THURSDAY, MAY 30, 1895.

THE SPIRIT OF COOKERY.

The Spirit of Cookery, a Popular Treatise on the History, Science, Practice, and Ethical and Medical Import of Culinary Art. By J. L. W. Thudichum, M.D., F.R.C.P.Lond. (London: Baillière, Tindall, and Cox; Frederick Warne and Co., 1895.)

THE scientific branch of culinary literature has just received in Dr. Thudichum's book an addition which cannot fail to attract the attention of those who give to the selection and preparation of food the consideration that the subject undoubtedly deserves. Of works which come under the denomination of kitchen text-books we have had of late years more than enough perhaps, but treatises on the culinary art from an academical and philosophical point of view have been few. "I could write," said Dr. Johnson, "a better book about cookery than has ever yet been written; it should be a book upon philosophical principles. Pharmacy is now made much more simple. Cookery may be so too. A prescription which is now compounded of five ingredients had formerly fifty in it. So in cookery. If the nature of the ingredients is well known, much fewer will do. Then, as you cannot make bad meat good, I would tell what is the best butcher's meat, the best beef, the best pieces; how to choose young fowls; the proper seasons of different vegetables; and then how to roast, and boil, and compound." The author of "The Spirit of Cookery" has evidently been guided by a similar recognition of the requirements of the case; and seeing that he is a member of a scientific profession which may be said to endow with special advantages those of the cloth who turn their attention to the study of food-stuffs and their treatment, it may be taken for granted that he has executed his task with competence and ability. His object has been "to produce such a system of general rules as will enable those who thoroughly master them to perform the principal culinary operations without reference to the frequently unintelligible records of the details of mere empiricism. These rules," continues he, "are based in the first place upon unimpeachable scientific data or fundamental truths which admit of no circumvention or compromise, and have to be obeyed under pain of certain failure. This obedience has at once its ample reward in clearing the subject of a mass of errors and delusions which disfigure it as a science, and impair its utility, and in placing into the hands of operators the means of attaining their object with certainty and elegance."

Strictly speaking, "The Spirit of Cookery" is a compendium of very useful information gathered, for the most part, from trustworthy sources; its theories are, generally speaking, sound, its principles excellent, and its rules good; but it can scarcely be called a practical work from an executive point of view, for the author rarely allows his descriptions of a process or a dish to go further than a mere sketch. Each branch of the art is nevertheless dealt with, and the principal methods of cooking, if not absolutely worked out in detail, are at all events carefully analysed.

After a glance at the objects of cookery, its literature in the past and present, the requirements of the kitchen, and the processes which appertain thereto, Dr. Thudichum comes to the subject of soup-making. That this is haustively treated, may be gathered from the fact ha more than one hundred pages are devoted to it. The salient feature of this discussion is an exposition of wha the author calls "the complete fallacy of the proposition that bones can either make, or help to make, any liquid that can have any value in cookery." This argument new, or rather let us call it a revival of an old controversy which has been forgotten. That a scientific writer as earnest and experienced as Sir Henry Thompson should have acknowledged, comparatively recently, the value of bones in cookery, in his work "Food and Feeding," would in itself justify our questioning Dr. Thudichum's rather peremptory dictum on this point. Speaking, however from absolutely practical experience to the contrary, we are forced to deny the accuracy of the contention. As a matter of fact, we have been in the constant habit of producing fragrant and savoury broths from the bones poultry and game, both cooked and uncooked, which we have found very valuable in sauces; while in soup-making our working has proved that after six hours cooking on the lines of the *pot-au-feu*, a very perceptible gelatinous ele ment is produced from the bones, which contributes to the quality of the stock. In all circumstances it is of course essential that the bones be broken as small as possible and in the case of those of poultry and game that they be pounded roughly in the mortar. The latest method, viz. that of setting the bones of meat and carcases of poultry intended for the stock-pot to be browned in the oven before addition, is an undoubted improvement, to which the author of "The Spirit of Cookery" would not object perhaps, the addition being made after the first stage of the broth-making, *i.e.* after the liquid (containing the meat alone) has been permitted to come to boiling point for the first time, simmering being conducted afterwards for the allotted period.

Touching the alleged costliness of extracting gelatine from bones, we think that Dr. Thudichum has lost sight of the fact that, inasmuch as kitchen fires are always burn ing, space can generally be found on the hot-plate for a vessel containing bones where it can simmer without any additional expense in the matter of fuel. We have found that in this way, with the aid of a few vegetables and herbs, very useful broths can be made for the moistening of stews, *purées*, &c., while it is well known that at Aldershot good wholesome pea and lentil soups are made on a bone-stock basis, which form an addition to the soldier's dietary that is much appreciated, and for which no better medium, considering the limited resources of the military kitchen, could be concocted.

We confess that we are surprised at Dr. Thudichum's apparent indifference to vegetables as a factor in the production of a good *bouillon*, for constant practice has satisfied us that all its fragrance and a large share of its pleasant flavour come to the *pot-au-feu* or soup from a very careful proportioning of the vegetables to the meat by weight. In a case of this kind it is idle to speak of "an onion" or "a carrot." We also wonder that he should mention the now obsolete method of clarifying broths with whites of egg and lemon-juice. The object is now attained by raw beef reduced to a pulp, mixed with both the yolk

and white of egg, by which the loss of flavour by the old process has been overcome.

In regard to the author's condemnation of the statement that "the French cook makes excellent and nutritious soup out of materials which the English housewife throws away as useless, while her *pot-au-feu* is composed of stray scraps carefully husbanded, which cost her nothing, but which when skilfully combined constitute a useful and inexpensive food," we would observe that the use of the word *pot-au-feu* is obviously a mistake, but that had *marmite* been substituted there would have been no cause for objection. What says Sir Henry Thompson? "This (the *pot-au-feu*) is a different thing from the common 'stock-pot' of the French peasant, so frequently termed a *pot-au-feu* and confounded with it. The primary object of the 'stock-pot' is to make a decoction for soup—of animal food if possible—and every morsel of flesh, poultry, trimmings from joints, bones well bruised, &c., which are available for the purpose are reserved for it." This turning to account of scraps is, to our thinking, by no means a "delusion," but a thing that should be encouraged in every economically conducted kitchen. In nearly every other respect we are able to concur with Dr. Thudichum. He is undoubtedly right in pronouncing against the so-called clear soups of restaurants and hotels, in denouncing the free use of wine to smother defects, and the heedless use of cream and butter in *potages liés*, *bisques*, and *purées*.

Turning to his precepts concerning processes, we also find much that we can accept as excellent. Here and there are points, of course, in regard to which the best authorities differ. We would never put fresh meat or poultry, when either has to be cooked for the table by boiling, into *cold* broth or water, having found the method advocated by Sir Henry Thompson better than any other, viz. to immerse the joint or bird in a boiling medium to solidify or coagulate the albumen which pervades the outer layer of meat, and after five or six minutes at that temperature to reduce the heat beneath the vessel to simmering point, never exceeding 180° F. We apply the same principle to the preparation of fish with equally satisfactory results, having proved the accuracy of Sir Henry's axiom that boiling fish in the ordinary manner is of all systems the most wasteful and unsatisfactory. There can be no doubt, though it is contrary to Dr. Thudichum's theory, that the greatest benefit is to be derived from broth made from fish-bones and "cuttings" of white fish, assisted by herbs and vegetables. This we employ as a moistening in our method of fish-poaching, and consider it superior to *court bouillon* with its excessive amount of wine, which Dr. Thudichum very properly condemns.

There is another point on which the doctor's advice is open to question. We refer to his definition of braising as a species of "roasting." Surely this is contrary to the teaching of the best authors. "Braiser la viande," says Dubois, "c'est la cuire à l'étuvée dans un bon fonds de façon à l'atteindre complètement, en lui conservant ses sucs nutritifs." How can a piece of meat be said to be "roasted" when it is moistened in the *braisière* with *bouillon* "*à hauteur*"? The fact is there are varieties of braising. The French cook adopts one method, for instance, for white, and another for brown meats, and, as we read in "Food and Feeding," these vary in treatment. In all the predominating feature is stewing, though the part of the meat exposed by the gradual reduction of the moistening broth may be browned by heat transmitted downwards from hot cinders on the lid of the vessel. The meat is really part stewed, part steamed, and superficially toasted. Dr. Thudichum says nothing of the amount of moistening *mirepoix* necessary for braising, the preliminary browning of the meat, the *couche de racines et oignons émincés* on which it should be placed, the reduction of the first partial moistening, and then the final filling up level with the top of the meat. Without these instructions, how is the student to have placed in his hands "the means of attaining his object with certainty and elegance?"

But the few points to which we have taken exception are of no great consequence in a work which covers as much ground as "The Spirit of Cookery." Some of them might perhaps have been passed over as appertaining to practical work, which Dr. Thudichum may not have intended to explain minutely. There is, as we have said, a great quantity of information which is beyond criticism, plenty of advice which is full of common sense, and a painstaking classification of the principal sections of the art which cannot but be useful to students of cookery. The scientific principles, by which all intelligent work should be guided, are very clearly laid down. The notes on the preparation of food for the sick-room and the camp are excellent, and all who recognise the necessity of encouraging cookery for the palate rather than for the eye will concur in Dr. Thudichum's observations regarding the vulgar folly of over-ornamentation.

WEATHER OBSERVATION AND PREDICTIONS.

Meteorology, Weather, and Methods of Forecasting, Description of Meteorological Instruments, and River Flood Predictions in the United States. By Thomas Russell, U.S. Assistant-Engineer. (New York: Macmillan and Co., 1895.)

Results of Rain, River, and Evaporation Observations, made in New South Wales during 1893. By H. C. Russell, B.A., C.M.G., F.R.S. (Sydney: C. Potter, 1894.)

THE first of these two books has for its aim the instruction of those who are interested in the weather, and wish to make forecasts on scientific lines, or to understand the principles which underlie the predictions issued by responsible authorities. The expression "scientific lines" is, perhaps, not justified. Experience plays, probably, as large a part as science. The knowledge of the character of the weather that has followed certain definite atmospheric conditions in former cases, is to some extent a guide as to what will happen when those conditions again present themselves, and possibly as true a guide as any result based on the wider knowledge of the general circulation of the atmosphere. Especially has the particular study of the direction and rate of motion of cyclonic areas, with their attendant phenomena of rain, and change of temperature permitted a greater amount of security in weather predictions for

short intervals of time. But this great certainty is based upon experience and observation, rather than upon purely thermo-dynamic principles.

The evidence of decisive progress in forecasting is wanting. Nor does the author hold out a very sanguine hope of the possibility of issuing in the immediate future successful weather forecasts over large districts from a central bureau. There are not more than six to twelve occasions, in the course of a year, for any part of the country, he tells us in the preface, "where successful predictions can be made, and for some places successful predictions are never possible." "Successful continuous predictions for every day are not possible." This is the opinion of one who apparently has ample means of forming an adequate judgment. It is the outcome in a country where the opportunities of framing forecasts are many and favourable. The service is well supplied both with funds and officers, the vast telegraphic system of the country is at the disposal of the Weather Bureau, the area over which the data are collected is extensive enough to enable the whole development of a storm to be watched and reported, while the favourable situation of Washington, in the extreme east of the continent, is a point not to be omitted. Yet after years of trial, the opinion of one who apparently has official connection with the system, or is at least well supplied with information from the Bureau, is, that the complete solution of the problem is not only impossible, but is only practically effective on the average less than once a month. If this be the result under favourable conditions, what, it may be asked, is the system worth in England, where our insular position cuts off the supply of any information from the West, the direction in which our principal storms approach, and the intelligence from the East has to be supplied by the courtesy of many nationalities, and more or less hampered by different telegraphic systems.

To return to the book, however, which in some respects is a little disappointing. There is an occasional appearance of hurry in the compilation of the work, which has sometimes prevented the author expressing himself with sufficient clearness, and with the reservations which are sometimes necessary. For instance, we are told, on p. 3, that there is less oxygen in the air when the wind is from the south, than when the direction is north. This may be true for the district in which the author lives, but as there is no indication where this particular locality is situated, and the preface is not even dated, we are left to infer that the remark applies to the earth generally, which can scarcely be correct. Again, on p. 184, in the description of secondary low pressures, occurs this sentence. "In Fig. 29, thunderstorms are very apt to occur with secondary low pressures." This statement is certainly a puzzle. On p. 190 we are referred to a map on the adjoining page. There is no map there, although this map is referred to in the list of illustrations. Readers will, however, find it at the end of the book. Sometimes, too, facts which are easily verified are not quoted with accuracy. On p. 5, the dates of the earth's perihelion and aphelion passage are given as December 23 and June 21 respectively. The area of the Caspian Sea is given on p. 101 as over 200,000 square miles, and on p. 201 as 180,000 square miles. But these and many other small blemishes can be removed in a future edition.

We are more concerned to look at the work as a whole, and to consider what special service is it likely to render among the host of meteorological treatises that are continually appearing on one or other side of the Atlantic We have, of course, the ordinary chapter on meteorological instruments; we have the cloud classification; we have the description of the rain and hail and snow, that too frequently make life unpleasant; together with all the winds that blow, or are likely to blow. And the oft-told tale, it must be confessed, is repeated in rather a jerky manner, partaking of something of the manner of a dictionary, wherein one is treated to a collection of definitions. The last chapters of the book are undoubtedly the best. There the author has something to tell us of processes not generally described in books like the present. To the charm of novelty is added the advantage that we feel we are listening to a practical expert, who can tell us all that is worth knowing about river-floods and overflows.

We come now to the second volume under notice. Fortunately in this country we are not frequently troubled by the overflow of rivers and the consequent destruction of property on the banks, and therefore the subject with us receives scant attention. Probably for this reason the report of the Meteorological Council is silent on such matters, though at times like last autumn, the inhabitants of Eton, Oxford, and the Thames Valley would have been gratified by a timely warning. It may have been that warnings were given, but from the absence from the Report of any mention of machinery adapted to this end, one would infer that this is an inquiry the Council do not consider worthy of their attention. Far different is it with the Astronomer at Sydney, whose latest report is mentioned at the head of this notice. There the subject is forced on the attention of scientific men; and on the unscientific, too, if he happen to live in a district where, as Mr. Russell reports, the rise of a river was so rapid that in less than two hours a part of a town was covered to a depth of three or four feet, and the people were glad to escape with their lives at the sacrifice of their property. Mr. Russell has great difficulties to contend with. He has not only the small equipment peculiar to a comparatively new colony, imperfect data, and the slow accumulation of facts, but the first warning of the rise of a flood may occur in uninhabited or thinly populated districts, with which communication is slow and uncertain. The American Bureau has not to struggle against these disadvantages, but the problem depends upon so many variable quantities that the complete solution is practically impossible.

