tend to convince him that the constantly growing demand for broader and more exact knowledge is ample warrant for the time and expense involved in the most profound astronomical investigation. In this direction lies the justification of astronomical research; on this basis the astronomer is sure of the stimulating support of every cultivated mind as long as the questions "why" and "how" are constantly reiterated and still are unanswered. On this ground, and on this alone, rest the valid reasons for the expenditure of corporate, municipal, or national funds for the establishment of expensive observatories and the prosecution of astronomical investigations; and in the closing years of this century the conscientious astronomer can in no way more thoroughly vindicate the highest claims of his science than by holding the standard of work well above the popular fancies of the hour, and by devoting his time and energy to that class of fundamental work that shall not only satisfy the rigorous demands of the present time, but shall make the last decade of the nineteenth century an important epoch in the real progress of astronomy.

## *GEOLOGY AT THE BRITISH ASSOCIATION.*

NEARLY fifty papers were contributed to Section C during the meeting of the British Association, and although no new facts or theories of startling interest were brought forward, the record of the year's geological work was decidedly above the average. Owing to Professor Lapworth's regrettable illness his address could not be delivered until Monday, and the chair at the meetings had usually to be taken by one of the vice-presidents.

Glacial and local papers occupied the first two days, the most remarkable being the pair by Messrs. Peach and Horne on the Radiolarian Chert of Arenig age, once probably a deep-sea ooze, which covers 3000 square miles in the southern uplands, and passes like the Moffat shales into sediment when traced towards the north. When the chert is traced to within half a mile of the Loch Doon granite the quartz has become quite granulitic, the radiolaria being still recognizable in the matrix although there is a faint development of mica; close to the granite the rock is completely recrystallized, and consists entirely of large quartz particles full of liquid cavities and rounded inclusions of biotite. Dr. Hicks claimed as pre-Cambrian some tender gneisses, schists, quartzites, and limestones, of the central Highlands, of which he gave microscopic descriptions, and Prof. Blake argued that the discovery of *Olenellus* of the type of *O. Thompsoni*, in beds above the Torridon sandstone, did not necessarily parallel these beds with those containing *Olenellus* beneath the Paradonides zone of America. Amongst the other papers dealing with Palæozoic rocks may be noted Prof. Blake's discovery of a felsite like that of Llyn Padarn, apparently intrusive into the Llanberis slates, seen in a new section in the Penrhyn quarries; Prof. Sollas's discovery of bodies like radiolaria in the slates of Howth, and the limestone of Culdaff; and Prof. Bonney's comparison of the pebbles of the English Bunter with those in the old red conglomerates in Scotland.

Several important glacial papers were read. Dr. Crosskey reported on the recording of new erratics chiefly in the north of England. Mr. Lomas traced Boulders of the Ailsa Craig, Riebeckite Rock, on Moel Tryfaen, in Anglesey and the Vale of Clwyd, at Liverpool and Birkenhead. Mr. Bell considered that the evidence from the shell-beds of Clava and Chapelhall was less consistent with the theory of submergence than with that of transportation by land ice. Messrs. Peach and Horne adduced evidence to show that in Sutherland and Ross-shire, at the time of greatest glaciation, the ice-shed was to the east of the present watershed, and the lofty mountains of Assynt and Loch Maree were glaciated by ice travelling westward. Mr. Clement Reid gave a list of twenty-eight species of Arctic plants from a series of silted-up tarns at Corstorphine and Hailes, near Edinburgh. Prof. Axel Blyth exhibited and described a beautiful set of plant remains preserved in calcareous tufas from Gudbrandsdal, in central Norway. The investigation of the Elbolton cave will probably be completed this year, and it has so far failed to reveal any trace of occupation by Palæolithic man. Messrs. Peach and Horne have studied one out of a group of caves in the Assynt limestone of Sutherlandshire, and found charcoal with split and calcined bones of reindeer, fox, and grouse in the upper layers, and a finely preserved canine tooth of brown bear at a depth of about five feet from the surface. Mr. Coates gave a description of the cuttings, chiefly in boulder-clay, in the Crieff and Comrie railway. And Mr. Kendall attributed the glacial period to variability in the heat of the sun.

Foremost amongst the palæontological papers stands that of Mr. E. T. Newton, in which was given an account of several remarkable skulls obtained from the Elgin sandstone and probably belonging to two or three species related to the African dicynodonts; together with these occurred the skull of a reptile allied to Pareiasaurus of the Karoo beds, but with no less than thirty horns varying from a quarter of an inch to three inches in length. Mr. M. Laurie described two new species of *Eurypterus*, two of *Stylonurus*, and one of a new genus, *Drepanopterus*, of Eurypterids from the Silurian rocks of the Pentland Hills. The work of the type committee still continues, and lists have been received from several museums and private collectors. Reports were also presented on Cretaceous Polyzoa and Palæozoic Phyllopoda, and a paper by Mr. Bullen Newton recorded the discovery of *Chonetes Pratti* in the carboniferous rocks of Western Australia.

The petrological papers included a note on the Malvern crystalline rocks, by Mr. Irving, one on the felsites, andesites, and diabases of Builth, by Mr. Woods; and a short note on the Limerick Traps, by Mr. Watts. Mr. Ussher endeavoured to prove that there must have been a rigid mass occupying the position of the Devon and Cornwall granites at the time when the stratified rocks were folded, in order to account for the deviations in their strike. Mr. Goodchild argued that the junction of the granite of the Ross of Mull was best explained by the absorption of sedimentary rocks in the granite. Mr. Harker explained the presence of porphyritic quartz in basic igneous rocks by supposing that it had formed in the upper layers of a magma basin, and sunk to its present position by gravity. Mr. Teall gave a sketch of the succession of rocks in an area of gneisses, which accorded with the succession from basic to acid types in plutonic masses; and Mr. Somervail endeavoured to explain the chief rocks in the Lizard area by segregation from a single magma.

Finally must be mentioned Professor Hull's paper on the Physical Geology of Arabia Petrœa; a very interesting paper by Miss Ogilvie, on the landslips in the South Tyrol, in which she showed how much the mapping of that region was complicated by the constant repetition of portions of the strata by landslips; a new classification of the New Red Sandstone of Northern England, by Mr. Goodchild; and papers on the Greensand and Fuller's Earth of Bedfordshire, by Mr. Cameron.

Dr. Johnstone Lavis's report on Vesuvius chronicled the phases of eruption in the past year, and was illustrated by a beautiful series of photographs, chiefly of fumarolles and spiracles in the streams of lava. Mr. De Rance's report on underground water was continued. Mr. Davison's earthquake report dealt chiefly with new forms of seismic apparatus, and the photographic committee recorded that the collection of geological photographs now numbered 700, amongst which half the English counties and Scotland were, however, poorly represented. An excellent exhibition of the photographs was held in a room provided for the purpose, where also the Geological Survey of Scotland showed a fine series of views illustrating the scenery and structures of the ancient gneisses and schists of the Highlands.

## MECHANICS AT THE BRITISH ASSOCIATION.

SECTION G had a good meeting at Edinburgh this year, there being a great improvement on last year's gathering at Cardiff. On the members assembling on Thursday morning the fourth inst. in the old University Buildings thc first business was naturally the Presidential address. Prof. W. C. Unwin, F.R.S., who this year occupied the chair, is eminently fitted to preside over the Mechanical Science Section. His knowledge of the scientific side of mechanics is well known, and his past experience in the region of practical mechanics puts him thoroughly in touch with the many engineers who frequent the section. His address, which we have already printed, was listened to by a large audience, the theatre being quite full. The vote of thanks to the President for his address was moved by Lord Kelvin and seconded by Mr. Deacon, of Liverpool.