The author of the treatise on meteorology lays it down that very little connection can be traced between meteorological laws and river floods, except perhaps in cases where the quantity of water is dependent upon the melting of the snow. In temperate zones, floods occur without any very noticeable great rainfalls. Intermittent rain may cause a river to rise very slowly, and almost imperceptibly, till it be bank-full, when a moderate rain makes the river overflow. Neither is there any decided connection between the river slopes and velocity, so that

the velocity of the flow cannot be computed from a knowledge of the slope. The character of the ground over which the rain falls—that is, the degree of permeability—is a fruitful source of uncertainty in predicting the probable rise. There are many other obvious sources of error, so that no one can be surprised to learn that the theoretical determination of a river rise cannot be treated as a problem in hydraulics. Without a system of gauges along the river, predictions are scarcely possible. With their employment, the problem becomes more or less one of practice and experience. This remark may be illustrated by showing how the rise of the river may be predicted for Pittsburg, a place where the observations of rainfall simply, are of little use in foretelling with accuracy the height to which the river will rise. The rise is predicted from observations of the rise at stations above the town, or on tributaries. Gauges are maintained at Oil City, Brookville, Confluence, Rowlesburg, Weston, and Johnstown. These towns lie both north and south of Pittsburg, and the greatest separation may amount to two hundred miles. The height of the river and its tributaries at each of these places not only exercises a different effect at Pittsburg, presumed to be proportional to the square root of the areas drained by the rivers at each station, but the height of the river at Pittsburg itself has also to be taken into the account. The higher the stage at Pittsburg, the less will the river be affected by the same rise at the upper stations. "It is assumed that the rise multiplied by the mean stage during the rise is comparable throughout different stages for Pittsburg." The factors deduced from the area drained vary from 2·1 for Oil City to 0·1 at Weston, and the observed rise between two consecutive days multiplied by these factors can be easily tabulated to exhibit the expected rise at Pittsburg. Mr. Russell has worked out some examples to show the successful application of this method. On February 16, 1891, the calculated height of the stage was 31·3 feet; the observed, 32 feet. On February 6, 1893, the calculated height was 23 feet; the observed, 23·1. It does not appear how far these examples are illustrative of the success attending the general application, but the system seems to leave nothing to be desired. The author takes us regularly down the Ohio River to Cincinnati, Louisville, and Cairo, the junction with the Mississippi, illustrating the modifications which varying conditions may render necessary. The Missouri and the Mississippi also receive their share of attention, and the book forms a very practical guide for those interested in such matters. The value of the whole process rests on the provision of a sufficient number of well-placed gauges, and a long series of observations, from which may be learnt the probable behaviour of the river under all circumstances. It is in this direction, apparently, that Mr. Russell, of Sydney, finds his opportunity, and the great mass of facts that he is collecting will be of the greatest use as the colony becomes more thickly peopled. We do not understand that he has yet arrived at the stage of predicting with accuracy and confidence the vertical rise and fall of the rivers over which he watches. His part, if apparently less interesting, is not less useful; and he is to be congratulated on the spread of his system of observations and his successful overthrow of many difficulties.

AN ALBUM OF CLASSICAL ANTIQUITIES.

Atlas of Classical Antiquities. By Th. Schreiber. Edited for English use, by Prof. W. C. Anderson, of Firth College, Sheffield. (London: Macmillan, 1895.)

THIS work should hardly be called an Atlas, since, though it contains a vast amount of matter, the disjointed arrangement is by no means that of an Atlas. The abundance of illustrations, however, makes the book exceedingly valuable to the student.

But although there may be, and is the *facundia*, the *lucidus ordo* is frequently wanting. Still, by the help of the excellent trilinqual index, supplied by the English editor, this defect is much remedied.

The book should also be judged by reference to what it aims to be. If considered as a work addressed to artists or specialists, great deficiencies in the technical execution of the plates would have to be complained of; but it should be looked at mainly as a series of rough sketches of ancient life as revealed to us through art, for the instruction of students in literature and commencing archæologists, or as a general book of reference. The above remarks refer entirely to Herr Schreiber's plates; nothing but praise should be accorded to Prof. Anderson as translator and expositor. The aim of the work is sufficiently stated in the preface.

"There springs up a desire for facts—facts as to the life of the ancients, their laws and their customs, their beliefs and their cults. Because no fact is despicable from the point of view of science, we further look into their daily life—the fashion of their dress and their houses, the arrangements of the theatre and the market-place. And since no source of facts can be so perfectly trustworthy as the works of contemporary art, those works gain an interest, arising not merely from their own beauty, but as the crystallisation of the visible life of the people, a mirror of their thought preserved to us like many actual Greek mirrors in the graves of the dead."

The series of plates begins with theatres and acting; and with respect, at least, to Roman or Romanised Greek theatres, they are very fully illustrated, both as regards the fabric and the actor, but there is a remarkable absence of the characteristics of the Greek theatre as distinguished from the Roman, which have been much under discussion of late years. Plate iii., Fig. 3, however, introduces a representation of the raised stage or λογεῖον, which, if the date ascribed to it in the text be accurate, bears strongly against the theory that all the action took place on the level of the orchestra until the raised *pulpitum* was introduced by the Romans. In Plate ix. we see that some of our modern building appliances have been in continuous use since classical times. In Plate x., Fig. 3, after Durm, the contrivance of the wooden blocks and pin in the joints of the columns of the Parthenon is not accurately shown, and it is therefore not surprising that in the text a difficulty is hinted at. The smaller shallow circle was not provided for the purpose of receiving a wooden cylinder to turn in. This was the function of the smaller pin or cylinder of hard wood, which was centred in the square wooden blocks which were fixed in each bed of the joint. The shallow circle in the stone was provided to receive the detritus caused by rubbing the stones together. In the same plate ornament is shown on the echinus of the Doric capital.

Decoration of this member is, to say the least, extremely doubtful. Two valuable plates follow of Olympia, in plan and perspective. The restored view of the Acropolis of Athens, however, is hardly so successful. The drawing is coarse, and it gives a very inadequate idea of the way in which the Acropolis dominates the valley to the south of it. In Plate xiv., Figs. 1 and 2 (the latter from a vase) are interesting from their connection with the Eleusinian mysteries. As many of the illustrations are necessarily taken from vases, it would have been serviceable for beginners if some representation with a short description of different kinds of vases, such as the cylix, the lecythus, &c., had been given. Plate xv. shows that votive offerings of models of diseased limbs and other bodily members, suspended at the altars of favourite saints, had their origin in classical times. In its reference to Fig. 2, of Plate xviii., the text gives a valuable reference to the recent discoveries at the Pantheon, which were lately made under the direction of the French architect, M. Chedanne.

Plate xix., Fig. 15, is interesting as showing that the division of the heavens into different *houses* of the mediæval astrologers had its origin in classical augury. Plates xx. to xxiv. are devoted to athletics. In Plate xxii. are illustrations of the method of throwing javelins by means of the *amentum*, a kind of sling attached to the shaft. Some are shown as being thrown overhand, and others underhand, and a curious method by which aid was given to jumping by means of weights held in the hands. Plates xxvii. to xxxiii. are devoted to games and arena combats. Fig. 4 in the first of these plates, from a wall-painting from Pompeii, is an interesting illustration, described thus in the text: "This painting is unique as a contemporary picture of an historical event. Tacitus ("Annals," xiv. 17) mentions a riot between the people of Nuceria and Pompeii which arose out of a gladiatorial show given by Livineius Regulus. It began with mutual taunts, and then stones were thrown and weapons used. The Pompeians were naturally the stronger party, so that many of the Nucerians were badly wounded, and several slain. As a consequence, Nero stopped the games for ten years. The painting shows the fighting going on in and about the amphitheatre." Fig. 1 in Plate xxxiii., from Brescia, shows that combats with wild beasts were still practised in 530 A.D. in Italy. In Plate xxxiv. we have representations of early Greek warriors and weapons, and also, but of later date, a besieged city from the Nereid tomb in the British Museum, and in Plate xli. a useful diagram showing the arrangement of a Roman camp. In the same and following plates Roman soldiers and their armour are well given, and Greek and other helmets. Young students of Cæsar "de Bello Gallico" will be thankful for the illustrations of the Rhine Bridge in Plate xliv. In Plate xlvi. is the difficult subject of the trireme and its oars. It contains only one original document (Fig. 8), namely, the sculptured relief found near the Erechtheum; the other figures are reconstructions in which the difficulty does not appear to have been grasped. The ancient relief certainly implies oars of different lengths; thus much cannot be controverted, but the only possible means by which the rowers on the different banks could have kept time would have been by an inversely corresponding difference given to the surface of the blades of the oars, which the reconstructions do not show.

Plates xlviiii. to li. are occupied by town gateways and fortifications. Then follow private houses, aqueducts, bridges, baths, and calculating boards. In Plate lxii. ancient sundials, which divided the day from rising to setting sun into twelve hours, irrespective of the difference of their lengths in summer or winter. Then follow various agricultural operations, and in Plate lxvi. a warehouse scene, the weighing silphium, a plant used in medicine, grown in Cyrene; a group of decidedly Egyptian type. Then ovens, Plate lxvii., for baking bread; Plate lxviii., for pottery. From Plates lxix. to lxxvi., various arts and crafts. The triclinium is shown and explained in Plate lxxvii. Then follows jugglery and games. Plate lxxxi. shows bridal scenes, followed by female dresses and costumes. In Plate lxxxvii. is a relief from the arch of Constantine, introducing several details of the Roman forum. Plate lxxxviii. follows with a graphic scene of civic life from a wall-painting of Pompeii. Then school scenes are illustrated with wax tablets and writing materials; there is also a pair of proportional compasses, having much analogy to the instrument in modern use. Plates xcii. A and xciii. tell the "tale of Troy divine," from a relief of the Augustan age, representing the Iliupersis, found near Bovillae; and the work concludes with a very complete series of burial scenes—that is, of interment—for there are no representations of cremation. But notwithstanding this and some other omissions, the hundred crowded plates of this volume, from which we have made only a few extracts, contain a vast store of objects for reference, and they are all very much enhanced in value by the descriptions and notes with which Mr. Anderson has enriched the book.

A DESIDERATUM IN MODERN BOTANICAL LITERATURE.

A Hand-book of Systematic Botany. By Dr. E. Warming, Professor of Botany in the University of Copenhagen. With a Revision of the Fungi, by Dr. G. Knoblauch, Karlsruhe. Translated and edited by M. C. Potter, M.A., F.L.S., Professor of Botany in the University of Durham College of Science, Newcastle-upon-Tyne. (London: Swan Sonnenschein and Co., 1895.)

IT is a curious, and not altogether a pleasant reflection, considering the activity which has been displayed by the botanists of this country within recent years, that we should still be largely dependent on foreign sources for our text-books in more than one main division of this particular science. It is doubtless true that the books are sometimes more or less edited, before they are presented to the English student, but still one can hardly help feeling that an entirely home-grown article, if issuing from first-rate hands, would prove a most welcome change.

It is with somewhat mixed feelings, then, that we greet the appearance of Prof. Warming's "Hand-book of Systematic Botany" in its English form. Moreover, we feel a little inclined at the very outset to quarrel with the title of the book before us; a *hand-book* of systematic botany embodying critical morphological discussion, is exactly what is now wanted—something which may be to us what Eichler's celebrated *Blüthendiagramme* was, and

indeed still is, to our German neighbours. But one can hardly allow that the present volume rises above the rank of a text-book, and of these we have plenty with us. Not that it is intended to depreciate the value of Prof. Warming's book; it is chiefly the question whether an increase of this particular kind of book is just now wanted at all, whilst there is no question whatever but that a genuine 'hand-book" is very much needed indeed. As far as the work goes it is very good, at least in its manner of dealing with the Angiosperms, but it does not go far enough. Thus the order Cucurbitaceæ, as an example taken at random, is dismissed with something less than four pages, and yet the plants included in this order abound in interesting characters. To treat these and others of a similar nature in a brief dogmatic fashion is to abandon the most interesting side of the subject, to say nothing of the educational opportunities which have been missed. But notwithstanding these features of the work, which, professing as it does to be a hand-book, appear to us to be serious defects, we readily admit that, taken as a whole, the account given of the flowering plants is one of the best existing in the English language. The lower groups of plants are less satisfactorily dealt with. In the Fungi, the general method of arrangement followed is that based on Brefeld's researches, but the difficulties connected with *Eremascus* are not touched upon. It may be doubted whether the student will gain a very clear idea of *Oidia*, which, he is told, must be distinguished from "true chlamydospores." The definition runs thus: "The former (*Oidia*), are more simple, the latter are somewhat more differentiated form of carpophore fundaments, which serve for propagation in the same manner as spores." But exactly wherein the difference really consists we seek in vain to find. A purist might object to the expression "brand"-fungi, which is used instead of the more familiar one of smut-fungi; a practical farmer, in this country at least, would also probably smile at the description given of the method of application of blue vitriol as a preventative of the disease caused by these organisms in cereal crops.

The treatment of the Muscinæ strikes us as far too cursory, especially in regard to the considerable amount of work recently done in connection with these plants. The brief statement of Celakovsky's view as to the homology of the moss sporogonium is only calculated to confuse the mind of a student by introducing purely idealistic notions, and its value without a full explanation is absolutely inappreciable. The catalogue of "orders" of mosses, given on pp. 196-197, is also particularly depressing.

The treatment of the vascular cryptogams is decidedly weak, and this is the more surprising, considering the activity which has long been displayed in the investigation of this division of plants. The general description of the embryo, given on p. 201, only applies to a few families, and is not by any means true for most of the groups. Again the usual mistake is made as regards the sporangium of Isoëtes, which is stated to be divided into "compartments one above another"; the fact, of course, being that it is not divided into "compartments" at all, as an inspection of a tangential section will suffice to show.

It is surprising, in a work issued in 1895, to find the old erroneous description of the germination of the gymnosperm pollen-grain still maintained. We note, however, with satisfaction that a popular mistake (which appears also in the text) is corrected in an editorial note, in which it is rightly stated that Cycads commonly *do* branch in a state of nature.

From what has been said, it will be clear that the treatment of the lower plants is inadequate, and it is to be regretted that Prof. Potter did not see his way to using his editorial discretion more freely. It is, however, easy to find fault with most books; but we have already said that, as regards the latter half of the volume, it is deserving of commendation, and we may add that it is well illustrated, and that, further, it contains, in the form of an appendix by Prof. Potter, a brief account of the chief methods of classification which have been used in arranging the members of the vegetable kingdom.

OUR BOOK SHELF.

The Noxious and Beneficial Insects of the State of Illinois. Eighteenth Report of the State Entomologist. Seventh Report of S. A. Forbes. For the years 1891 and 1892. (Springfield, Ill., U.S.A., 1894.)