The first paper on the list was a contribution from Mr. James Dredge and Mr. Robert S. McCormick on the American Exhibition, which is to be held next year in Chicago. The paper gave a good general description of the coming show from the engineer's point of view; but the subject is one that offers better scope for the members of Section F. It is manifestly impossible to give anything like a good engineering description within the limits of a short paper, whilst the advantages and disadvantages of exhibiting might well have supplied a theme for discussion in the Economic Section. In fact, the discussion which followed the reading of the paper turned wholly on this branch of the subject. The next three papers were of a sanitary nature. Prof. George Forbes and Mr. G. Watson, of Leeds, both dealt in the disposal of town refuse, the former bringing in the electrical lighting of Edinburgh as a part of his scheme. Mr. Forbes points out that in the electric lighting of towns the demand for power is but for a few hours daily. With no system of accumulators, or power storage, this necessitates a large plant compared to that which would suffice if the demand could be made continuous. The author, therefore, proposes to use Arthur's Seat as an accumulator, by forming a reservoir on its summit, and into this reservoir water would be pumped continuously. The head of water thus obtained would be used for working turbines, which would be of sufficient power for the maximum demand. There would thus be a gain through keeping the steam engines constantly at work, smaller engines could be used, and there would not be the loss incidental to raising steam or keeping the boiler fires banked. The great feature of the scheme, however, is to use the dust-bin refuse of the city as fuel for raising steam. The author would erect destructors, and the waste heat from these would be passed through the boiler flues. Prof. Forbes quoted figures in support of his contention that the scheme is practicable, and he instanced what has been done at Southampton, and elsewhere, in the matter of using domestic refuse for steam-generating purposes. We are not able to criticise the details put forward, but we may venture to say that, if the scheme can be worked out practically, engineers will have put before them an example of the use of waste material which many have not hitherto considered capable of being so successfully applied. The author stated that the refuse of a city, if properly burnt, would generally supply sufficient heat to raise the steam necessary for the electric lighting required. That is a very satisfactory adjustment of supply and demand, and if Prof. Forbes can show municipal engineers how to put it in practice he will have rendered a most important service for which every one should be devoutly grateful. After disposing of the particular scheme for the refuse destruction and electric lighting of Edinburgh, the author gave some interesting particulars of that which has already been done in this country in the matter of burning town refuse.

The next paper was contributed by Mr. G. Watson, of Leeds, and was an excellent treatise on the refuse-destructor question. The various types of apparatus which have already been put in use were illustrated by wall-diagrams, and the chief points in their construction were explained. Mr. Watson is of opinion, and he supported his opinion by results of actual experience, not only that dust-bin refuse can be burned in a properly constructed destructor without nuisance, but that the waste heat can be used for raising steam; or, if required, that dust-bin refuse and sewage sludge, containing 90 per cent. of moisture, may be satisfactorily burnt together, the Horsfall destructor being, apparently, particularly suitable for the purpose. The whole subject is one of great and growing importance. It is to be regretted that both these papers were not printed and distributed previously, so that a thorough criticism of the various points raised might have been made during the discussion.

A paper by Mr. R. F. Grantham, on the absortpion and filteration of sewage was next read. The author gave accounts of many examples that have been carried out in different parts of the world, and of experiments made in this connection. Mr. Grantham is of opinion that the Maplin and Foulness Sands at the mouth of the Thames might be used to advantage for treatment of the sewage of London.

The next paper was of a different character. It was by Mr. G. F. Deacon, and contained a description of the work the author had carried out in shield tunneling in loose ground whilst constructing the Vyrnwy Aqueduct tunnel under the Mersey. The work, as is generally known, was one of remarkable difficulty, and the manner in which the various obstacles to its completion were overcome affords a valuable lesson for engineers.

Mr. D. A. Stevenson next read a paper in which he advocated the construction of a ship canal between the Forth and the Clyde. The scheme included a tunnel high enough to pass the masts of big vessels, and locks sufficiently large to take in ocean-going steamers. The estimated cost is £8,000,000. After a short discussion of this paper the section adjourned.

On the next day, Friday, the 5th inst., the first business was the reading of a paper by Mr. D. Cunningham, in which he described a mechanical system for the distribution of parcels. The device was illustrated by means of a working model, without the aid of which, or drawings of the mechanism, it would be difficult to make the principle understood.

Mr. Alexander Siemens next described two electric locomotives which his firm had recently supplied to the City and South London Railway. These, as it is proper they should, have been more successful in their working than the engines originally placed on the line. The armatures of the motors are wound on the axles, so that no gearing is required. According to diagrams displayed, the efficiency varied between about 90 and 94 per cent. Each locomotive, fully equipped, weighs 13½ tons, and the weight of the train of carriages is about 21 tons, without passengers. The weight, we believe, is considerably greater than in the original locomotives used on the line, and this is undoubtedly an advantage. Mr. J. H. Greathead, Professors Silvanus Thompson, and G. Forbes took part in the discussion; in replying to which the author attributed the success of the motors to large armatures and large field magnets. Prof. Silvanus Thompson stated that Messrs. Mather and Platt, of Manchester, are now building an electric locomotive which is to be more powerful than anything that has gone before.

Hydraulics next occupied the attention of the section, Messrs. F. Purdon and H. E. Walters describing an interesting tide-motor which they have devised and constructed. The machine takes the form of a floating barge or flat, which is moored athwart the tide-way. There are two drums placed some distance apart, and on these drums a chain is made to travel by floats attached to it, which floats project downwards into the water, and are carried along on the forward stroke by the action of the tide, whilst the return stroke is made in the air. As the flat is moored athwart the stream—in order to utilize the greatest possible area of the current—and as the chain travels fore and aft, guides are used to conduct the water in the proper direction to actuate the floats or paddles. The guides also concentrate the stream. These are roughly the fundamental features of the design, further details of which we are unable to give through limits of space. The machine, however, is very interesting, and is perhaps one of the most promising and best worked-out motors of its kind. There appears now to be better prospect for inventions of this nature than heretofore, on account of the facilities offered for transport of power by means of electricity. It is always a tempting problem to try to use some of the vast store of energy running to waste in the tides, although the question is one beset with practical difficulties that have been sufficient hitherto to make tide-motors very scarce.

A paper by Mr. Pearsall, in which he described a new arrangement of hydraulic ram, which he had made, was next read; Prof. Blyth described a new form of windmill on the principle of the Robinson cup anemometer; and Mr. G. R. Redgrove having read a contribution on Levavasseur's flexible metallic tubing, the second day's proceedings were brought to a close.

The next sitting was held on the following Monday, the section not meeting on Saturday. The arrangement was decidedly a pleasant innovation, the Saturday morning's meeting being by no means popular. Whether there be few or many papers, it seems impossible to get through a sitting in a short time, as there are always one or two speakers, at any rate, who will spin the discussions out, so that those who are obliged to stay to the end have no time to get lunch before starting on the excursions. Section G made a trip to Glasgow on the Saturday, and were rewarded by perhaps the finest exhibition of marine machinery ever collected in a single installation. This comprised the propelling engines of one of the pair of enormous vessels the Fairfield Company are building for the Cunard line. The engines were erected in the shop, and one was enabled to get a fair prospective of their grand proportions, such as will be impossible when they are confined to their natural position on shipboard.

On the section again assembling on the Monday following the first business was the reading of the report of the committee appointed to consider "The Development of Graphic Methods in Mechanical Science." This report had been prepared by Prof. Hele-Shaw, of Liverpool, who must have spent a vast amount of pains in compiling the very bulky document, which was read in abstract. The bibliography should be especially valuable. This is the second report that has been presented by the committee, and, we believe, the subject is to be further investigated. The use of graphic methods is far less common with engineers than it might be with advantage, and the matter is one which the Mechanical Section of the British Association is especially fitted to deal.

Mr. Preece next read two papers, in the first of which he took the municipal authorities to task for causing stack pipes to be disconnected from the drains, and thus depriving these natural lightning-conductors of their lead to earth. If Mr. Preece's prognostications are fulfilled there will be a great increase in casualties from lightning when the new legislation comes widely into effect, unless some other means be taken to make connection between stack pipes and earth. Mr. Preece did not read his second paper, but contented himself with saying a few words to signify its scope. Its title was "The use of secondary batteries in telegraphy." For the past seven years secondary batteries have been used at the Post Office to supply current to two large groups of circuits, one group consisting of 110 single needles, and the other of 100 Morse inkers and sounders.

Mr. Gisbert Kapp next read a practical and interesting paper on "Power Transmission by Alternating Current," describing an installation which has been carried out at Cassel. In that town the water supply is a municipal undertaking, the source being at a distanee of four miles or so from the town. In the summer a large quantity of water is used, and for this reason a certain amount of pumping has to be done. The pumps are worked by turbines. In the winter the existing natural gravitation supply is sufficient, and the turbine pumps are, therefore, not required. It is, of course, in winter that the chief demand for light occurs and then the turbines, in place of being idle, are used for driving dynamos. Mr. Kapp explained by means of diagrams the manner in which a storage system is carried out so that the turbines may be kept constantly at work. The power is transmitted by a single phase alternating current from the generating station to two sub-stations at Cassel. At one of the sub-stations there is a battery which is charged during the hours of light load, to be in turn drawn upon during the time of heavy load. Each of the two sub-stations contains a transformer so that the distribution is by continuous current, whilst between the generating station and the sub-stations the current is alternating, the pressure being 2000 volts. The installation was the work of Mr. Oskar von Millar, Mr. Kapp designing the alternators. The author gave a good many details of the arrangement of which the above is an outline. In the discussion which followed an interesting point was raised as to the effect of putting the alternators out of step. The author said that in the present instance he had no hesitation in putting the load on suddenly and no effect followed, but if the load were suddenly taken off, the machine would start howling in a frightful manner until it again got in synchrony. This was alarming at first, but not otherwise hurtful.

Mr. E. H. Woods next read a paper in which he gave particulars of a new design of electric locomotive. The driving wheels are placed horizontally, the necessary grip being, we understood, obtained by springs, which press the pairs of wheels against a central rail. There is an ingenious device for points and crossings which was illustrated by a model. The motor is to be kept running continuously, the grip of the wheels being released when the train is stopped, the power then be absorbed by frictional brakes. The relative value of this device naturally depends on the length of the stoppage. Mr. Kapp and Prof. Forbes both spoke on the question of continuous running motors, neither appearing to look with favour on the device.

Monday is generally devoted wholly to electrical engineering, but on this occasion the papers on the subject were not sufficiently numerous to fill up the sitting. The rest of the day was, therefore, filled up with papers of a miscellaneous nature. The first of these was a contribution by Lieut. W. B. Basset, R.N., who described a very ingenious coin-counting machine which has been recently placed in the Royal Mint. It would be impossible to describe this apparatus without the aid of drawings; but it may be stated that 3,000 coins can be counted in a minute, or one ton in three-quarters of an hour. The coins are made to move along a channel of such a size that only one can pass at a time. They are forced along by means of two driving wheels, actuated by an electric motor. At the lower end of the channel is a wheel with notches in its rim, the notches being of a shape that the coins just fit into them. The wheel is made to turn by the coins as they are forced forward, the action being comparable to that of a rack and pinion, the rack being formed by the procession of coins pushed forward by the driving wheels. The counting wheel must necessarily pass a coin for each notch or tooth it advances, and as a given number of teeth always go to a revolution, an accurate record is obtained. The machine in the Mint is arranged to count pence, half-pence, piastres, half-piastres, and Hong Kong cents. It counts on an average over two million coins a month without error.

Mr. Killingworth Hedges next read a paper on "Anti-Friction Material for Bearings used without Lubrication." This referred chiefly to a bearing composed of finely-powdered carbon mixed with steatite, which the author had found valuable. He referred to the advantages of non-lubricated bearings, such as saving in labour, cost of oil, and cleanliness. In the discussion which followed, Professor Unwin well summed up the question by saying that though there might be a higher co-efficient of friction with a non-lubricated bearing, manufacturers could generally well afford a small additional expenditure of power in order to be free from the defects of oiled bearings.

A paper by Mr. B. H. Thwaite on high-pressure boilers, which does not call for notice here, was the last read on this day.

The last day on which Section G sat was Tuesday, the 9th inst., when the proceedings were opened by a paper by Mr. D. A. Stevenson, entitled "Petroleum Engines for Fog Signalling," being read. The paper, which was read by Mr. C. A. Stevenson in his brother's absence, stated that the maximum number of hours of duration of fog in Scotland was 395 per annum. For sounding the siren various motors are available, which may be actuated by the waves or tides, manual labour, clockwork, steam, hot air, gas, or oil. The author states that the oil engine is the best for the purpose. He states, however, that all fog signals which appeal to the ear must be of an unreliable nature, and he would prefer some method, such as had been proposed by Mr. C. A. Stevenson, in which an electric conductor is laid down off a coast, so as to act on an instrument attached to each vessel. It would have added to the value of the paper had sufficient detail of this device been given to afford the meeting an idea of its general principle. As the description stands we quite fail to see how a useful result could be brought about. An interesting discussion followed the reading of this paper, in which the chief feature was the speech of Mr. A. R. Sennett, who pointed out that water is a better medium than air for conveying sound, and reminded the meeting that sound was very liable to be deflected by "acoustic clouds." Tyndall found that the presence of such clouds reduced by one-third the distance at which a given sound could be otherwise heard. Mr. David Cunningham, the harbour engineer at Dundee, gave a remarkable example of the influence of acoustic clouds. He had gone out in a steam yacht when the siren was in operation. At a distance from it of half a mile the sound was not to be heard, but when they had steamed four miles the siren was again audible. It had been sounding the whole time. To return to Mr. Sennett's remarks, that speaker said he proposed taking advantage of the sound-carrying power of water in the following way. He would have the siren, which indicated a danger, submerged in place of being in the air. It would be arranged to give off a certain note. In each ship there would be a chamber to which the sea would have access, and in this would be a diaphragm which would be tuned to the same note as that emitted by the siren. By the well-known law the diaphragm would not resound unless the note to which it might be attuned were in harmony with that given off by the siren, and therefore false alarms would not be given by the sounds produced by paddle wheels or in other ways. An officer would be placed in a padded cabin, so as to isolate him from the noises of the ship, and by means of an ordinary speaking-tube he would be able to hear the vibrations of the diaphragm, which, as stated, would only take place when they synchronised with the sound-waves produced by the siren. Mr. Sennett's proposal is ingenious, and may contain the germ of a principle of great value. We understood him to say that he had made some experiments in this direction, and that these had been encouraging. It is obvious, however, that investigations of this nature must be somewhat costly, and can lead to but little prospect of pecuniary reward. We would suggest that the matter is one that might well be taken up by the Board of Trade or the Trinity House. Perhaps some of those big ship-owners who do their own insurance might be induced to give assistance in this direction. It is quite possible, and indeed probable, that we have been entirely on the wrong tack in sending sound-signals through the air. The experience of Prof. Hughes, quoted by Mr. Sennett, when he found the sound of two stones being knocked together under water could be heard for a distance of half a mile, and heard so distinctly that the Professor did not wish to repeat the experiment, bears on this point. An ordinary bell has been struck under water, and the sound conveyed a distance of nine miles.

Mr. C. A. Stevenson next read a paper of his own "On the Progress of the Dioptric Lens as used in Lighthouse Illumination." This paper was largely historical, going back to the early days of the century, when Alan Stevenson introduced the Fresnel apparatus in Great Britain, and bringing the record up to the year 1886, when the author proposed the spherical lens, an example of which was introduced in one of the Fair Isle lighthouses. This introduction of the spherical refractor has made practicable the construction of more powerful apparatus, with less total space occupied. It has also rendered practicable a quadrilateral arrangement with hyper-radiant lenses. This arrangement has been installed at Fair Isle, the lenses being cut so as to give two flashes from each side of the quadrilateral. An experimental example for Ireland is 2 m. focal distance, and the spherical refractor is 7′ 6″ in diameter, and will give one flash from each side of the quadrilateral.