THIS report is mainly devoted to insect attacks affecting "Indian corn" (sometimes known with us as "maize," in the U.S.A. shortly as "corn"), and coming from the trustworthy and well-qualified pen of Prof. Forbes, will be of much service in the country of the crop dealt with, and, in points noticed regarding such of these "pests" as are of very similar habits with our own, may be studied here with much advantage.

The "Monograph of Insect Injuries to Indian Corn extends to 165 pages, dealing with insects of very various kinds, including amongst them what, without entering here on their scientific appellations, may be generally described as ants of various kinds; beetles, including allies of our turnip flea beetle, wireworms, with click beetle parents, and chafers, with their grubs (truly noted as "the immemorial enemies of agriculture on both sides of the Atlantic"); aphides, or plant lice of various kinds, and some other insects.

The information is the result of ten years' investigation of the economic entomology of the Indian corn plant by the official entomologist of Illinois, joined to such additions from published matter as it appeared desirable to embody with his original observations; and in the words of the writer, whilst a portion of the information is such as he hopes will be "intelligible and practically useful to the actual tiller of the soil," he has also incorporated with this, for "the special benefit of the entomologist, more detailed and thorough-going discussions of the insects themselves, and of their life-histories, habits, and injuries, together with descriptions of the species in all stages as yet recognised."

These minute descriptions, especially of the early stages (so important to the economic entomologist, and so difficult, too often, to obtain) in themselves give the work a high value, and in the practical part there is much to be studied with great benefit. To give a single instance—the indifference of wireworms to various kinds of poisons prepared for their consumption on seed placed for their use (p. 49).

The report is greatly to be recommended to the study of economic entomologists, and its value is added to by fifteen well-executed full-page plates of many of the insects referred to, also by an exhaustive index of thirteen pages, so complete and well arranged as in some instances almost to give headings for a life-history of the insect referred to.

E. A. O

LETTERS TO THE EDITOR.

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

The Origin of the Cultivated Cineraria.

REFERRING to records of the history of cultivated Cineraria, I found (1) that considerable sports, or seedlings presenting notable and striking variations, arose in the early days of the "improvement" of the Cineraria; (2) that there is evidence that the improved varieties were of hybrid origin. I concluded, therefore, that Mr. Dyer's statement that our Cinerarias have been derived from *C. cruenta* "by the gradual accumulation of small variations" was misleading in two respects. As we have now had the benefit of a fuller statement of Mr. Dyer's case, I ask leave to explain why it is that I still hold to my original conclusion.

Meanwhile, however, Prof. Weldon, intervening, has offered an apparently sustained criticism of my evidence, which to those no better prepared may have a formidable look.

We will first examine some of Prof. Weldon's minor points. In preface let me say that I do not contend that *no* sports or named varieties have ever been believed to have arisen directly from *cruenta*, or from plants so-called (for, as Willdenow hinted,[1] the name may have been misapplied to hybrids in the past as now); and, indeed, I gave Drummond's words that his *cruenta* "sported freely from seed."

Something was made also of the wise caution which Burbidge gives in his general "Introduction" (p. 118), putting the reader on his guard against specific assertions as to the origin of hybrids. I mention, therefore, that I have received from Mr. Burbidge a letter warmly supporting the opinion given in the body of his book (p. 249) that the Cinerarias are of hybrid origin.

But now for what Prof. Weldon takes to be the real strength of his attack. He says that I omitted passages proving that according to contemporary opinion many of the named varieties cultivated between 1838 and 1842 "were not hybrids," but were "believed to be pure-bred *cruenta*." Upon what grounds this statement has been made, the reader shall now learn, not perhaps without astonishment.

The passage on which he chiefly relies is taken from Mrs. Loudon's article (*Ladies' Mag. of Gard.*, 1842, p. 111), to which I referred for the statement that in the writer's opinion the first important departure in the improvement of the Cineraria was made when Drummond hybridised *cruenta* with *lanata*. She goes on to say that, "since that time, numerous experiments have been made and hybrids raised" from several species. Next, that "some of the most beautiful Cinerarias now in our greenhouses, have been raised by Messrs. Henderson, Pineapple Place, particularly *C. Hendersoni* and the King, both raised from seeds of *C. cruenta*." This is the passage I omitted. Prof. Weldon says that this "passage clearly shows that in the writer's [Mrs. Loudon's] belief, the hybrids produced by Drummond and others, had not given rise to two at least of the named varieties of her time," and that she believed the King and *Hendersonii* to be descended from *cruenta* alone. This Prof. Weldon tells us is certain

Now, were we even bounded by the limit Prof. Weldon has set to his own researches on this question, we might hesitate to assume that whenever it is not expressly declared that a plant is a hybrid, we may be sure that the author thought it was pure-bred. As it happens, however, I can meet the charge with a weapon sturdier than the fine point of "dialectic." The answer is quite simple and curiously complete.

I shall now prove that both the King and *Hendersonii* were well known as hybrids both to Mrs. Loudon and to others. Let me point out:

(1) That the words say that the King and *C. Hendersonii* were raised from *seeds* of *cruenta:* as to the *male* parent, nothing is there said.

(2) That even if the evidence ended here, a discriminating reader might have suspected (what I shall presently prove) that Mrs. Loudon's *particular* statement about the King, *Hendersonii*, &c., is merely meant as an expansion of her previous *general* statement that since Drummond made his beginning numerous hybrids had been raised.

(3) That, were the matter doubtful, other passages in Mrs. Loudon's works prove this to be her meaning. For in *Ladies' Comp. to Flower-Gard.*, 1849 (s. v. Cineraria), she states, "the finest hybrids are *C. Waterhousiana*, *C. Hendersonii*, and the kind called the King." Again, in *Ladies' Flower-Gard., Greenho. Plts.*, 1848, p. 178, speaking of the woolly leaves, &c., of *lanata*, she says, "these peculiarities are found in all the numerous hybrids that have been raised from it. Perhaps the most ornamental of these is the hybrid called the King."[1] Of this, therefore, I presume Mrs. Loudon believed *lanata* to be the father, *cruenta* the mother.

(4) Lastly, that in order to have learnt that the King and *Hendersonii* were "between 1838 and 1842" considered to be hybrids, Prof. Weldon need not have gone far. He tells us he has read the articles on *C. Webberiana* (*Paxt. Mag.*, 1842, p 125) and on *C. Waterhousiana* (*ibid.*, 1838, p. 219), to which I gave references. Will it then be believed that in the first of these very articles *the King is referred to by name as a notable hybrid;* and that in the second article, "*C. cruenta*, var. *Hendersonia*" is with others named as *one of* "*the hybrids raised and grown by Messrs. Henderson, Pine-apple Place?*"

I do not know if it is wished that I should further refute Prof. Weldon's charge of "want of care in consulting and quoting the authorities." I am not unprepared to do so. I shall be glad to explain why Mrs. Loudon was probably right in substituting the name *tussilaginis* for *tussilagofolia;* to show why *Webberiana*, price 10s. 6d. (*Gard. Chron.*, 1842, p. 665), may be called a striking advance on its contemporaries, price 2s. 6d. (*Gard. Chron.*, 1842, p. 633), together with many other matters not yet treated of in this discussion.

My first objection to Mr. Dyer's statement was taken on the ground that there is historical evidence that sports, or seedlings presenting notable variations, occurred in the early days of the improvement of the Cineraria. To this, after reading his letters with great care, I do not find any specific answer. He tells us that the history as he gave it would be "in accord with general horticultural experience." It obeyed then a rule to the proof of which exceptions are indeed not lacking. He says, further, that to improve a plant the only safe way is by "selecting the minutest trace of change in the required direction," and "by patiently and continuously repeating the operation." Now this would be all very well if we knew nothing about the origin of the Cineraria; but against the evidence that seedlings presenting striking variations did as a fact arise, and against the historical evidence that Cinerarias, much as we know them, did as a fact come into existence within some twelve years, such *à priori* expectation is worth nothing at all.

To my second objection, that there is evidence that the chief start in the improvement of Cinerarias came as the result of hybridisation, Mr. Dyer has given more attention. He proposes to meet it by rejecting the whole of the historical evidence as unsound, and preferring the conjecture to which he says an inspection of the modern plants has led him. The historical evidence is to go because we are told certain horticulturists are ignorant men. I premise that this is not a principle which Darwin, whom Mr. Dyer would claim as his master, would have endorsed.

But before judging, let us try to consider what was the objective evidence on which the gardeners made up their minds that the new Cinerarias were hybrids. I may illustrate this by reference to a seedling now growing in the Cambridge Botanic Garden, to which Mr. Lynch, the curator, kindly called my attention. The case is of special interest in view of Mr. Hemsley's objection that it requires skill and care to raise a hybrid in the Compositæ. It was with regret I learnt that this careful writer was not with me in this matter.

This seedling was raised from a seed of our plant of *lanata*, which was received from and is exactly similar to those at Kew.[2]

[1] He says ("Enum. Pl. Berol.," 1809, p. 893) that Cinerarias are grown in gardens under the name *cruenta*, though really very different from it, having flowers almost like those of *lanata*. To these he gave the name *C. hybrida*. Moreover, from Bouché's experiment, we know that the seedlings of this *C. hybrida* were very variable.

[1] So famous a hybrid was the King, that I regret that I did not mention it in my first letter. I did not do so, as I found no coloured plate of it. Mr. John Fraser, of South Woodford, kindly informs me that he remembers it as the best of the woody sorts formerly grown. Its flowers were about the size of a penny, rays white tipped with purple, leaves downy and of a silvery hue on the underside. Its seedlings were unreliable.

[2] There labelled *Héritieri* (of DC.=*lanata*, L'Hér.). I note that though otherwise agreeing exactly with the *lanata* described by L'Hér., de Candolle and Webb, the inflorescence of these plants differs, being a loose corymb of some twenty heads, instead of the single flowered peduncle (*rami semper monocephali*, Webb) of the old authors. Whether this variation is known in wild plants, I cannot tell.

In habit and size our seedling is not at all like *lanata*, but might be taken for a poor specimen of the common Cinerarias. In several characters it is intermediate between *lanata* and the latter. The stem is rather woody, less so than in *lanata*, but it is thick like those of garden kinds: petioles like *lanata* in having no auricles: leaves, nevertheless, large like those of garden kinds, the backs very woolly, but largely purplish, as in many cultivated sorts. Now this plant must be either (1) a sport from *lanata* in the direction of the garden forms, or (2) an accidental hybrid between *lanata* and one of the cultivated kinds growing in the same house with it (we have no others). The latter seems more likely—an opinion in which Mr. Lynch fully concurs.

Similarly Bouché (*Wittm. Monatss.* xxii. p. 298, orig. not seen, quoted from Focke, *Pfl. Mischlinge*, 1881, p. 201) says that a hybrid between *C. Webbii* (Schlz. Bipont.) and *cruenta* arose in the Berlin Botanic Garden as the spontaneous product of these species growing side by side.

It was, I think, on evidence like this that the parentage of the older hybrids was conjectured; but that Drummond and Henderson certainly—and possibly others—did make definite efforts to hybridise, cannot on the evidence be doubted. That these efforts went no further than the brushing of pollen of some species upon the flowers of others, I fully believe, and that on such evidence the *precise* parentage cannot be assigned is obvious. Nevertheless distinct seedlings resulted. In a few years, as the writer in *Paxt. Mag.*, 1842, p. 125, says (in an article urging to fresh efforts in crossing), this hybridisation "was the means of creating quite a novel and superior race." There were the new plants: how had they arisen? Those who doubt that these new kinds were hybrids must choose the other horn of the dilemma, and accept them as sports pure and simple.

That the historical records may contain errors, I am fully aware; but if they cannot be accepted in detail, should they be altogether rejected? We might perhaps reserve a doubt whether the King came precisely from pure *cruenta* fertilised by *lanata*; whether *cruenta* var. *lactea* was a hybrid between *cruenta* and *populifolia* (as de Candolle surmises); whether *Waterhousiana* was the offspring of true *cruenta* and true *tussilaginis*; whether Mrs. Loudon's statement that the species used were *cruenta*, *lanata*, *aurita*, *tussilaginis*, and *populifolia*, or Moore's belief that *cruenta* and *tussilaginis*, with perhaps *Héritieri* (= *lanata*), *maderensis* (= *aurita*), and *populifolia* ("Cross and Self-Fert.," p. 335, *note*), or Otto's similar declaration (Regel's *Gartenflora*, 1857, p. 66), or that of the *Jour. d'hort. Gand*, 1846, already given, should each be taken without hesitation as full and complete statements of the whole truth, but that they contain a substance of truth is hardly in question.

Against this Mr. Dyer offers nothing but an opinion derived from an inspection of certain modern plants. He who has confidence in the results of this method must suppose our knowledge of the laws of inheritance to be much more complete than I believe it to be. It is not the method Darwin used. Take a well-ascertained case. Who would know from inspection of the Himalaya rabbit that it came directly from the Silver-greys or Chinchillas? (See *Animals and Plts.*, i. p. 113.) It is unlike them, is of sudden origin, and yet breeds true.[1] To suppose that in cross-bred offspring given characteristics of the parents must be found, is to assume the precise question which in a discussion of organic stability is at issue. Let it be remembered that on the hypothesis of hybrid origin for our Cinerarias it is supposed that they result from several species and varieties, crossed not once only, but many times, in wholly irregular ways. Can it be seriously expected that any special resemblance to a given ancestor should be still traceable?[2]

My position then is this. We heard Mr. Dyer's statement; turning to the literature I found an entirely different account, borne out by copious and on the whole fairly attested evidence, pointing irresistibly to the conclusion that the Cinerarias are species which hybridise freely, and that our modern forms have arisen through such hybrid unions.

[1] To Mr. James, of Farnham Royal, a celebrated grower, and to his foreman, I am indebted for several interesting points, and especially for the following: Formerly blue self-coloured Cinerarias were scarce in his strain, but some years ago he introduced some plants of a French strain. After this, and presumably as a result of the cross between his own and the French kinds, there appeared a strain of blue selfs. These, though shy seeders themselves, transmit their peculiarity so strongly that they have to be kept in a house apart, for fear that their character should assert itself to the exclusion of everything else.

[2] In order to meet Mr. Dyer on his own ground, I have assumed, what I cannot admit, that in none of the various modern strains traces of the different parent-species appear.

Mr. Dyer has well said that "if you take any statement that Mr. Darwin has put forward, you may feel assured that behind it is a formidable body of carefully considered evidence not likely to be upset." By the courtesy of an opponent I have been directed to a passage in "Cross and Self-Fertilization," 1876, p. 335, where (before describing experiments showing considerable self-sterility in the garden Cineraria) Darwin gives this definition of his material, "*Senecio cruentus* (*greenhouse varieties, commonly called Cinerarias, probably derived from several fruticose or herbaceous species much intercrossed*"). It seems, therefore, that in this matter also Mr. Darwin has, to use Mr. Dyer's words, "squeezed out" of the evidence "all that it would profitably yield."