Mr. A. R. Sennett next read a paper which was both interesting and of practical importance. Its theme was the much ill-treated smoke-prevention question, and we may at once say it was refreshing to find this important but ever-abused problem approached in an intelligent manner. Mr. Sennett has evolved a very simple device which, it might perhaps be rash to say, has exorcised the smoke fiend in regard to boiler furnaces; but if we are to accept his statements—and we see no reason why we should not—there is no longer excuse for steam users allowing smoke to emerge from boiler chimneys. We all know it is not difficult to prevent smoke if fuel economy be left out of the question, but Mr. Sennett tells us he not only prevents smoke, but saves coal. The latter part of the claim is vouched for by Professor Alexander Kennedy, who is perhaps our best authority on this subject; and, with regard to the smoke prevention, Section G was able to judge for itself, as the author had a fair-sized return-tube boiler at work in a yard close to the meeting-room. The paper was of considerable length, but was listened to with interest throughout. By means of wall diagrams, devices of various classes, previously introduced, were illustrated and described. These played much the same part as the awful example at a teetotal lecture, only serving to emphasize the virtues of the author's own invention. Some of them, it must be confessed, were sufficiently absurd; one especially, in which the products of combustion were cleansed from soot by a sand filter, afforded the meeting a good deal of amusement. We imagine the impression of the average engineer to be that the drier and hotter the air fed to a furnace the quicker and more perfect would be the combustion. This Mr. Sennett shows to be not exactly the fact, or, at any rate, that the presence of steam with the air promotes combustion. He says that hydrogen, steam, or aqueous vapour, in the furnace is necessary. He combats the view, "too readily assumed," that the presence of an excess of oxygen contained in dry air will of necessity effect complete combustion. The advantage of supplying air above the grate bars, as well as below, is, of course, well understood, and it is with the volume of air introduced above that the anthor chie ly deals. His device consists chiefly of an air injector, the steam for inducing the air-current being super-heated in a coil placed in the chimney. The apparatus is termed a transformer, because it transforms the kinetic energy of a small current of steam at high pressure into that of a large current of air at low pressure: a description which conveys the whole scheme of the invention, although the working out of the details requires some attention. With the transformer Mr. Sennett has carried out some experiments. He worked it firstly by steam, and secondly by compressed air, and he found that the volume of air required for combustion was very much less in the former case than in the latter. In explanation, or rather in illustration, of this fact the author quotes several interesting facts. Mr. H. Brereton Baker investigated the phenomena which accompany the burning of carbon and phosphorus in oxygen. Finely powdered charcoal was carefully dried and sealed up in a hard glass tube containing oxygen saturated with water. The tubes were placed in a flame, and the carbon burnt with bright scintillating flashes. When the oxygen was dry no combustion took place in the tube, though the latter was heated to bright red; a result which came clearly as a surprise to many of the members of non-chemical Section G. Mr. Baker has said that the results obtained clearly show that the burning of carbon is much retarded by drying the oxygen. With regard to the presence of moisture and the behaviour of carbonic oxide gas in oxygen the effect is even more remarkable. The author quotes Prof. H. B. Dixon, who says: "That if the mixture of the two gases be very carefully dried it is no longer explosive, and a platinum wire may be heated to redness in it without causing explosion; oxidation of the carbon monoxide to dioxide then taking place gradually, and only in the immediate neighbourhood (at the surface) of the glowing wire. A burning jet of carbonic oxide may even be extinguished by plunging it into a jar containing dried oxygen." We will quote one more interesting fact in connection with this subject. Sir Lowthian Bell has noticed that the gases at the throat of blast furnaces, which are of a temperature of about 250 to 300 Cent., are not inflammable in atmospheric air. Any small quantity which escapes does so without undergoing combustion. But the moment a tuyere commences to leak the gas takes fire; just as a small quantity of hydrogen in the eudiometric researches produced explosion in a mixture not previously influenced by the electric spark. The author does not attempt to decide whether the acceleration or retardation of the union of oxygen with the evolved hydro-carbon gases is due to the presence of aqueous vapour or of the hydrogen. Section G may fairly look to Sections A or B for enlightenment upon that point.

We have given so much space to what we think the most interesting part of Mr. Sennett's paper that we may, perhaps, be doing him the injustice of suggesting that other points do not receive attention. This, however, is not the case, for he does not lose sight of the leading canons of furnace practice, such as proper admixture of the gases, adequate space for combustion, keeping the gases from contact with the heating surface (from this point of view the cooling surface) of the boiler, and other matters, of a similar nature. The result of the whole arrangement is that smoke is undoubtedly prevented from issuing from the funnel. In the boiler referred to a very dirty coal was burned, the result being a particularly pungent smoke, which was sometimes carried down among the spectators by an eddying wind. When the transformer was put in operation this smoke entirely disappeared. Upon the apparatus being put out of action the sable cloud was again to be seen rolling forth from the chimney-top. These operations were repeated several times, the fire being constantly supplied with green fuel, so as to keep it in its smokiest condition.

Following Mr. Sennett's paper a contribution on the same subject was read by Colonel E. Dulier. The author of this paper deals with the domestic fire, to which, of course, the greater part of the smoke of civilization is to be attributed, but he does not aim at the prevention of smoke, but simply to its arrestation before its gets into the air. In order to effect this object he proposes to wash the chimney gases with a spray, and thus precipitate all soot. He also claims to arrest the greater part of the sulphurous acid, which is of even greater importance. Every dweller in towns and cities will wish Colonel Dulier well in his enterprise, but there are some very big difficulties in his way. The biggest perhaps is that before the plan can become general legislation must be brought to bear. Unhappily dwellers in towns and cities are so little disinterested that the average householder would prefer to see his next-door neighbour erect a costly apparatus (the first cost for a seventeen-chimney house is said to be about £50) rather than go to the expense himself. The large quantity of water required for a general smoke-washing would be a serious problem, not only of cost but of supply at any price, although it is quite possible this difficulty could be, as it should be, met. The cleaning out of the apparatus would be also a serious matter, for the tarry deposit due to smoke-washing is of a particularly tenaceous nature.

The sewage problem next occupied the attention of the meeting, Mr. Crawford Barlow reading a paper on "The London Sewage Question." Mr. J. Cooper also read a paper on "The Sanitation of Edinburgh." The last paper read at this meeting in this section was contributed by Mr. H. C. Carver. It related to fire extinction on board ship. The author has devised an apparatus by means of which he can turn the effluent gases from the boiler furnaces into the hold of a ship where fire is raging; the gases having been previously washed and cooled. The apparatus has been tried practically, and has been found to answer remarkably well. The ordinary practice is to turn boiler steam into a ship's hold; but the spent gases from the furnace are naturally more effective, as steam condenses, and air is thus drawn in. Nevertheless, steam is better than nothing.

After the usual votes of thanks the business of the section was brought to a close.

## *ANTHROPOLOGY AT THE BRITISH ASSOCIATION.*

AFTER the President's address, on Thursday, August 4, Mr. E. W. Brabrook read a paper on the Organization of Local Anthropological Research. The writer, as the representative of a joint committee of delegates from the Society of Antiquaries, the Folklore Society, and the Anthropological Institute, communicated a plan for an ethnographical survey of the United Kingdom, by which observations should be made simultaneously in selected localities on the ancient remains, the local customs, and the physical characters of the people. The matter is one that will not brook undue delay, as the evidence is fast slipping out of our grasp.

The Rev. Frederick Smith read a paper on the Discovery of the Common Occurrence of Palæolithic Weapons in Scotland. The author has made patient and long-continued search in modern and ancient gravel beds of existing rivers, in "Kame" deposits, and finally in certain phases of boulder clay; and he finds abundant evidence in the shape of glaciated, broken, and crushed specimens of the weapons of palæolithic man. He has collected at least 350 specimens, which he believes to be definite evidence of the long-continued sojourn of palæolithic man north of the Border.

A paper on Cyclopean Architecture in the South Pacific Islands was read; also the Reports of the Anthropometric Laboratory Committee, and of the Anthropological Notes and Queries Committee.

In the afternoon the following papers were read:—Dr. L. Manouvrier, On a Fronto-Limbic Formation of the Human Cerebrum; Prof. G. Hartwell Jones, The Indo-Europeans' Conception of a Future Life and its Bearing upon their Religions.

On Friday, Mr. J. Graham Kerr exhibited a collection of weapons, articles of clothing, and a fire drill, used by the Toba Indians of the "Gran Chaco." He accompanied the exhibition with a few explanatory remarks. The specimens had been obtained from a tribe of the Tobas on the banks of the Rio Pilcomayo. Amongst weapons the chief were bows and arrows, the former being noteworthy from their reinforcement by a back string. The arrows were of cane, with long wooden points made of cascarandá. An arrow with an iron head was also shown, the head being formed of fencing wire beaten out.

Mr. J. Montgomerie Bell exhibited a collection of flints from the North Downs of Kent, which he called "pre-palæolithic." The peculiarities of these flints is that they are not shaped into particular forms by the will and skill of the workman, as palæolithic flints are, but they are simply stones taken from the ground and used almost in the state in which they are picked up; only the edges are altered; they are chipped flints rather than shaped flints; used tools, not made tools. Mr. Bell explained the reasons which had convinced him of their authenticity; namely, that the chipping is regular and purpose-like, such as Nature is not likely to have hit upon; it is sometimes within a hollow curve, where natural agencies could not act; the edges of many unbulbed flints have far more regular marks of wear, which is the true indication of use by man, than many bulbed flakes possess, whose edges have undoubtedly been used; and lastly, there is a sequence in the types which leads into the types of the river-valley period.

Mr. J. Theodore Bent read a paper on the Present Inhabitants of Mashonaland and their Origin. The inhabitants of this country are an oppressed and impoverished race of Kaffirs, who dwell amongst the rocks and crannies of the mountains. Their recognized name—Makalanga—means "the children of the sun," and there were traces of a higher civilization amongst them. Their origin is obscure, but references to them by early Arabian writers prove beyond doubt that a similar people inhabited the country one thousand years ago. Each tribe has its totem. Their religion has a monotheistic tendency, but they sacrifice to ancestors, and sacrifice goats to ward off calamities. Their manners are courteous and refined, and their skill in music is considerable.

Prof. A. C. Haddon contributed a paper on the Value of Art in Ethnology. In order to study such an intricate subject as Decorative Art from the point of view of the Biologist it is necessary first to confine one's attention to savage art where the problems are presented in a simpler form. In taking a definite area into consideration, such as British New Guinea, one finds that there are several distinct and well-defined artistic provinces. The Torres Strait district was characterized by the prevalence of straight and angled lines to the exclusion of curved lines and the representation of animal forms, the latter being associated with totemism. In the Gulf District the human face and form is the basis of almost all their art. In the Port Moresby District decoration is in the form of panels and mainly straight and angled lines; whereas in the South Cape and Archipelago District there is a wonderful richness of design in which curved lines are abundant.

It is well known that in this latter district there has been a great mixture of race. It would appear that homogeneous peoples have a uniform style in their art, but that race mixture tends to varied artistic treatment.

Dr. J. S. Phené read a paper on the Similarity of Certain Ancient Necropoleis in the Pyrenees and in North Britain. At Luchon, a spot where the traditions of the Pyrenees were most concentrated, remarkable customs had till recently been practised. The locality abounded with interments of a peculiar kind, more or less surrounding a central mound, serpentine in form, the head of which had been cut away and a small church erected in the cavity. The walls of this antique little church are covered with votive tablets of early Christian and pagan Roman times. Almost all the features shown had been discovered by the author in Somersetshire, Bedfordshire, Argyleshire, and Peebleshire.

The following papers were read:—A Contribution to the Ethnography of Jersey, by Dr. Andrew Dunlop. Notes on the Past and Present Condition of the Natives of the Friendly Islands, or Tonga, by Mr. R. B. Leefe. Damma Island and its Natives, by Dr. F. Bassett Smith. The Reports of the Mashonaland Committee, and of the Canadian Committee were also read.

In the afternoon a discussion on Anthropometric Identification was opened by Dr. Manouvrier, who described the system of measurements introduced by M. A. Bertillon into the French Criminal Department, and showed the manner in which they were made. He said that by its means the identification of criminals was made absolutely certain. Dr. Benedikt of Vienna also bore testimony to the efficiency of M. Bertillon's system and strongly advocated its introduction into Great Britain. Dr. Garson referred to Mr. Galton's method of identification by means of finger marks.

As a result of this discussion the Council have been requested to draw the attention of her Majesty's Government to the subject.

A discussion on the subject of Criminal Anthropology was opened on Saturday by Dr. T. S. Clouston, who reviewed the work done in this and other countries, and pointed out the failure of the workers to agree on any anatomical, physiological, or psychological data for establishing a criminal type.

If inquiry established physical, hereditary, and psychological bases of criminality, the State would have to treat the criminal from a point of view entirely different from the punitive method. The essential likeness of the epileptic and the criminal brain is one of the most striking of Dr. Benedikt's observations. What were to the doctor symptoms of disease were to the policeman and the magistrate proofs of criminality. In the rich family the physician looked after the case, in the poor family the policeman and the gaoler. Yet both cases were equally phases of brain development due to hereditary weakness.

Dr. Benedikt emphasized the importance of studying criminals of different types. They must study the classes from which the criminals came, and must not confuse the poor and miserable with the criminal classes.

On Monday Sir William Turner exhibited the coiffure of a Kanaka labourer who had been employed on a sugar plantation in Queensland. The mode of dressing the hair in locks, each of which was tied round with a narrow ribbon formed of vegetable fibre, was described. 834 such locks were present in the coiffure, and it was estimated that about 120 hairs were in each lock, making in all about 100,000 hairs in the coiffure.

Prof. Struthers read a paper on the Articular Processes of the Vertebræ in the Gorilla compared with those in Man; and on Costo-vertebral variation in the Gorilla.

Mr. J. P. Mansel Weale made a communication on the probable derivation of characteristic sounds in certain languages from the noises made by animals.

Dr. Louis Robinson read a paper on the prehensile power of infants. Long-continued experiments had proved that the muscles of the hands and arms of a newly-born infant are far stronger in proportion to weight than those of most healthy adults. In many cases a newly-born child would hang and support its weight with ease for a minute, and some for thirty seconds longer. Several infants less than a week old hung for over a minute and a half, a few others a fortnight old for nearly two minutes, and one child of about three weeks old for two minutes thirty-five seconds. If the child were in a good temper to begin with it would hang quite placidly until its fingers began to slip, when it at once evinced distress, and screamed lustily as if from a fear of the consequences of falling. An examination of the foot of an infant showed that it was much more hand-like than that of the adult. The heel was much narrower than in after life, and the fore part of the sole, instead of presenting a rounded smooth surface, was flat or even concave, with creases like those of the palm of the hand. The author was not aware that any explanation could be given of these lines, so characteristic of a prehensile organ, on the foot of the human infant, other than that they were vestiges of anarboreal state of existence. He believed that it was due to the habit of the young clinging to the body of a parent who would require to use all her limbs for climbing.

Dr. Hepburn read a paper on the Integumentary Grooves on the Palm of the Hand and Sole of the Foot of Man and the Anthropoid Apes.

In a communication on the Contemporaneity of the Maori and the Moa, Mr. H. O. Forbes gave an account of the exploration of a cave in the neighbourhood of Christchurch, which had been closed by the landslip of a great part of the mountain at whose base it lay. From the remains of the last feast partaken of by the dwellers in this cave, it was clear that Moa eggs had been eaten by them, and therefore that the bird that laid those eggs was contemporaneous with the eaters. The ornamentation of the implements, &c., found in the cave proved that the cave-dwellers were true Maoris.

In the afternoon Dr. Garson opened a discussion on Human Osteometry, in the course of which Sir William Turner explained and demonstrated his method of taking the capacity of crania by the use of shot poured into the cavity of the skull through a funnel, the spout of which was 2 cent. long and 2 cent. in diameter. It was claimed for this method that it gave the actual capacity and did not over measure it as is the case with the plan adopted by Broca.

On Tuesday Dr. J. G. Garson exhibited some composite photographs of United States' soldiers.

Dr. Francis Warner contributed some Observations as to the Physical Deviations from the Normal as seen among 50,000 Children. The most important defects were found to be those of the cranium as indicated by the proportion among them delicate, dull, and with nerve disorder or weakness; many of these cases are doubtless due to rickets. Small heads were especially common among girls, the only defect to which they seem specially liable. The greatest amount of defectiveness did not occur in the poorest districts; for in the wealthier parts of London 12½ per cent. showed deficiency, while in the poorer districts only 7 per cent. showed defects.