Here I would fain leave the subject. But perhaps it may be suggested that though Darwin's Cinerarias were probably hybrids, our Cinerarias may not be their descendants. Such a suggestion involves the supposition that in some hidden place there was a thin red line of pure *cruenta* waiting for the moment when it should oust the hybrids. If this be seriously suggested, I shall ask where such a strain was kept, and what steps were taken to preserve its purity. In view of the evidence that chance blendings occur freely, to keep a pure strain would require some care. Until this has been proved, we shall not, I think, be wrong in supposing that each grower worked on the material his predecessors had created, and that our Cinerarias are the lineal descendants of the hybrids raised in the first half of this century,

In the course of this discussion, Mr. Dyer has treated me to some hard words, which I do not particularly resent. Whether I have deserved them is not, perhaps, for me to judge. But I will ask Mr. Dyer to point out when, on being asked for the facts upon which I have based a view, I have replied that that was a "matter for future collection." The facts I have been able to collect may be few, but by a study of the writings of my antagonists, I have not been able to add materially to their number.[1]

W. BATESON.

St. John's College, Cambridge, May 26.

IT has been pointed out to me that my remarks on Mr. Bateson's account of the Cineraria have been interpreted in a sense of which I did not dream when I wrote them.

I wish, therefore, to say that, although I do not believe Mr. Bateson's reading of the passages I quoted to be the true one, yet I have never questioned his sincerity in suggesting it, and I am pained to find that I have seemed to do so.

May 24. W. F. R. WELDON.

Boltzmann's Minimum Function.

I GATHER from Mr. Culverwell's last letter (NATURE, April 18), and Mr. Bryan's (May 9), that we may regard the following conclusion as established, namely, the proof of the H theorem, for any system depends on a certain condition (A) being fulfilled among the coordinates and momenta of the molecules forming the system. Considering these as elastic spheres, and using Dr. Watson's notation, $fdp_1 \ldots dq_3$ is the chance that a sphere shall have for coordinates and momenta $p_1 \ldots p_1 + ap_1$, &c., and $Fdp_1 \ldots dQ_3$ the chance that another sphere shall have $P_1 \ldots P_1 + dP_1$, &c. The condition required is that f and F are independent, even for two spheres on the point of collision.

Otherwise we may express it. Let there be n spheres in space S. Let us suppose Mr. Culverwell to assign to each its position at time $t = 0$, and Mr. Bryan to assign independently to each its component velocities. Then the condition A is fulfilled when $t = 0$.

We can then prove that when $t = 0$ $\frac{dH}{dt}$ is negative, or, as Herr Boltzmann would have us say, is more likely to be negative than positive.

Now arises a question which seems to me to deserve consideration. Assuming our system to be finite, and to be left to itself unaffected by external disturbances, does it necessarily

[1] It has been impossible for me to incorporate in this letter all the mass of information which has been most generously sent me by correspondents since this controversy began. It is suggested that I should point out that Mr. Dyer's use of the word "feral" to mean "wild" is not usual. A correspondent tells me that it was probably first used in the special sense of "run wild" by Hamilton Smith, *Nat. Libr., Mammalia*, 1839, ix. p. 92. It has since been so used by many authors, especially Darwin, *An. and Plts.*, i. p. 117, &c.

follow that condition A, being now satisfied, will continue to be satisfied for all time?

If the answer be Yes, then of course $\frac{d\mathrm{H}}{dt}$ will continue to be negative, until at length H reaches its minimum, and the system attains to perfection in the form of the Maxwell-Boltzmann law. If that is necessarily the future of our system, then, as Dr. Watson says, the Maxwell-Boltzmann law is not only a sufficient, but a necessary condition for permanence.

I am not aware, however, that this doctrine of (so to speak) final perseverance has ever been proved to be true. I do not think it can be regarded as axiomatic.

It seems to me that if we are to make our finite system reach perfection with any certainty, we must resort to the principle to which I appealed in my first letter on this subject—that every material system is constantly receiving disturbances from without, the effect of which is to keep condition A in working order, and so to make $\frac{d\mathrm{H}}{dt}$ generally negative. Otherwise we must regard our system as only part of an infinitely extended system, the parts of which, when not too distant, mutually influence each other.

S. H. BURBURY.

Research in Education.

IT is quite unnecessary for Mr. D. S. T. Grant to suffer "dialectic annihilation" (see p. 5) in order to discover Prof. Armstrong's definite scheme of scientific education, inasmuch as in 1889-90 such a scheme was published by a Committee of the British Association, of which Dr. Armstrong was an active member.

As I believe many schools are still waiting for evidence as to the practicability of the scheme before adopting it, I venture to quote my own experience. I have been engaged for some time in practically applying this method to the teaching of girls of various ages, and am in a position to state that the scheme is perfectly workable.

It is not, of course, suggested that students should find out every known fact in chemistry or physics by a process of personal research—life is not long enough; but, if their early training be on these lines, they are in a much better position later on to accept, or if necessary reject, the work of others. A scientific method of thinking is of far more value than an accumulation of facts, and so it is extremely important that children should begin this kind of work before their logical perceptions have become obliterated by a continued application to irregular verbs. The problems set to young children are naturally of a very simple nature, and I do not leave the girls to themselves to "struggle to the truth by a process of trial and error." I state the problem to the class, and I usually find the girls have plenty of suggestions to offer as to its solution; these suggestions I criticise, and as soon as a practicable method has been found, the girls work it out for themselves. The early problems involve measurements of length, area, volume, and weight, and naturally the use of each new instrument is explained and illustrated. Simple physical problems follow these, such as experiments on relative density, and thus children are led to realise and appreciate the common properties of matter. After this training they are much more ready to solve elementary chemical problems. Certainly they could never work long enough to discover Dalton's laws for themselves, but they can quite appreciate classical experiments, and see how theory supplies an explanation of the facts. I am quite aware that if children are to work in this way they cannot be expected to sit still in their places with the look of passive receptivity on their faces, which is conventionally regarded as the proper appearance of well-disciplined scholars. They must move about, and should be encouraged to talk to each other about their work. I am convinced that a class of about eighteen is quite large enough if sound work is to be done; and if at any time their excitement becomes noisy, I find that a threat of numerical problems is quite sufficient to make them continue their practical work more peacefully.

It seems to me that physiology and hygiene, as usually taught in girls' schools, are absolutely pernicious and unscientific. Girls learn a list of the circulatory organs as they do the kings of England, and with less advantage. It would be considered criminal in them to doubt any of the facts in their books, although many are wrong, and yet, I take it, scientific training misses a great point if it does not engender a wholesome spirit of doubt. But the worst feature of all is the way in which girls are taught certain things in theory of the meaning of which they have not the faintest notion. They can tell one that water is H_2O, but the real significance of the symbol is perfectly unknown to them, and of course they are not able to understand it without some chemical training, in spite of the fact that some schools consider themselves very advanced and practical if the lessons are emphasised by the burning of hydrogen and the manufacture of oxygen. Numberless examples of similarly useless facts could be quoted, which are learnt under the name of hygiene—teachers, parents, and girls vainly believing that this is science. But all these facts are forgotten as soon as some examination is passed, and nothing is left behind; whereas a logical system of scientific training produces an effect on the mind which it is impossible to overrate. Surely the aim of education should be to produce not people who are full of facts, but those who can make the best use of the brains they possess, who are clear-headed, and able both to perceive and take advantage of opportunities that may be afforded them.

Central Foundation School for Girls, London. L. EDNA WALTER.

The Bibliography of Spectroscopy.

IT will be within the recollection of many of your readers that, in the year 1879, a committee was appointed by the British Association to report on the state of our knowledge of spectrum analysis, and I was asked to undertake the preparation of a bibliography of spectroscopy from the year 1870. It was not thought necessary to begin at an earlier date, for a bibliography of the subject is to be found in Roscoe's "Spectrum Analysis." With the help of several members of the committee, lists of spectroscopic papers were prepared, and appeared in the British Association Reports for 1881, 1884, and 1889. In that year Mr. H. J. Madan kindly consented to join the committee, and as he was then resident in Oxford he was able to afford valuable assistance in checking the references, and the section of the list that was published last year is almost entirely his work, as I had found it impossible to spare the time to go to London to look up the references in the libraries. Mr. Madan is now living in Gloucester, and therefore out of reach of scientific libraries; he has, notwithstanding, shown his interest in the subject by making frequent visits to Oxford and London to continue the work. He finds, however, that the work is hardly practicable for one so far removed from the great centres; and my object in writing this letter is to ask if any one will volunteer to relieve him from this duty—that is, on the supposition that the list is of real use to workers on spectroscopic subjects. Many of the readers of NATURE will be able to give valuable opinions on this matter, and probably to suggest improvements in the manner in which the list is drawn up.

It has been suggested that the four sections of the list should be rearranged and published as one continuous catalogue. The advantages of this for the purpose of reference are obvious; but from an estimate obtained last year, the cost of printing would not be less than £100. Dr. Tuckermann also very kindly proposed that the "Bibliography of Spectroscopy" drawn up by him and published by the Smithsonian Institution in 1888, should be incorporated with the British Association lists; this would very materially increase the expenditure.

Mr. Madan is quite willing to undertake gratuitously the literary work involved in the collection and rearrangement of the various sections. But the expense of publication is so great that the British Association can hardly be expected to bear the whole of it, although it is quite likely that a liberal grant might be made. Probably also grants might be obtained from other societies interested in the work, if it appears that the catalogue would be of special utility to those engaged in research. The balance might be met by a moderate charge for each copy sold.

Cooper's Hill, May 15. HERBERT MCLEOD.

An Aquatic Hymenopterous Insect.

NO doubt many of your readers are aware that, in 1863, Sir John Lubbock gave an account of an extraordinary hymenopterous insect which he had observed swimming in a basin of water taken from a pond at Chislehurst. Another observer (Mr. Duchess, of Stepney) had also found a single specimen about the same time; then, in 1881, Mr. Bostock found one in some pond water at Stone, Staffordshire, since which time it does not appear to have been recorded by any one. I have searched many ponds for it year after year, but without success.

On Saturday, May 4, the Quekett Microscopical Club held one

of its excursions in search of pond life, the neighbourhood visited being Totteridge and Mill Hill. Mr. W. Burton obtained two small phials of the water for examination, and the first pipette of water turned out into the trough contained a minute fly, which Mr. Burton kindly brought to me, when I immediately identified it as the *Polynema natans* (Lubbock, *Trans. Linn. Soc.*, vol. xxiv. 1864, p. 135, plate 23).

As this capture was, for the fourth time, the result of chance, Mr. Burton and I set out (May 6) to search for more specimens. After dipping our nets in and carefully examining the contents for over two hours, my patience was at last rewarded by seeing a beautiful female, struggling to free its wings from the mass of minute vegetation gathered in the dipping net. After a few hours more search, I found four males, which, together with the female, I transferred to an observation tank, where all soon disported themselves in the liveliest manner, swimming, or rather flying, under water for over four days, during which period they did not, to my knowledge, once leave the water. I have since obtained others, which are under close observation, and in course of time I hope to trace out their life-history.

Perhaps, owing to the microscopic dimensions of many of the *Mymaridæ* (Haliday), very few entomologists have paid any attention to this most interesting and fascinating family of beautiful "Fairy Flies," to whose industry we are no doubt largely indebted for our freedom from "blights" of many kinds. They are, indeed, mere specks, scarcely visible to the eyes of ordinary folk, and yet they have their place in nature.

I am inclined to think that when the type collection of the *Mymaridæ*, made by the late Mr. Haliday, has been thoroughly examined, this name *Polynema natans* will have to give place, so far as the genus is concerned. I hope that before very long we shall have figures of all the genera in this most interesting group.

FRED. ENOCK.

Halley's Chart.

I HAVE been much interested with the letter of Dr. L. A. Bauer in your last number, as I happen to possess a map, or chart, bound up with a number of Dutch, German, and French maps of the end of the seventeenth and the first years of the eighteenth centuries. The latest map with a date is 1704. This English map is evidently the same as 974 (4) mentioned by Dr. Bauer. It is entitled "A new and correct chart showing the Variations of the Compass in the Western and Southern Oceans, as observed in y^e^ year 1700, by his Ma^ties^ command by Edm. Halley." The dedication reads as follows, in Latin: "Majestati semper Augustæ Gulielmi III. D.G. Magnæ Britanniæ Fra. & Hib. Regis Invictissimi. Tabula hæc Hydrographica Variationum Magneticarum Index. Devotissime Consecratur a Subdito Humillimo Edm. Halley." At one side of the map is the following: "The curve lines which are drawn over the seas in this chart do show at one view all the places where the variation of the compass is the same: The numbers to them show how many degrees the needle declines either Eastwards or Westwards from the true North: and the double line passing near Bermudas and the Cape de Virde isles, is that where the needle stands true without variation."

The chart is in excellent condition, but has no name or printer on it. The only indication is "J. Harris, Sculp." The course of a vessel going from and returning to England is clearly marked.

THOS. WARD.

Northwich, May 27.

ON THE LINE SPECTRA OF THE ELEMENTS.

I THINK Lecoq de Boisbaudran was the first who called attention to the fact that the line spectra of the elements are by no means so irregular as they seem to be at first sight. He discovered the similarity in the spectra of the alkalies and alkaline earths, and pointed out how the lines in the spectra of these two families seem to be shifted towards the less refrangible side with increasing atomic weight. Mascart, in 1869, found two strong triplets of lines in the ultra-violet spectrum of magnesium, similar to the strong green triplet so prominent in the solar spectrum. He says: "Il semble difficile que la reproduction d'un pareil phénomène soit un effet du hasard; n'est-il pas plus naturel d'admettre que ces groupes des raies semblables sont des harmoniques qui tiennent à la constitution moléculaire du gaz lumineux? Il faudra sans doute un grand nombre d'observations analogues pour découvrir la loi qui régit ces harmoniques." But the wave-lengths corresponding to these rays were then not accurately known, and so the most interesting feature concerning the oscillation frequencies, or the number of waves which pass any fixed point in unit of time, remained unnoticed. It was later on shown by Hartley, that the differences between the wave-numbers of the three lines seem to be the same for all the triplets. This constant difference of wave-numbers repeated in a number of doublets, of triplets, and of more complicated groups of lines, has now been observed in the spectra of many elements. There are repetitions of doublets in the spectra of sodium, potassium, rubidium, cæsium, copper, silver, aluminium, iridium, thallium; of triplets in the spectra of magnesium, calcium, strontium, zinc, cadmium, mercury, manganese, and of more complicated groups of lines in the spectra of tin, lead, arsenic, antimony, bismuth. In all these cases the differences seem to be absolutely constant. For, notwithstanding the great accuracy with which Rowland has taught us to determine the wave-lengths, the law holds good. As an example, I give the list of doublets in the spectrum of thallium, according to Prof. Kayser's and my determinations. The number of waves passing a fixed point in unit of time, is equal to the distance the light travels in unit of time divided by the wave-length. If we measure the wave-lengths in vacuo, the distance the light travels is the same for all rays. We may then choose as unit of time, the time that light requires to travel one centimetre, so that the wave-number is simply equal to $1/\lambda$, λ being the wave-length in vacuo, measured in centimetres. In this manner, we get rid of the necessity of settling the velocity of light, which as yet has not been measured with anything like the accuracy with which the wave-lengths are known.

$1/\lambda$	Difference.	Estimated limit of error.
18684·2		
	7792·4	0·32
26476·6		
28324·1		
	7793·0	0·63
36117·1		
30952·1		
	7792·7	0·74
38744·8		
33569·4		
	7795·7	4·90
41365·1		
34217·7		
	7792·5	0·90
42010·2		
34526·2		
	7795·2	4·50
42321·4		
35372·1		
	7792·6	1·20
43164·7		
36879·2		
	7791·8	2·40
44671·0		
37503·0		
	7790·8	2·70
45293·8		
38305·0		
	7791·8	6·80
46096·8		
38663·3		
	7789·1	7·30
46452·4		
39157·0		
	7790·3	8·20
46947·3		

The mean of the twelve differences, assuming their weights to be inversely proportional to the square of the estimated limit of error, is 7792·5. When the wave-lengths are not reduced to vacuo, the differences are also very nearly constant, because the reduction alters them all nearly by the same amount. But it was a source of satisfaction to me, that the reduction brought all the deviations from the mean value well within the limits of error, whereas without the reduction the second difference had been just beyond the limit. These twelve doublets do not comprise half the number of wave-lengths that have been

observed in the spectrum of thallium. But, nevertheless, I think any one will agree that their numerical relation is no chance coincidence. Let us now make a drawing of these doublets to the scale of $1/\lambda$. Evidently the twelve first lines will give the same picture as the twelve second lines. Let us therefore, to simplify matters, only plot down the twelve first lines. At first glance this does not show any remarkable regularity; but if we drop the fourth and sixth line, we can arrange the rest in two series, as is shown in Fig. 1, both rows resembling the series of lines in the spectrum of hydrogen, which are so accurately represented by Balmer's formula. Recurring now to the general list of lines observed in the spectrum of thallium, we find that all five lines of the first series are accompanied on their more refrangible side by strong and easily reversed lines, while the lines of the second series are single. Thus not only does the symmetry of the drawing justify the separation of the lines into two series, but their

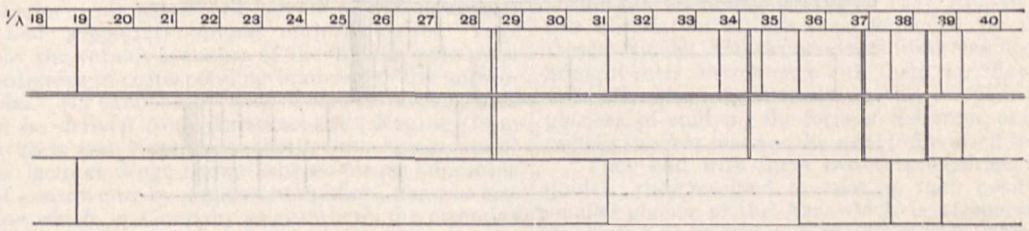


FIG. 1.

appearance teaches us the same. We may expect to find that a formula similar to that of Balmer connects the lines of each of these two series. Indeed, for suitable values of A, B, C the wave-numbers may be calculated from the formula,

$$A - Bn^{-2} - Cn^{-4}$$

A and B having nearly the same values for both series, and n assuming the values 4, 5, 6, 7, 8 for the first, and 3, 4, 5, 6, 7 for the second series. One may state the formula thus: if the wave-numbers be plotted as ordinates to the abscissæ $1/3^2$, $1/4^2$, $1/5^2$, &c., the points form a parabola. If we now go on substituting for n the subsequent whole numbers, we find that all these calculated wave-lengths really exist in the spectrum. But they are weaker and weaker for higher values of n. Prof. Kayser and I have been able to observe the wave-lengths calculated by the formula of the first series for $n = 9, 10, 11, 12, 13, 14, 15, 16$, and by the formula of the second for $n = 8, 9, 10, 11, 12, 13, 14, 15$. We searched for the second members corresponding to these lines, but could not detect them, owing to our plates not being sensitive enough for wave-lengths as small as 2100. However, they have nearly all been observed by Cornu. If we accept Cornu's wave-lengths, we now have two series of doublets of equal width in the scale of wave-numbers, and a drawing of them shows a remarkable symmetry (Fig. 2). The drawing comprises 47 out of 60 lines that constitute the arc spectrum of thallium, including Cornu's observations. Of the thirteen lines left, five are the strong lines, mentioned above, that accompany the five first lines of the first series on their more refrangible side. The distance between each line and its companion grows smaller as we advance to smaller wave-lengths, the last distance being not more than 0·45 10^{-8} cm. It seems probable that the next lines also have their companions, which, however, so closely coincide with them that it has not been possible to separate them. So there are only eight lines left, the positions of which do not enter into the general plan of the spectrum. Among these eight lines there are two doublets of the same difference of wave-numbers as all the other doublets. Both widen asymmetrically—one towards the more refrangible side, the other to the less refrangible side. Thus we may say that only four lines out of sixty do not show any signs of a system according to which they are grouped.

I have given this detailed account of the arc spectrum of thallium only as an example; for I might describe many more spectra that show a similar regularity in the distribution of many of their lines. But there is another interesting point. The distribution of lines in the spectra of chemically related elements shows evident signs of a common plan. I will, for instance, describe the series of triplets in the spectra of magnesium, calcium, and strontium.

The most prominent lines in the visible spectrum of magnesium are the three green lines 5184, 5173, 5168 10^{-8} cm. forming the group b in the solar spectrum. In the ultra-violet, at least ten repetitions of this group have been observed, two more being doubtful on account of their weakness and nebulosity. The differences of wave-numbers have been found to be the same in all the groups, as may be seen from the following list. The wave-lengths have not been reduced to vacuo, because all three lines of one group are so near one another that they would all be changed by nearly the same amount, so that the differences of wave-numbers would practically remain the same.

λ			1/λ	Difference.
5183·84	...	...	19290·7	
				40·9
5172·87	...	...	19331·6	
				19·9
5167·55	...	...	19351·5	
3838·44	...	...	26052·2	
				40·7
3832·46	...	...	26092·9	
				20·1
3829·51	...	...	26113·0	
3336·83	...	...	29968·6	
				40·9
3332·28	...	...	30009·5	
				19·8
3330·08	...	...	30029·3	
3097·06	...	...	32288·7	
				40·9
3093·14	...	...	32329·6	
				20·5
3091·18	...	...	32350·1	
2942·21	...	...	33988·1	
				40·9
2938·67	...	...	34029·0	
				19·5
2936·99	...	...	34048·5	
2848·53	...	...	35105·8	
				20·0
2846·91	...	...	35125·8	
2781·53	...	...	35951·4	
				41·1
2778·36	...	...	35992·5	
				20·2
2776·80	...	...	36012·7	
2736·84	...	...	36538·5	
				40·6
2733·80	...	...	36579·1	
				19·4
2732·35	...	...	36598·5	
2698·44	...	...	37058·4	
				40·1
2695·53	...	...	37098·5	
				21·4
2693·97	...	...	37119·9	
2672·90	...	...	37412·6	
				42·8
2669·84	...	...	37455·4	
				22·2
2668·26	...	...	37477·6	
2649·30	...	...	37745·8	
				38·4
2646·61	...	...	37784·2	
				19·8
2645·22	...	...	37804·0	

In the sixth triplet, the first line has not been observed. There is a very strong line 2852·22 not far from where the

first line of the triplet should be. But this one is out of the question on account of its enormous energy, which would be quite out of comparison with the other lines. So we must suppose that the first line of the triplet is concealed by the strong line. Indeed, on the plates Prof. Kayser and I have examined, it would be impossible to detect a line close to 2852. Again, as in the spectrum of thallium, these triplets form two series (see Fig. 3), and again we find that the wave-numbers of the first, second, and third lines in each series are very accurately represented by a formula,

$$A - Bn^{-2} - Cn^{-4},$$

n standing for the row of entire numbers. For each series there are three values of A, but only one value of B, and one value of C. The three values of A are very nearly the same in both series, indicating that the ends of both series coincide. The lowest number for which the formula gives a positive value is $n = 3$. To this value corresponds the strong green triplet. But in the other series the corresponding triplet ought to be found near 13000 10^{-8} cm. where photographic methods fail. It may be that it is identical with the lines that Becquerel has found near 12000 and 12120, the first of which, he says, is possibly double. The deviation between these and the calculated values is not so very great, considering the wide extrapolation of the formula. A small change in the value of C would alter the formula much more for $n=3$ than for the higher values of n. Besides, we believe the formula only to be an approximation to the true function which may be developed into a series of descending powers of n^2. If this is so, the neglected terms would affect the values of the formula much more for the low values of n, than for the higher ones. The separation of the triplets into two series is not only suggested by the symmetry of the distribution, but also by the aspect of the lines.

In the spectra of calcium and strontium, we also find triplets with the same differences of wave-numbers, and their appearance teaches us in each spectrum to separate them into two series. We then see that the distribution of triplets shows a remarkable similarity to that in the spectrum of magnesium.

The dotted lines in the figure mean that the corresponding rays have not been identified with certainty. There are many lines beside those forming the triplets. For magnesium, the triplets contain 33 out of 56 lines, for calcium 33 out of 106, for strontium 29 out of 97. We have found that, as a rule, the higher the melting point of an element, the greater is the percentage of lines in the arc spectrum that do not belong to the series. From magnesium to calcium, and from calcium to strontium, the triplets widen and shift to the less refrangible side of the spectrum. The same thing happens in the spectra of other groups of chemically-related elements, the difference of wave-numbers of the doublets or triplets being somewhat proportional to the square of the atomic weight.

There is one more feature which seems interesting in regard to the connection of the spectra of different elements. In all the formulæ of series that have been observed, the coefficient of n^{-2} does not vary more than about 10 per cent. from its mean value, if we except one of the two series of doublets in the spectrum of aluminium where the variation is somewhat larger. I think, when in some time a satisfactory theoretical explanation of the symmetry in the spectra of the elements will be given, this co-efficient will prove to be an important physical constant.

C. RUNGE.

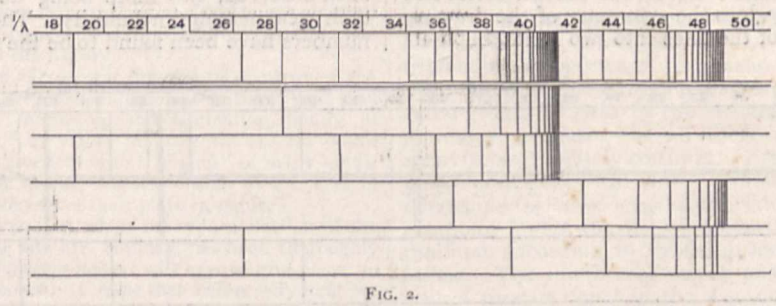


FIG. 2.

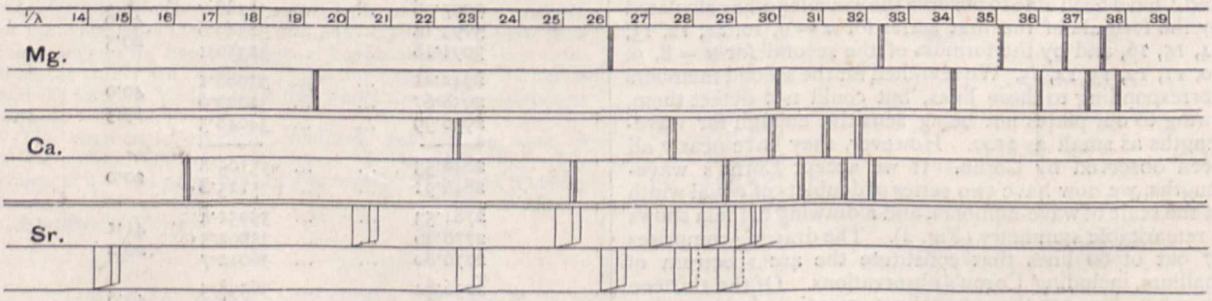


FIG. 3.

KARL VOGT.

THE life of Prof. Karl Vogt, who died on May 6, was no tranquil scientific career, for he was a fighting philosopher. He first comes into notice in 1839, working with Agassiz, then Professor at Neuchatel, on the "Freshwater Fishes of Central Europe." This great work, never completed, determined the direction of Vogt's best research during the rest of his long life. It was only in 1888–94 that the "Traité d'Anatomie Comparée," by Vogt and Jung, was published in Paris, taking high rank as a standard authority, and likely to retain it. He returned from Paris to his native town of Giessen, where he had been appointed Professor. But the revolution of 1848 soon burst forth, and we hear of him as an advanced Democratic Deputy contending for liberty and progress with the trenchant oratory he could use alike in politics and science Political forces were too strong against him, and

he had to depart from his university and country, finding a home again in Switzerland, where he took up the double life of biologist and politician as a Professor at Geneva, and a prominent member of the National and Federal Council. His all-round knowledge is testified to by papers on Alpine geology, petrology, and prehistoric archæology. Those who were present at the Norwich meeting of the Congress of Prehistoric Archæology in 1868, remember his robust presence and slashing speech. To this subject, at the time rising into notice, belong Vogt's discourses, well known in the English translation, edited by Dr. James Hunt, and published by the Anthropological Society in 1864 under the title "Lectures on Man: his Place in Creation, and in the History of the Earth." There is so much forcible reasoning in this book, that it may still be read with profit thirty years after date. It is true that the thesis of the book which gained it favour with the polygenist school, whose desire was to trace the races of mankind to several locally and specifically distinct origins, is one which would nowadays hardly find supporters among anthropologists. Vogt held that the various branches of the human race trace their pedigrees to corresponding branches of the anthropomorpha. He cannot see "why American races of man may not be derived from American apes, Negroes from African apes, and Negritos, perhaps, from Asiatic apes." In these lectures Vogt shows a by no means admirable mode of controversy by unpleasant epithets, more or less like those which, in Germany as elsewhere, the orthodox world had poured on "infidels" and "materialists." But his sense of humour was blunt, and he evidently did not see that religion, which has swayed the universal human mind from untold ages, is a cosmic force which, by its very immensity, should be out of the reach of jokes like calling a low-type cranium an "apostle-skull." Even more remarkable in this respect is Vogt's "Köhlerglaube und Wissenschaft," an invective in the name of science on the credulous piety which, in countries where the trade of the charcoal-burner is plied, finds its best example among these isolated ignorant forest-folk. To the newer school of anthropologists, the term "charcoal-burner's belief" suggests quite a different sense. One would sit down by them and question them in order to find surviving in their minds ideas which are fossils from the most ancient times.