The following papers were read by Prof. A. Macalister:—On Skulls from Mobanga, Upper Congo; On some Facial Characters of the Ancient Egyptians. It was remarkable how little variety was to be found in the heads of these ancients. The hairs of the eyebrows were small, and that on the head was not woolly but wavy. The nose was well formed, usually prominent, rather high-bridged and narrow. The nostrils were narrow, and very rarely was there much of a moustache. The chin was narrow and tapered. There were no traces of holes in the lobes of the ears. Prof. Macalister also read a paper On the Brain of an Australian.

Dr. Garson read a communication On some very Ancient Skeletons from Medum, Egypt. These skeletons were somewhere about 6000 years old, and their most interesting feature was that in the upper and lower limbs they had markedly negro characters. In the pelvis they had intermediate characters between the Egyptian and the Negro, while in the head they had well-marked Egyptian characters.

The following papers were also read:—C. Phillips, On a Skull from Port Talbot, Glamorganshire; Dr. R. Munro, On Trepanning the Human Skull in Prehistoric Times; E. H. Man, On the Use of Narcotics by the Nicobar Islanders, and certain Deformations connected therewith.

The reports of The Indian Committee, of The Prehistoric Remains of Glamorganshire Committee, of The Elbolton Cave Committee, and of The Prehistoric Inhabitants Committee were submitted.

In the afternoon Mr. G. W. Bloxam exhibited The Philograph—a Simple Apparatus for the Preparation of Lecture Diagrams, &c., and Dr. Louis Robinson showed a series of photographs illustrating his paper on the prehensile power of infants.

## *CONFERENCE OF DELEGATES OF CORRESPONDING SOCIETIES.*

FIRST CONFERENCE, AUGUST 4, 1892.

THE Corresponding Societies' Committee was represented by Prof. R. Meldola (chairman), Sir Douglas Galton, Mr. G. J. Symons, Mr. W. Whitaker, Mr. E. B. Poulton, Mr. Cuthbert Peek, Dr. Garson, and Mr. T. V. Holmes (secretary).

The Chairman, after welcoming the delegates to the seventh conference which had been held under the new rules of the Association, said during the seven years of their existence they had, he ventured to think, done some good work for the Association and for themselves. They occupied now in relation to the Association very much the same position as one of its sectional committees, and for that they were very largely indebted to Sir Douglas Galton, who had very keenly watched their proceedings, and had taken a great interest in them. The report of the committee was then submitted, and the different subjects which had engaged attention during the year were dealt with under the heading of the Association Sections to which they belonged.

In Section A the Chairman introduced the subject of Temperature Variations in Lakes, Rivers, and Estuaries, but no delegate specially interested therein being present, the Conference proceeded to that of Meteorological Photography. Mr. Clayden and Mr. Symons spoke of the desirability of photographs illustrating the damage done by whirlwinds and floods, and Mr. W. Watts (Rochdale) said that the Society he represented was taking up the subject. Mr. Symons mentioned the Helm Wind of Crossfell and the peculiar cloud accompanying it, photographs of which would be useful. Mr. Watts stated that a difficulty in photographing the effects of floods arose from the state of the weather during their occurrence, and Mr. Cushing (Croydon) exhibited photographs of a recent thunderstorm. The Chairman then remarked that Mr. Kenward (Birmingham), who was unable to be present, had sent a letter stating that for some years in Birmingham meteorological observations had been made in the building called "The Monument." Mr. Symons and Dr. Stacey Wilson discussed the mode of operations pursued at Birmingham.

After some remarks by Prof. Merivale, the Chairman, and Mr. Symons, the Conference passed on to Section B.

In Section B the Chairman introduced the subject of the conditions of the atmosphere in manufacturing towns, and Mr. Mark Stirrup (Manchester) and Mr. Watts (Rochdale) said that observations and experiments were being made thereon in their respective districts.

Mr. De Rance (Section C) stated that the 18th Report of the Committee on Underground Waters had been read that morning; that the Committee thought it should be reappointed, and that a volume containing abstracts of the previous Reports should be published. The Committee on Coast Erosion hoped to conclude its labours next year. The Committee on Erratic Blocks continued to do good work. The Local Societies could do much to assist this Committee by noting the position of boulders, and by preserving them from destruction. Prof. Lebour (Section C) postponed his remarks on Earth Tremors.

Mr. Watts (Rochdale) spoke upon the denudation of high-lying drainage areas, and some observations he had made on the amount of material brought down by flood waters, and the degree of protection given by heather, grass, and peat. Dr. H. R. Mill said that something had recently been done in Germany to ascertain the amount of sediment in river water. He thought it very desirable that a series of observations should be made to determine the relative values of woodlands and heather in protecting land, and was inclined to suggest the formation of a Committee for that purpose. Mr. Watts said he would be glad to give information as to the methods followed in Rochdale.

*Geological Photography.*—Mr. Arthur S. Reid (East Kent) said that Mr. Jeffs had asked him to speak on the work of this Committee. The number of photographs amounted to about 700. He exhibited a specimen volume of photographs, and explained the way in which they were mounted and bound. He thought it important that some uniform plan of photographing geological subjects should be adopted, and that the plates used should be orthochromatic or isochromatic. Mr. W. Gray then spoke of the photographic work done by the Belfast Naturalists' Field Club, and Dr. Stacey Wilson of that of the Birmingham Philosophical Society; Mr. J. Barclay Murdoch mentioned the course proposed by the Geological Society of Glasgow, and the Chairman recommended the use of orthochromatic plates.

The Chairman invited remarks on the destruction of native plants and of wild birds' eggs. The Rev. E P. Knubley (Yorks. Nat. Union) alluded to the Report presented to Section D on the disappearance of native plants and its causes. Mr. Watts said that two or three members of the Rochdale Society proposed to work at this subject. Mr. Mark Stirrup had a short paper by Mr. Leo. H. Grindon on the disappearance of wild plants in the neighbourhood of Manchester. The Chairman thought it might be read at the second conference. Mr. Cuthbert Peek remarked on the great difficulty of obtaining a conviction in cases in which ferns and other wild plants had been taken from private grounds.

*Destruction of Wild Birds' Eggs.*—The Rev. E. P. Knubley said terrible damage had been done by the destruction of birds' eggs. It was a serious matter, but it was very difficult to know what to do in regard to it. For instance, take the case of the great skua, which nested in the Shetland Islands; in 1890 it is said that not a single chick was reared on the whole of the Foula colony. Every egg was taken, and in 1891 all the eggs of the first laying were taken by the inhabitants and sold to dealers. Other rare birds which nested in the Shetland Islands were also persecuted. He had it on good authority that last year not more than two or three nests of the red-throated diver got off their young; and the black-throated divers were not more fortunate. One shilling apiece was given by dealers for the eggs of the red-throated diver and 10*s*. a brace for those of the black-throated diver. The whimbrels, which also nested on the same islands, had been reduced to about twenty pairs, and were likely to disappear. The red-necked phalarope was very much in the same circumstances. The dealers gave a commission to a local man, who was to get about 3*d*. a dozen for every egg collected of all sorts and kinds. The local men in turn got the herd boys to sweep the country of every egg they could lay hands on, big and little, and for these they got about 1*d*. a dozen. That was one way in which parts of Scotland had been regularly swept, and that in spite of such protection as the owners could afford. They had men who followed about strangers all day, but the natives took the eggs at night. Then, again, one might mention that one heard that in Edinburgh there was a gentleman who made it his boast that he had over 100 eggs of the golden eagle. What was to be done with a case of that kind? In some parts of England things were not any better. The nesting stations of the lesser tern which existed on the Fifeshire coast, the Lincolnshire coast, and at Spurn, in Yorkshire, would shortly disappear altogether. The oyster catcher and the Arctic tern had practically ceased to nest on the Lincolnshire and Yorkshire coasts, and the ringed plover was much scarcer than formerly. The redshanks and greenshanks had in many parts also been persecuted to the death. The nests of the bearded reedling, whose breeding station in the British Islands was the Norfolk Broads, had been to his own knowledge systematically poached for sale for a number of years. The only hope seemed to him to be in the creation of a public feeling against the extermination of these birds. It would be difficult to advocate anything like legislation. The most practical plan he had seen was this—that the Imperial Legislature should grant powers to the County Councils to protect known nesting-places in their districts for certain months of the year, say from April 1st to June 30th. Such a plan would be simple, and might be effective; but for one thing they should endeavour to do all in their power to help the owners and occupiers of land to protect the birds and their eggs during the breeding season. They might also see if they could not enlist the aid of the gamekeepers, who, with the farmers and proprietors, were beginning to find out that all birds were not their enemies. Collectors and dealers should also be discouraged. Just as he came there that day he had been told that 200 eggs of the stormy petrel had been taken from one island on the west coast of Ireland and given to one dealer.