As a zoologist Vogt's reputation rests upon less equivocal grounds. The subject supplied him with fewer opportunities of displaying his anti-theological bias, and he brought his great powers to bear upon a number of problems, with the result that he added largely to the progress of zoology. His writings are numerous, and range over a wide variety of subjects; and he by no means confined himself to comparative anatomy, but made observations which entitled him to honourable rank among physiologists. In his "Traité d'Anatomie Comparée" he tells us, in the preface to the second volume, that he has studied and dealt monographically with no less than twenty-two types of animals, belonging to nearly every class of the animal kingdom. Much of this work was begun in the earlier part of his career, when he published many papers and several monographs upon the forms which he has afterwards chosen as types in his text-book. He was an active embryologist in earlier days, and wrote on the development of Filaria (1842), Batrachia (1844), Cephalophora (1856), and Crustacea (1873). In 1853 he published observations on the fertilisation of the ovum. He made a special study of the Siphonophora in 1852–54, and produced in 1868 an admirably illustrated monograph, entitled "Recherches sur les Animaux inférieurs de la Méditerranée," which deals with Siphonophora and pelagic Tunicata. His work on Branchipus and Artemia, published in 1872, is well known. Vogt's activity did not decrease with advancing years, as is testified by his contributions to current scientific literature and the publication of his text-book. His abilities were great, and he had a keen appreciation of the importance of the special problems of zoology to which he directed his attention. But his interests were too various, and his work ranged over too great a number of subjects, to admit of his rising to the position of a first-rate authority in any one of them. Had he applied himself solely to one course of study he would, by his powers of investigation and his vigorous method of exposition, have found a place among the foremost biologists of the century. As it was, he dissipated too much energy and thought in attempting to grasp too wide a range of knowledge.

E. B. T.
G. C. B.

At the meeting of the Paris Academy on May 6, M. Blanchard referred in the following terms to the part Vogt took in the study of the formation and movement of glaciers, under the direction of Louis Agassiz.

"At the beginning of August 1845, Agassiz arrived at the hospital of Grimsel, accompanied by Carl Vogt, Desor, Nicolet, and two students from Neuchatel. They brought their instruments with them, for they had come with the idea of determining the temperature of the glaciers, of studying the form of the snow, and of ascertaining in what manner the *névé* forms itself into ice.

"They had with them two very experienced men as guides; they resolved to take up their position on the smaller glacier of the Aar, which is of special interest; the surface is strewn with masses of rock, which produces an effect of a heap of ruins. On approaching the moraine, the investigators perceived that the glacier had advanced considerably since the previous year. A hut, left by Hügi, one of the first explorers, had disappeared.

"After a brief survey, they fixed the place of installation near a large block, and the guides set to work to build a small house large enough to hold six people. The walls were built of dry stones; large flagstones served as boards; beds were made of layers of grass, covered with oilcloth and other coverings, and were thought perfect.

"As a matter of fact, the opening which gave access to the house was very small, but still Carl Vogt could enter, and where Carl Vogt could pass every one could. Instead of a door, a curtain was put up. In the night, before going to bed, it was decided that the dwelling should be called the "Hôtel des Neufchâtelois"; this name was, therefore, cut on the rock in big letters, and time has consecrated it.

"Does not this reunion of young savants in the solitude, in the middle of a nature both grand and sad, offer a curious spectacle to the imagination? The noises of the pleasures of this world and of public affairs does not ascend as far as the hut on the glacier of the Aar: aspirations and joys, unknown to most mortals, agitate the hearts there. These men, who without effort, without regret, renounce comfort for many a long day, dream of penetrating into the deepest secrets of nature; they discuss gravely most formidable questions, and laugh over many incidents. Agassiz never loses his good humour, and Desor abandons himself to joking. Carl Vogt, always sparkling with fun, and himself capable of enlivening an assembly of monks, effectually prevents the possibility of *ennui*.

"Amongst the investigators, who are stirred by the same thought, peace is never broken; on the sea of ice, with no other witnesses than the blocks of granite, and the peaks covered with eternal ice, there are no rivals. In proportion to the extent of his aptness every one sets himself with energy to the common work. Agassiz is the undisputed chief, the recognised master. To bring a stone to the monument he was building, was the only thing the zealous workers cared about.

"They rose early at the 'Hôtel des Neufchâtelois'; on the stroke of four they had to be up. The time of dressing was rather trying, as the water was so cold and made them shiver; but that over, nothing more was thought of than continuing their research. Agassiz volunteers to bore holes; the ice can only be cut with great difficulty, for it resists the instruments. While this operation is being done, Carl Vogt examines the red snow, the strange hue of which is due to the presence of myriads of microscopic beings; he discovers many kinds of infusoria, and a pretty rotifer sowing the snow with its purple-coloured eggs.

"Carl Vogt was never inactive; in the last years he published, together with M. Jung, a treatise on zoology. Every one will acknowledge that a life so well spent is an honour to humanity." W.

NOTES.

SCIENCE is but poorly represented in the list of the Queen's birthday honours. Lord Playfair, previously a K.C.B., has accepted the honour of G.C.B. Rear-Admiral W. J. L. Wharton, Hydrographer to the Navy, has been made a Companion of the Order of the Bath. Mr. W. M. Conway, whose climbs in the Himalayas led to the publication of some interesting scientific results, has been knighted.

DR. E. FRANKLAND, F.R.S., Correspondent of the Paris Academy of Sciences, has been elected Foreign Associate, in the place of the late Prof. van Beneden.

DR. ESMARCH, of Kiel, has been elected a Correspondent of the Paris Academy of Medicine.

PROF. THOMMSEN, who has been a Corresponding Member of the French Academy of Inscriptions since 1860, has been elected a Foreign Associate, in the place of the late Sir H. Rawlinson.

THE *Times* correspondent at Melbourne says that a meteorological observatory has been established on the summit of Mount Wellington, Tasmania.

A MILLION acres of forest land has been reserved by the Province of Ontario as a great natural park for the preservation of native animals and plants.

THE discourse at the Royal Institution to-morrow evening will be delivered by the Earl of Rosse, the subject being, "The Radiant Heat from the Moon during the progress of an Eclipse." That on June 7 will be by Prof. A. Cornu, F.R.S. This lecture will be delivered in French, and the title will be, "Phénomènes Physiques des Hautes Régions de l'Atmosphère."

THROUGH a gift of Mr. W. C. McDonald (says *Science*), McGill University has secured thirty-five acres of land for botanical gardens and an observatory. From the same source we learn that the residue of the estate of Mary D. Peabody has been left to the Catholic University of Washington, for the foundation of scholarships (probably three or four of the value of 5000 dollars each) in the chemical and physical sciences.

AMONG the appointments abroad, we notice that Dr. N. V. Ussing has accepted the Professorship of Mineralogy in the University of Copenhagen, Dr. F. Karsch has become Extraordinary Professor of Zoology in Berlin University, Prof. Emil Behring has become Ordinary Professor of Hygiene at Marburg, and Dr. Zorawski (privat-docent in mathematics at Krakau) has been promoted to an Extraordinary Professorship.

THE electrical power developed at the Niagara Falls will soon take the place of steam for several hundred miles distance from the Falls, including New York City. An important proposed application is to the Erie Canal, which has just opened for the season. Experiments will be made for applying the power by a trolley system, and the reduction of expense will probably drive out all other means of transportation for grain, &c., from Buffalo to tide water, during the season of navigation.

AT the International Horticultural Congress, opened at Paris on Saturday, resolutions were unanimously adopted to the effect: "(1) That the French Government should associate itself with the request addressed by the Italian Government to the Swiss Confederation, with a view of obtaining the revision of the Berne International Convention, and the free circulation between all countries signatory to the convention, of all vegetables and vines, accompanied by a certificate of origin; and (2) that the postal administration should return to the old reduced tariff, of which periodical publications on horticulture have hitherto had the advantage."

EFFORTS are being made (says the *American Naturalist*) to raise a fund of 12,000 dollars for the purpose of bringing Mr. Peary and his two assistants home from North-west Greenland early next autumn, and, in connection with this, to prosecute scientific investigations during the available summer season. It is hoped, by this means, to charter and fit out a staunch steamer, built for Arctic service and commanded by experienced Arctic navigators, which shall start from St. John's, Newfoundland, on or about July 5, 1895, for Inglefield Gulf, North-west Greenland, lat. 78° N., Mr. Peary's headquarters.

WE have received a notice concerning three "Priestley" Scholarships in Chemistry, two "Bowen" Scholarships in Engineering, and one in Metallurgy, which have been founded by the late Mr. T. Aubrey Bowen, of Melbourne. They are intended to encourage and afford facilities for the higher study of these subjects in Mason College, where they are tenable for one year, with the possibility of renewal at the discretion of the Council of the College. The annual value of each is £100. Although, naturally, good work done at Mason College will be regarded as a specially favourable qualification, the Council have generously thrown all the Scholarships open to general competition. The first award will be made in September next, and all particulars may be learned on application to the Secretary of the College.

THE gold medal of the Linnean Society has this year been awarded to Prof. Ferdinand Cohn, of Breslau, whose name is well known in connection with the *Botanic Journal*, which he has conducted, largely adorned with his own contributions, from 1870 to the present time. The work of Dr. Cohn extends over half a century. He was one of the earliest to investigate the life-history of the lower Algæ, and to demonstrate that they are not asexual. His important paper on *Protococcus pluvialis*, published so long ago as 1850, was translated by Busk for the Ray Society. Subsequent papers by him, on the mode of reproduction of *Sphæroplea annulina*, and on the development of *Volvox*, mark a distinct advancement in botanical science. The medal referred to was awarded to him at the anniversary meeting of the 24th inst., and has been forwarded to Breslau, for his acceptance, through the German Embassy.

AT the anniversary meeting of the Royal Geographical Society, held on Monday, the Founder's Medal was presented to Dr. John Murray for his services to physical geography, and especially to oceanography during the last twenty-three years, also for his maps of the floor of the ocean, his calculations regarding the volume of continents and oceans, his study of the origin and formation of coral deposits, and for the stimulus he has given to researches in physical geography. The other awards were the Patrons' Medal, to the Hon. George N. Curzon, M.P., (1) for his work on the history, geography, archæology, and politics of Persia; (2) for his journeys in

French Indo-China, which have resulted in further publications of geographical as well as political and general value; and (3) for his journey to the Hindu Kush, the Pamirs, and the Oxus, together with a visit to the Amir of Afghanistan, in his capital of Kabul. The Murchison Grant, to Mr. Eivind Astrup, for his remarkable journey, with Lieut. Peary, across the interior glacier to the northern shores of Greenland; and for his independent journey along the shores of Melville Bay; the Back Grant, to Captain C. A. Larsen, for the geographical and meteorological observations made by him during his Antarctic voyage in 1894, and for his discovery of an active volcano on Christensen Island, of several other islands, and of part of the east coast of Graham Land; the Gill Memorial for 1895, to Captain J. W. Pringle, R.E.; and the Cuthbert Peek Grant for 1895, to Mr. G. F. Scott-Elliot, for his explorations of Mount Ruwenzori, and of the region to the west of the Victoria Nyanza.

WE wish the American Metrological Society success in its efforts to extend the use of the metric system in the United States, and to procure general agreement with regard to the constants of science. Its objects are ambitious, as the following statement of them, from *Science*, will show: (1) To improve existing systems of weights, measures and moneys, and to bring them into relations of simple commensurability with each other. (2) To secure universal adoption of common units of measure for quantities in physical observation or investigation, for which ordinary systems of metrology do not provide, such as divisions of barometer, thermometer, and densimeter; amount of work done by machines; amount of mechanical energy, active or potential, of bodies, as dependent on their motion or position; quantities of heat present in bodies of given temperatures, or generated by combustion or otherwise; quantity and intensity of electro-dynamic currents; aggregate and efficient power of prime movers; accelerative force of gravity; pressure of steam and atmosphere; and other matters analogous to these. (3) To secure uniform usage as to standard *points of reference*, or physical conditions to which observations must be reduced for purposes of comparison, especially temperature and pressure, to which are referred specific gravities of bodies, and the zero of longitude on the earth. (4) To secure the use of the decimal system for denominations of weight, measure, and money derived from unit-bases, not necessarily excluding for practical purposes binary or other convenient divisions, but maintained along with such other methods, on account of facilities for calculation, reductions, and comparison of values, afforded by a system conforming to our numerical notation.

ON January 18, the great seismometrograph at the Osservatorio del Collegio Romano at Rome registered five complete pulsations of slow period characteristic of earthquakes originating at a great distance. They commenced at 4h. 37m. 30s. p.m. (Greenwich mean time), and lasted 1m. 22s., giving an average duration of 16·4 seconds for each pulsation. On the same day a severe earthquake was felt along the east coast of Japan, and was recorded at Tokio at 3h. 48m. 24s. The distance between this place and Rome being about 9500 km., the pulsations must have travelled with an average velocity of 3·2 km. per second (see NATURE, vol. l. pp. 450-51; vol. li. p. 462). At Nicolaiew and Charkow, in the south of Russia, the horizontal pendulums were disturbed for nearly an hour, the epoch of maximum amplitude occurring a few minutes earlier than at Rome.

MR. MARSHALL HALL publishes in the *Alpine Journal* (vol. xvii. p. 438) a note on the progress made in the study of glaciers, for which purpose a Committee was appointed at the meeting of the International Congress of Geologists at Zürich. Good work appears to have been done, in exploring and mapping, among the glaciers of New Zealand, in the course of which Franz-Joseph Glacier, on the west coast, was found to end at a height of 692 feet above the sea, and a distance of four miles from it. The rate of movement is, of course, variable; an average of the observations (with certain omissions) gives 154·2 inches per diem. Valleys containing large glaciers give indications that the ice has been higher than it is at the present day, and has paused at four different levels. Work also has been done among the glaciers of the eastern side of New Zealand, and a few facts are recorded; among them, that in advancing the ice appears not to plough up the earth. In conclusion, Mr. Marshall Hall calls upon mountain climbers to help in the work of the Committee.

A PAPER on "The Brain of the Microcephalic Idiot," by Prof. D. J. Cunningham, F.R.S., and Dr. Telford-Smith, read before the Royal Dublin Society nearly a year ago, and noticed at the time in these columns (NATURE, vol. l. p. 287), has just been published in the Society's *Transactions*. The authors give the results of a thorough examination of the brains and skulls of two typical microcephales. Their study leads them to accept the view arrived at by Sir George Humphry, from an examination of microcephalic and macrocephalic skulls, viz.: "There is nothing in the specimens to suggest that the deficiency in the development of the skull was the leading feature in the deformity, and that the smallness of the bony cerebral envelope exerted a compressing or dwarfing influence on the brain, or anything to give encouragement to the practice lately adopted in some instances of removal of a part of the bony case, with the idea of affording more space and freedom for the growth of the brain. In these, as in other instances of man and the lower animals, the brain-growth is the determining factor, and the skull grows upon and accommodates itself to the brain, whether the latter be large or small."

DR. W. M. HAFFKINE has brought together his Indian experiences in anti-choleraic inoculations, and has published them in the *Indian Medical Gazette*. In spite of the very numerous difficulties which he had to encounter in carrying out his investigations, Dr. Haffkine has succeeded, with the assistance of others, in inoculating no less than 32,166 individuals with his cholera vaccine. Every pains was taken to obtain trustworthy records of the results derived from these inoculations, and, as far as can be judged from the data to hand, the balance appears to be decidedly in favour of the process. This is perhaps especially brought out by Dr. Haffkine's work in Calcutta, where the percentage of attacks and deaths amongst the inoculated was 1·18 per cent., whilst amongst the non-inoculated the percentage of cases amounted to 15·63 per cent., and of deaths 11·63 per cent. One fact has indisputably been established by these investigations, and that is the harmlessness of the operation; in view of this it is to be hoped that the inoculations may be more widely spread, and further facilities thus offered for the collection of observations on this very important subject.

A YEAR'S actinometric observations, made at the Konstantinow Observatory, Pawlowsk, are recorded by J. Schukewitch in the *Repertorium für Meteorologie*. They have led to some unexpected results regarding the intensity of the sun's radiation at different seasons of the year. This intensity, as measured on the surface of the earth, depends upon the altitude of the sun and upon the transmitting power or opacity of the atmosphere. The intensities were measured by a thermometer with blackened bulb, which was exposed to the sun side by side with a precisely similar one which was kept in the shade. To test whether the two thermometers were identical in their behaviour, two successive readings were taken, in which first the one and then the other was shaded. It was found necessary to take the mean of these two readings in each case. The tables embodying the results contain, besides the intensity, the state of the sky, the altitude of the sun, and other meteorological data. From these tables the yearly course of intensity of the unclouded sun at noon

is worked out. It shows a principal maximum in April, a secondary maximum in September, and chief minimum in November. The intensity of solar radiation for equal altitudes is greatest in winter and least in summer, a circumstance which tends to equalise the winter and summer temperature. A great diminution of transmissibility is brought about by that phenomenon so characteristic of the middle-European continent, called in Germany *Höhenrauch*, an elevated stratum of peat-smoke which gives a faint and rather pleasant odour, usually taken to indicate the continuance of fine weather. The author finds greater opacity in front of an atmospheric depression, and greater transmissibility after it. The clearest air is preceded by a heavy summer rain.

THE Meteorological Council have published a valuable set of monthly meteorological charts of the Red Sea, showing the prevalent winds and currents, with other information of use to seamen passing through the Suez Canal to India. The wind observations alone number nearly 75,000, and have been supplied from logs specially kept for the Meteorological Office, from ships belonging to the Royal Navy, and various other sources. Each chart, of which there are twenty-four, contains useful remarks referring to the leading features, which are shown graphically, and the introduction to the Atlas contains an interesting general summary by Lieutenant C. W. Baillie, R.N., Marine Superintendent. The wind charts show that from October to January northerly winds are prevalent over the northern half of the sea, and southerly over the southern portion. From February to May the northerly winds extend further south, while southerly winds prevail from near Perim to about the 16th parallel. From June to September, northerly winds blow over nearly the whole sea. Gales are most frequent between November and March; they generally blow from the southward, and are mostly met with in the southern part of the sea. The currents are somewhat erratic, and while occasional strong streams are experienced locally, their velocity is not usually great over large areas. The Gulf of Aden may be taken as an exception, as the currents often set there with considerable velocity. An interesting feature has been noticed in the range of sea-temperature in the Strait of Bab-el-Mandeb, near the Island of Perim, where it amounts to 26° at the period of the S.W. monsoon. The whole work shows evidence of the great care and labour bestowed upon it.

THE extent to which many of the American agricultural experiment stations are devoting attention to the culture of small fruits and other minor crops is perhaps significant of an impending change in the economic bearings of the management of the soil, and of the partial displacement of the *grande culture* which has hitherto almost monopolised the field of experimental inquiry. Bulletin No. 55 of the Purdue University Station, Lafayette, Indiana, opens with a description of experiments with small fruits, carried out in response to the numerous inquiries received from farmers and others concerning the different varieties of such fruits. Strawberries, raspberries, blackberries, currants, gooseberries, and grapes, form the subject of this section of the report. Field experiments with maize and oats are next dealt with, and amongst the results noted, it is stated that better yields have followed the sowing of two bushels or more of oats per acre than that of any smaller quantity. The bulletin concludes with a notice of experiments with sugar beet; but in view of the desperate condition to which the beet-growers of France are at present reduced—despite the artificial support which the sugar industry there receives under the bounty system—we cannot see any immediate hope for the American beet-sugar industry. This, indeed, is practically admitted in the bulletin, for it is said: "The condition of the sugar business throughout all sugar-producing countries is such that there seems to be little probability of capital being invested in beet-sugar plants in this country at present." The points which are reported upon include comparison of varieties, time of harvest, the respective effects of bacterial disease and beet scab on the sugar content of beets, the effect of loosening beets some time before lifting them from the ground, special thinning, tests of foreign and American seed, and yield and cost of crop per acre. It is concluded that, under more favourable economic conditions, beet factories might advantageously be established in the State of Indiana.

A PAPER by Wilhelm von Bezold, on the lines of equal disturbance of the magnetic potential of the earth, appears in a recent number of the *Sitz. der Akad. der Wiss. zu Berlin*. The deviation of the potential at any place from the mean value of the potential corresponding to the parallel of latitude passing through this place being called the disturbance, the author gives the theory of the lines of equal disturbance. He shows that the westerly (or easterly) component of the earth's magnetism is given by the rate of change of the disturbance of the potential along the parallel of latitude or $W = \frac{\partial Va}{\partial y}$ where Va is the disturbance for the potential, and ∂y is an element of a latitude circle. Hence it follows that a knowledge of a westerly component of the earth's field for the whole surface of the earth suffices to everywhere determine the disturbance in the magnetic potential, and draw the lines of equal disturbance. Wherever the lines of equal disturbance are tangential to a circle of latitude $\frac{\partial Va}{\partial y} = 0$, and hence $W = 0$, or all such points will lie on the agonic lines, *i.e.* the lines along which the declination is zero. At all places where the lines of equal disturbance are tangential to the terrestrial meridian the northerly component of the earth's field has its normal value. The author has constructed a chart of these lines for the epoch 1880, using the data given in the magnetic charts published by G. von Quintus Icilius. The mean value of the magnetic potential for the latitude λ is found to be given with a high degree of accuracy by the expression $V_n = K \sin \lambda$, and the author considers that this simple expression must have some special significance, and not be merely an empirical formula.

A PAPER, by Mr. G. C. Whipple, entitled "Some Observations on the Growth of Diatoms in Surface Waters" (*Technological Quarterly*, vol. vii.), is a valuable contribution to the study of the periodic frequency of microscopic organisms in freshwater areas. The work is noteworthy as having been carried on in a biological laboratory attached to the Boston Water Works. The author's general results are here given: (1) That the growth of diatoms in ponds is directly connected with the phenomena of stagnation; that their development does not occur when the lower strata of water are quiescent, on account of greater density, but rather during those periods of the year when the water is in circulation from top to bottom. (2) That diatoms flourish best in ponds having muddy bottoms. (3) That in deep ponds there are two well-defined periods of growth—one in the spring and one in the autumn; that in shallow ponds there is usually a spring growth but no regular autumn growth, and that other growths may occur at irregular intervals as the wind happens to stir up the water. (4) That the two most important conditions for the growth of diatoms are a sufficient supply of nitrates and a free circulation of air, and that both these conditions are found at those periods of the year when the water is in circulation. (5) That while temperature has possibly a slight influence on the growth of diatoms, it is of so little importance that it does not affect their seasonal distribution. (6) That the increase of diatoms takes place substantially in accordance with the law of geo-

metrical progression, and that the cessation of their growth is caused by the diminution of their food supply.

MR. H. G. WELLS's scientific fantasy, the "Time Machine," which has been appearing as a serial in the *New Review*, will be published in volume form, by Messrs. Heinemann, in the course of a few days.

MR. GISBERT KAPP has arranged with Messrs. Whittaker and Co. for a translation from the German of his new work on the "Alternate Current Transformer." The volume will be published in the "Specialists' Series" in the autumn.

THE papers on the relation of diseases of the spinal cord to the distribution and lesions of the spinal blood-vessels, recently contributed by Dr. R. T. Williamson to the *Medical Chronicle*, have been reprinted and published in book form by Mr. H. K. Lewis.

THIS week's new editions include Prof. T. Preston's philosophical "Theory of Light," published by Messrs. Macmillan. More than one hundred pages of new matter have been added, a valuable addition being an account of Prof. Newcomb's experiments to determine the velocity of light. The second edition has appeared of the late Prof. Cayley's "Elementary Treatise on Elliptic Functions" (Macmillan), the first edition of which was published in 1876. Another second edition, received during the past week, is "A First Book of Electricity and Magnetism," by Mr. W. Perren Maycock. This book, now greatly enlarged, is published by Messrs. Whittaker and Co.

THE Deutsche Seewarte, which, with the year 1894, has completed its twentieth year of useful activity, has just issued the seventeenth volume of *Aus dem Archiv*. This work, which has contained many elaborate and valuable discussions in meteorology, navigation, and nautical astronomy, is now devoted more especially to discussions of practical utility to seamen. Among the articles of more general scientific interest may be mentioned one by Dr. Grossmann, on the application of Bessel's formula n meteorology, and one by Dr. Maurer, on the application of graphical methods in meteorology and physics generally; the latter investigation may possibly lead to the substitution of this method for the use of tables in some of the problems of nautical astronomy.

THE additions to the Zoological Society's Gardens during the past week include six Hairy-footed Jerboas (*Dipus hirtipes*), two Lesser Egyptian Gerbilles (*Gerbillus egyptius*), two Lybian Zorillas (*Ictonyx lybica*), two Grey Monitors (*Varanus griseus*), two Egyptian Mastigures (*Uromastix spinipes*), three Egyptian Geckos (*Tarentola annularis*), a Common Chameleon (*Chamæleon vulgaris*), seven Common Skinks (*Scincus officinalis*), two Cerastes Vipers (*Vipera cerastes*), two Diademed Snakes (*Zamenis diadema*), from Egypt, presented by Dr. John Anderson, F.R.S.; a Grysbok (*Neotragus melanotis*, ♀), from South Africa, presented by Mr. J. E. Matcham; a Wapiti Deer (*Cervus canadensis*, ♀), a Japanese Deer (*Cervus sika*, ♀), a Burchell's Zebra (*Equus burchelli*, ♂), two Polar Hares (*Lepus glacialis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

MERCURY AND VENUS.—The planet Mercury is now an evening star, and will be favourably placed for observation until towards the end of June. The greatest elongation will occur on June 4 at 13h., when the planet will transit about 1h. 42m. after the sun; the declination will then be nearly 25° north, and the apparent diameter a little over 8″. Jupiter will be in close proximity to Mercury during the present period of its visibility, so that observers not employing telescopes must be careful to discriminate between the two; at the elongation, Mercury will precede Jupiter by about 8m. in R.A., and will be about 1½ degrees farther north. The two planets will be in actual conjunction on June 8 at 4h., Mercury being 0° 47′ N. of Jupiter.

Venus, also, is most favourably situated for observation at the present time, and the great brilliance of the planet in the western sky after sunset cannot fail to attract the attention of the most indifferent. It will not, however, reach maximum brightness until August 13. The greatest eastern elongation will occur on July 11, and the apparent diameter will increase from 16″ on June 1 to 59″ at the inferior conjunction on September 18.

THE TOTAL SOLAR ECLIPSE OF 1898 JANUARY 21-22.—In addition to the eclipse of the sun which will take place on August 8, 1896, and for which we understand preparations are already well in hand, there will be another important solar eclipse before the end of the present century. This will occur on January 21–22, 1898, and the *Nautical Almanac Circular*, No. 16, gives local particulars of the same for that portion of the path of the shadow which lies across India. At Rajapur the duration will be 2m. 1·9s. and the altitude of the sun 53°; at Nagpur, 1m. 17·7s. with an altitude of 46°; and at a position south of Benares, 1m. 43·6s. with an altitude of 40°. Information as to the meteorological conditions prevailing at various points along the track of the eclipse during the latter part of January is being collected through the assistance of Mr. Eliot, Meteorological Reporter to the Government of India. It is proposed to publish this information early in 1897.

As the next sun-spot minimum is not due until the year 1900, observations of the phenomena of this eclipse will furnish information as to the solar conditions during the transition from maximum to minimum.

THE ASTRO-PHOTOGRAPHIC CHART.—The third part of the second volume of the *Bulletin* of the International Permanent Committee, gives an account of the present state of the great undertaking to prepare a photographic catalogue and chart of the heavens. The reports from the various participating observatories indicate in general a rapid advance towards the completion of the photographs which are intended to form the basis of the catalogue; four of the eighteen observatories have already completed the zones allotted to them, and it is expected that at least eight more will reach this stage by next spring. Systematic work at the South American observatories has been seriously interfered with by political events; but it is satisfactory to learn that the Australian and Cape of Good Hope astronomers are prepared to come to their assistance. An immense number of catalogue plates with short exposures has been taken with the various instruments, no less than 753 having been taken at Paris, and 1562 at the Cape. The measurement of the catalogue plates is also in a forward state at several of the observatories, but the reductions have scarcely been commenced.

For the chart itself, not one-third of the requisite photographs have yet been obtained, but the progress of this part of the work is necessarily slow, in consequence of the long exposures required.

Dr. Gill proposes that the Committee should meet in 1896, to reconsider the various questions left open at the former conference, among which one of the most important relates to the scale of magnitudes to be adopted.

Four important memoirs also form part of the present report. Prof. Turner and M. Prosper Henry discuss different methods of reducing the plates, M. Trépied gives his experience and views as to the determination of magnitudes, and M. Donner discusses the various corrections for instrumental errors.