Mr. E. B. Poulton, Oxford, said that if they discouraged the purchase of eggs, the trade of the dealer would soon cease.

Mr. G. J. Symons said it was an old saying that there would be no thieves if there were no receivers; and possibly there would be no dealers if there were no collectors. They should discourage as much as they could this spoliation of the nests of rare birds.

Mr. Mills, Chesterfield, thought it would do good if some small recognition were given to gamekeepers to assist in protecting the nests of the birds.

The Chairman asked if it would not strengthen the hands of Mr. Knubley if the meeting was to pass some resolution on the subject.

Sir Douglas Galton hoped any resolution of the kind would make an appeal to egg-collectors.

A Delegate suggested that it might do some good if the name of the Edinburgh gentleman with the 100 eggs of the golden eagle were published.

Mr. Whitaker suggested that the gentleman with the eggs should have the feathers of the birds also presented to him with the addition of a little tar. (Laughter.)

Mr. Knubley said he would submit a resolution at the next conference.

In Section E the Chairman remarked that last year there had been a discussion on the cost and antiquity of ordnance maps. Sir Douglas Galton said that a Departmental Committee was inquiring into the matter. Mr. Sowerbutts spoke of the badness of the teaching of geography in schools, giving examples from examination papers.

*Flameless Explosives.*—Prof. Merivale (in Section G) said he had nothing to report. The Durham strike had interfered with their arrangements, the proposed laboratories having been utilized as stables.

Under Section H Dr. Garson reported that there had been no applications to the Committee last year for aid in connection with anthropological exploration. He contended, however, that local bodies, when they meant to make such explorations, should give them notice. Valuable hints could be given them as to how they should proceed. Notice was also taken by Dr. Garson of certain anthropometric inquiries which were being conducted as to the effects on the health and physique of the public school system.

The Secretary, at the request of the Chairman, read an extract from a letter of Mr. Kenward, of Birmingham, giving particulars of an anthropometric laboratory established at Birmingham, like that of Mr. Francis Galton at South Kensington. Mr. Watts and Dr. Garson added a few remarks. The Chairman proposed that a claim should be made for the usual grant towards carrying on the work of the Corresponding Societies Committee, and the Conference adjourned.

SECOND CONFERENCE.—August 9.

The Corresponding Societies Committee was represented by Prof. R. Meldola (Chairman), and Messrs. Symons, Whitaker, Cuthbert Peek, Garson, Poulton, Rev. Canon Tristram, Sir Rawson Rawson, and T. V. Holmes (Secretary).

The Chairman made a proposal that in future some subject in which the delegates were generally interested should be brought as a short paper before the conference, such as the management of local museums, and the relations of County Councils to technical instruction, and the working of the Technical Education Acts. This was considered an excellent suggestion. Mr. Symons mentioned that he had arranged with Mr. Griffiths that delegates on the first day of the meeting of the British Association should be supplied with copies of the reports on subjects in which they were interested. This would give them longer time than they had at present to make themselves acquainted with the work which was being done. Mr. Robert Brown thought it would be a good thing if the printed report of the proceedings of the conference of delegates could be sent to the delegates earlier than at present. After some additional remarks from Mr. Cushing and the Chairman, the meeting proceeded to sectional work. In connection with the meteorological work in Section A, Mr. Symons spoke of the value of making observations on the temperature of underground waters, especially when new wells were being formed; and Mr. Whitaker remarked on the equally important point of the fluctuations of water in wells.

In Sections B and C there was nothing to bring before the Committee. When the work of Section D was reached an interesting discussion took place on the disappearance of native plants. Mr. Mark Stirrup began the discussion by reading a short note from an eminent Manchester botanist on the state of the district in that respect round Manchester. Mr. Sowerbutts, Manchester, said he believed the gentleman from whom the notes had been read was largely responsible for the eradication of rare plants round Manchester, inasmuch as he published a very charming book indicating where they were to be found. (Laughter.) Mr. Coates, Perthshire, said their Naturalists' Field Club, in publishing accounts of excursions or notices in papers of rare flora, only indicated generally where these were to be found. And Mr. W. Gray said that the Belfast Nat. Field Club acted in a similar way.

The Rev. Canon Tristram, Durham, next addressed the delegates on the question of making their field clubs more useful. He strongly advocated that these clubs should combine natural history, archæology, and geology; and that their function should be, not to destroy, but to preserve all that was rare and curious in a district. Lately their field excursions in many places had been too much of a picnic party. On the subject of local museums, the Canon argued that, as a rule, these should only contain objects of local interest, and he suggested that an approach should be made to the County Councils in order to get assistance for forming and keeping such museums in order. In regard to spoliation of districts of rare plants and ferns, the Canon advocated the formation of a public opinion on this question. On the question of the preservation from destruction of the eggs of rare birds, the Rev. E. P. Knubley, Leeds, moved the following resolution, which was seconded by Mr. E. Poulton, Oxford, and agreed to:—

"The conference of delegates, having heard of the threatened extermination of certain birds, as British breeding species, through the destruction of their eggs, deprecates the encouragement given to dealers by collectors through their demands for British-taken eggs, and trusts that the corresponding societies will do all that lies in their power to interest and influence naturalists, landowners, and others in the preservation of such birds and their eggs."

On this subject Canon Tristram also spoke, and put in a strong plea for the preservation of birds of prey—pointing to the case of the mice plague in Dumfries and Lanark shires as a result of destroying the balance of nature by wholesale killing of birds of prey. The resolution brought forward by Mr. Knubley was cordially adopted by the meeting.

In Section E Mr. Sowerbutts said that he should like to be able to communicate during the year with other delegates who were interested in geographical education.

In Section H Mr. E. W. Brabrook brought under the notice of the delegates the Ethnological Survey of the British Isles, which it was proposed to undertake by a committee of the Association on the suggestion of the Society of Antiquaries, the Folk-Lore Society, and the Anthropological Institute. Schedules would be sent down to societies, and he asked the co-operation of the delegates. Mr. Brabrook agreed with Canon Tristram in thinking that archæology should be one of the subjects of study of a field club. Mr. Whitaker said that in his district the Hants Field Club always did its best to protect antiquities; and Mr. Gray said that at Belfast the Field Club not only tried to preserve ancient remains, but also photographed them. Some of these photographs he exhibited. Canon Tristram mentioned the difficulties Field Clubs sometimes had with clergymen who were over-zealous in church restoration; and Mr. Tate (Belfast) alluded to the exertions of his society on that point; while the Chairman thought the clergy were not always as black as they were painted in this matter. Mr. Brabrook made some remarks on the best mode of making an archæological survey, pointing out the best sources of information, as regards the way of carrying it out.

Finally, Mr. Sowerbutts thought better terms might be obtained from the railway companies for delegates and others travelling to meetings of the British Association. The Chairman and Mr. Symons promised to represent the matter to the Council of the Association, and the conference adjourned.

## SCIENTIFIC SERIALS.

THE *American Meteorological Journal* for July contains the following articles:—On the appearance and progressive motion of cyclones in the Indian region, by W. L. Dallas. The object of the inquiry is to see whether the cyclones of the Indian Ocean originate from the unequal distribution of temperature over and above the earth's surface. The author favours the assumption that cyclones are a production of the upper atmosphere, and thinks that the evidence, although far from conclusive, goes to show that (1) cyclonic storms descend from and retreat to the superior layers of the atmosphere; (2) the whirl may travel along in the upper atmosphere, giving only faint indications of its presence at the earth's surface; (3) the movements of cyclones agree generally with what may be supposed to be the movements of a superior layer of the atmosphere.—S. A. Hill, a memoir, by Edna Taylor Hill.—The eye of the storm (conclusion), by S. M. Ballou. The cause of the clearness of the eye is attributed by the author to the deficiency of the air at the outer edge of the calm, owing to the deflective force of the earth's rotation and the upward and outward movements of the air before reaching the centre; the deficiency being supplied by a gradual settling of the air over the whole area, thus dissolving the cloud stratum and showing the blue sky. The author admits that the discussion of the subject shows the need of more observations concerning the phenomenon.—Recent efforts towards the improvement of daily weather forecasts, by H. Helm Clayton. The author states in a clear and interesting form the various rules which have hitherto been established, and draws attention to a law of averages discovered by Francis Galton, which might with advantage be used in weather forecasting, for, although only applied by Mr. Galton to heredity, it is probably universal. For example, if a storm during a given twelve hours has moved with a velocity below the average, the probability is that it will move with a velocity one-third nearer the average during the next twelve hours.—The other articles are—on the sea breeze, by W. C. Appleton, and temperature sequences, by H. A. Hazen, being an inquiry as to whether, if the temperature has been high or low for a certain period, we may anticipate the contrary condition shortly. The inquiry does not seem to have led to any result which could be turned to practical use.

*Bulletin of the New York Mathematical Society*, vol. i., No. 10 (New York, the Society, 1892).—The opening article is a review (pp. 217-223) of "An Elementary Treatise on the Differential Calculus by Joseph Edwards" (2nd edition, Macmillan, 1892), by Miss C. A. Scott. Whilst the reviewer praises the "lucid and incisive style," the well-chosen words and the well-balanced sentences, she does not fail to make a slashing attack upon details, and to point out "certain specially vicious features." There is considerable force in Dr. Scott's criticisms, and it is probable that a careful consideration of them will enable Mr. Edwards still further to improve his, in many respects, excellent treatise. The remaining short contributions are a note on resultants, by Prof. Haskell; and collineation as a mode of motion, by Dr. Bôcher (originally delivered as a lecture before N. Y. M. Society (pp. 225-231). The usual notes, new publications, and index close the first volume of this new mathematical venture.

In the *Botanical Gazette* for June, Mr. A. F. Foerste has an interesting paper, illustrated, on the Identification of trees in winter.—Mr. Charles Robertson continues his notes on the mode of pollination of American plants.—Mr. A. P. Morgan describes two new genera of fungi belonging to the Hyphomycetes, *Cylindrocladium* and *Synthetospora*.

In the *Journal of Botany* for July, M. G. Massee describes and figures a new marine lichen from the coast of Scotland, *Verrucaria lætevirens*, and continues his description of new species of fungi from the West Indies.—Mr. W. H. Beeby argues in favour of the occurrence of natural hybrids among plants. In the number for August, Rev. E. S. Marshall supports the claim of *Cochlearia grœnlandica*, and the editor that of *Sagina Boydii*, to be considered as British plants; both are figured. In the continuation of his Notes on *Potamogetons*, Mr. Arthur Bennett describes two new species, *P. Delavayi* from China, and *P. tricarinatus* from Australia.

The articles in the *Nuovo Giornale Botanico Italiano* for July are all geographical. Among them Dr. A. N. Berlese and Signor V. Pegliore give a monograph of the Micromycetes of Tuscany, 293 in number. The list includes several new species, and one new genus, *Phæopeltosphæria*, belonging to the Sphæriaceæ.—Signor S. Sommier commences a very interesting description of the physical features of the lower valley of the Obi in Siberia, with some account of its botany.

In Nos. 5 and 6 of the *Bullettino della Soc. Bot. Italiana*, most of the articles are also of local interest. Signor A. Jatta describes a new genus of lichens, *Siphulastrum*, from Tierra del Fuego.—Signor E. Baroni gives a full description of the anatomy of the fruit and seeds of *Eugenia myrtillifolia*.—Signor L. Re contributes an account of the spherites found in *Agave mexicana* and other Amaryllidaceæ.

## SOCIETIES AND ACADEMIES.

### Paris.

**Academy of Sciences**, August 22.—M. Duchartre in the chair.—Heat of combustion of some chlorine compounds, by MM. Berthelot and Matignon. The method of the calorimetric shell was employed for determining the heat of combustion of certain acid bodies. Monochloracetic acid, $C_2H_3ClO_2$, gave + 174·2 calories at constant volume, and + 173·9 at constant pressure, as the result of two combustions with camphor in presence of arsenious acid. The values obtained for trichloracetic acid, $C_2HCl_3O_2$, were + 106·3 at constant volume, and 105·4 at constant pressure. Trimethylene chloride, $C_3H_4Cl_2$, burnt in the presence of an equal quantity of camphor, gave a mean of 3·900 calories per gramme of the substance.—On glyoxylic or dioxyacetic acid, by the same.—M. Pasteur, in presenting to the Academy a work by Dr. Daremberg on Cholera, its Causes, and Means of Guarding against it, called attention to the following points: "Dr. Daremberg, in one of the principal chapters of his book, protests with great force against the pollution of the water-courses by drain-waters, and equally against the pollution of the soil by the distribution of these waters on the land under cultivation. He thinks that the germs of cholera, in the form of the bacillus which produces it, can remain living and virulent in the soil for several years, and eventually lead to the spread of the disease. Thus the cholera in the environs of Paris would have originated in cholera germs preserved since the last epidemic in 1884."—Thermo-chemical study of certain organic bodies with mixed functions, by M. Léo Vignon.—Quantitative determination of peptone, by precipitation in the state of peptonate of mercury, by M. L. A. Hallopeau. This method is claimed to be superior to the polarimetric, the calorimetric, and the absolute alcohol methods as being a complete precipitation admitting of more trustworthy measurements than the first, and less difficult than the second. A solution of peptone, which must be neutral or very slightly acid, is precipitated by a large excess of mercuric nitrate. The precipitate of mercuric peptonate, white, flocculent, and bulky, falls almost immediately to the bottom of the vessel. It is allowed to settle, and then poured on to a filter of known weight, washing with cold water until no precipitate is produced by sulphuretted hydrogen. The increase in the weight of the filter, dried at 106° to 108°, represents the weight of the peptonate of mercury; multiplying this by 0·666 gives the amount of peptone present. The mercuric nitrate is readily obtained from the "pure" commercial nitrate. Since this contains an excess of free nitric acid, which partially redissolves the peptonate of mercury, the acid must be removed by heating the nitrate with ten times its weight of water for fifteen or twenty minutes, filtering and heating to near boiling in a porcelain capsule. Then stir and add a few drops of carbonate of soda until the precipitate of oxide of mercury is no longer redissolved.—Etiology of an enzootic disease of the sheep, called Carceag in Roumania, by M. V. Babes. In the very fertile and often submerged islands of the Danube, where the shepherds from Roumania and Transylvania congregate, and where there are always hundreds of thousands of sheep, a disease occurs among them, especially in May and June, to which often a fifth of the herd will succumb, especially if it should have been brought thither from a distant pasture. It is an acute malady of a febrile nature, combined with hæmorrhage and œdema, and always with hæmorrhagic and sometimes necrotic inflammation of the rectum. In the red corpuscles of the blood are found round, immovable cocci, often undergoing subdivision. They are very similar to those observed in the corresponding cow-disease known in America as the Texas fever.—On a new chemical function of the comma-bacillus of Asiatic cholera, by M. J. Ferran. The growth of this microbe is always rapid and luxurious in the ordinary culture solutions; if they contain milk-sugar, it is incomparably more so; but the growth ceases entirely as soon as the solution becomes acid by the development of lactic acid, and the vitality of the microbe is extinguished. It seems reasonable to employ lactic acid in lemonade against cholera, and to aid its action by the anexosmotic power which morphin offers us; this substance would perhaps hinder the absorption of the toxic substances, and would prolong the action of the lactic acid by opposing its rapid elimination.

## CONTENTS.