AWARD OF THE WATSON MEDAL.—On the recommendation of the Board of Trustees of the Watson Fund, the U.S. National Academy of Sciences last year unanimously awarded the Watson medal to Dr. S. C. Chandler, for his investigations relative to variable stars, his work in connection with the variation of terrestrial latitudes, and his researches on the laws of that variation. The recommendation was noted in these columns a year ago, and a description of the founding of the award was given (NATURE, vol. l. p. 157). The medal was presented to Dr. Chandler at the recent meeting of the National Academy, and *Science* for May 3 contains the report of the Trustees, setting forth the grounds upon which the award was made, and briefly stating the history of the investigation of changes of latitude. Dr. Chandler's work upon the subject began with observations made by him in 1884-85. His observations, continued uninterruptedly for thirteen months, revealed a progressive change of a pronounced periodical character in the

instrumental values of the latitude. Circumstances prevented him from carrying on the work until six years later, when he took up the problem again. The results then obtained are published in a series of eighteen papers in the *Astronomical Journal* (1891–94), exclusive of a series of five papers upon a topic closely related thereto, namely, the aberration-constant. These papers have been noted from time to time in this column, so it is unnecessary to do more than refer to them now.

In connection with variable stars, besides the incidental work of observation and discovery which Dr. Chandler has contributed to it, his work has involved the collection of all the data in astronomical history, their discussion, and the formulation of the elements of their light-variations into numerical laws. His important researches upon cometary orbits are also well known to astronomers.

A LECTURE EXPERIMENT.

A FURTHER description of the use of the electric furnace recently exhibited at the Royal Society, for the purpose of lecture demonstrations, may be useful, as pictures, some six feet across, of the interior of the furnace may readily be projected on the screen. This is effected by the aid of the device which has already been given in NATURE (p. 17, Fig. 2). The result is really very beautiful, though it can only be rendered in dull tones by the accompanying illustration (Figs. A, B). It may be well, therefore, to state briefly what is seen when the furnace is arranged for the melting of metallic chromium. Directly the current is passed, the picture reflected by the mirror, E (Fig. 2, *loc. cit.*), shows the interior of the furnace (Fig. A) like a dark crater, the dull red poles revealing the metallic lustre and grey shadows of the metal beneath them. A little later these poles become tipped with dazzling white, and, in the course of a few minutes, the temperature rises to about 2500° C. Such a temperature will keep chromium well melted, though a thousand degrees more may readily be attained in a furnace of this kind. Each pole is soon surrounded with a

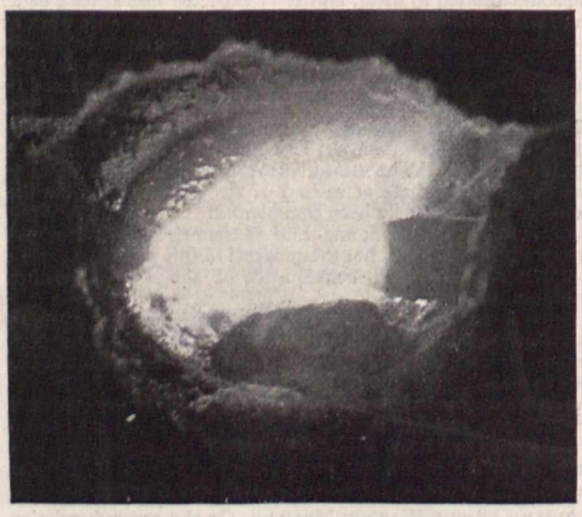


FIG. A.—This represents the interior of the furnace containing molten chromium as is seen either by reflection on a screen or by looking into the furnace from above, the eyes being suitably protected by deeply tinted glasses.

lambent halo of the green-blue hue of the sunset, the central band of the arc changing rapidly from peach-blossom to lavender and purple. The arc can then be lengthened, and as the poles are drawn further and further asunder, the irregular masses of chromium fuse in silver droplets, below an intense blue field of light, passing into green of lustrous emerald; then the last fragments of chromium melt into a shining lake, which reflects the glowing poles in a glory of green and gold shot with orange hues. Still a few minutes later, as the chromium burns, a shower of brilliant sparks of metal are projected from the furnace, amid the clouds of russet or brown vapours which wreath the little crater; while if the current is broken, and the light dies out, you wish that Turner had painted the limpid tints, and that Ruskin might describe their loveliness.

The effect when either tungsten or silver replaces chromium is much the same, but, in the latter case, the glowing lake is more brilliant in its turbulent boiling, and blue vapours rise to be condensed in iridescent beads of distilled silver which stud the crater walls.

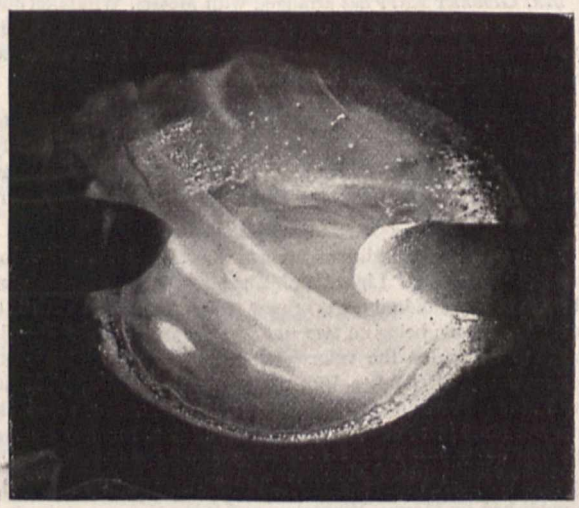


FIG. B.—In this case the arc was broken the instant before the photograph was taken. The furnace contained a bath of silver just at its boiling point. The reflection of the poles in the bath, the globules of distilled silver, and the drifting cloud of silver vapour, are well shown.

Such experiments will probably lend a new interest to the use of the arc in connection with astronomical metallurgy, for, as George Herbert said long ago—

> "Stars have their storms even in a high degree,
> As well as we";

and Lockyer has shown how important it is, in relation to such storms, to be able to study the disturbances in the various strata of the stellar or solar atmosphere. Layers of metallic vapour which differ widely in temperature can be more readily obtained by the use of the electrical furnace than when a fragment of metal is melted and volatilised by placing it in the arc, in a cavity of the lower carbon. W. C. ROBERTS-AUSTEN.

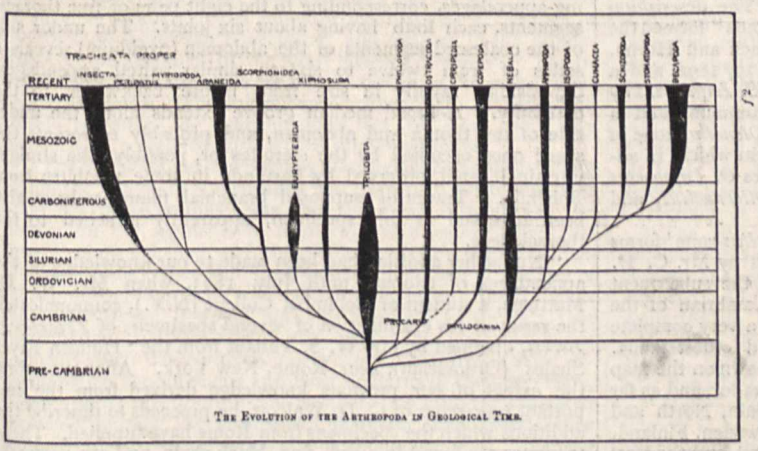
THE LIFE-HISTORY OF THE CRUSTACEA IN EARLY PALÆOZOIC TIMES.

IN his recent anniversary address to the Geological Society, the President, Dr. Henry Woodward, F.R.S., after the usual distribution of medals and awards, the reading of obituaries of deceased Fellows, and some preliminary matters relating to the affairs of the Society, including the moot question of the introduction of ladies as visitors to the evening meetings, devoted the remainder of his address to a brief discussion of "Some Points in the Life-history of the Crustacea in Early Palæozoic Times." Dr. Woodward continued as follows:—"Of the various groups of the Invertebrata whose ancestry extends into Palæozoic times, none possess a greater interest for the geologist than the Crustacea, whose existence is proved as far back as the Lower Cambrian rocks; while their near allies, the Arachnida, have been met with in strata as old as the Silurian.

"My earliest papers on the Eurypterida appeared in 1863 and 1864, and an account of *Stylonurus* and *Hemiaspis* was communicated to this Society in 1865, just thirty years ago. In that year (1865) I had the pleasure, with my friend and fellow-worker, the late J. W. Salter, F.G.S., of publishing a 'Chart of Fossil Crustacea,' in which an attempt was made to show the evolution in time of the various forms belonging to this class, graphically depicted on an engraved folding-sheet, with explanatory text. In it we pointed out that the main development of the crustacea in Palæozoic times consisted of the great groups of the Trilobita, the Eurypterida, the Xiphosura, the Phyllopoda, and the

Ostracoda. The faint beginnings of other great groups were also indicated, such as the Macrouran-decapods represented by *Anthrapalæmon* and other forms in the Coal Measures; the Stomatopods by *Pygocephalus Cooperi*, the Amphipods by *Gampsonyx*, both in the Coal Measures; and by *Prosoponiscus* in the Permian. Lastly, the Cirripedia, by the anomalous form *Turrilepas*, from the Wenlock Limestone.

"In November 1866, I laid before this Society the evidence upon which I based my arrangement of the *Pterygoti* and *Limuli* in one order, for which I adopted Dana's very appropriate name of Merostomata (or 'thigh-mouthed' animals)—expanded to include all those ancient crustaceans comprehended in the two sub-orders of Eurypterida and Xiphosura, and forming two groups of long-bodied and short-bodied forms, quite parallel to the Brachyoura and Macroura in the Decapoda; even the intermediate forms—corresponding to the Anomoura—being paralleled by the Hemiaspidæ (*Hemiaspis*, *Pseudoniscus*, &c.). This group formed the subject of a monograph published by the Palæontographical Society (1865–1878) comprising 17 genera and 84 species—69 of which are Palæozoic in age. The integrity of this group, founded on the researches of Huxley, Salter, Dana, Hall, and many others besides myself, has been firmly maintained, although many attempts have since been made to detach it from the Crustacea and place it with the Arachnida. For instance, it was proposed by Dr. Dohrn, in 1871, to include the Merostomata in a still larger division, under Haeckel's term Gigantostraca, which was made by expansion to embrace the Merostomata and the Trilobita, and to be placed *between* the Crustacea and the Arachnida.



THE EVOLUTION OF THE ARTHROPODA IN GEOLOGICAL TIMES.

"In arguing for their retention before this Society in 1871 I wrote:—'Take away the trilobita from the pedigree of the crustacea, and I submit that one of the main arguments in favour of evolution to be derived from the class, so far from being strengthened, is destroyed. From what are the crustacea of to-day derived? Are we to assume that they all descended from the phyllopods and ostracods—the only two remaining orders whose life-history is conterminous with that of the trilobita? Or are we to assume that the arachnida are the older class?' 'If,' says Fritz Müller, 'the crustacea, insecta, myriapoda, and arachnida are indeed all branches of a common stock, it is evident that the water-inhabiting and water-breathing Crustacea must be regarded as the original stem from which the other terrestrial classes, with their tracheal respiration, have branched off.'

"In the above-quoted paper I pointed out that the young *Limulus*, when it quits the egg, has the hinder body as large as the head-shield, and the nine segments composing it are most clearly marked out, the abdominal spine being quite rudimentary and forming in fact the 9th segment. This is the so-called '*Trilobiten-stadium*' of Dohrn.

"'At this stage,' says Packard, 'the young swim briskly up and down, skimming about *on their backs* by flapping their gills, not bending their bodies.' This locomotion of the young *Limulus*, by swimming upon its back, near the surface of the water (by means of its gill feet), agrees very closely with the habit of *Apus*, of *Chirocephalus*, and *Artemia*, and is extremely suggestive of its affinity to the phyllopoda, with which, at this stage of its existence, it has many points in common, as well as with the trilobita.

"It is interesting to notice that the Xiphosura (king-crabs)—which form the surviving representatives of this ancient order of the Merostomata, and are so widely distributed in the Coal Measures of North America, Britain, &c.—have likewise been discovered as far back in time as the Upper Silurian of Lanarkshire, being represented by a small form which I named and described, in 1868, *Neolimulus falcatus*, having eight thoracic segments apparently free and movable, but wanting the tail-spine, which probably was developed later in life, or may have been represented by an extremely short terminal plate, as we see is the case in the young larval *Limulus*. Thus the earliest fossil king-crab known probably resembled closely the free-swimming larva of the living king-crab as it leaves the egg.

"As to whether the Eurypterida—with their evidently aquatic branchiated respiration, their jaw-feet provided with swimming- (not walking-) extremities—are in the direct line of ancestral relationship to the recent scorpions, I may refer again to my paper 'On some Points in the Structure of the Xiphosura,' &c.:—'This is one very strong argument, to my mind, in favour of the higher zoological position of *Pterygotus*—that, being extremely larval in its anatomy, it consequently possessed the capacity for further development, and so has been modified and disappeared'—its latest representatives being met with in the Coal Measures, where the then earliest known examples of fossil scorpions had also been found. But the discovery, almost simultaneously, by Thorell and Lindström in Gotland; by B. N. Peach in Scotland; and by Whitfield in North America (in 1885) of actual pulmonated land scorpions in rocks of Upper Silurian age (as far back, in fact, in geological time as the earliest known occurrences of *Pterygotus*, *Slimonia*, and *Eurypterus*) indicates that the air-breathing scorpions were derived from a *still earlier* and as yet undiscovered aquatic progenitor possibly in Cambrian or pre-Cambrian times.

"Simultaneously with the commencement of my own work on the Merostomata, J. W. Salter undertook a monograph on the British Trilobites for the Palæontographical Society in 1864. No one who takes up this fine work of our old friend can avoid a feeling of regret that Salter's valuable life and splendid palæontological knowledge should not have been longer spared to us to carry on to its completion this most important service.

"Following up the progress of our knowledge of the trilobites, I may note that Dr. Henry Hicks made his first communication to this Society in 1865 on the genus *Anopolenus*, and between 1871 (when he came to London from the happy hunting-grounds of St. David's and joined the Geological Society) and 1876, he communicated to this Society a series of papers on the faunas of the 'Menevian,' the Lingula Flags, Tremadoc Slates, and Arenig series, giving descriptions of no fewer than thirty-four species of trilobites, belonging to eighteen genera, from those ancient rocks.

"But numerous as are these additions to our knowledge of the trilobites of Wales, they only represent a part of Dr. Hicks's discoveries, many of which were announced by Salter; the most important being that of the finding of a large *Paradoxides* at St. David's, proving the existence of a Middle Cambrian or '*Paradoxides*-zone,' coextensive with the vast area over which these early rocks have been observed, and occupying a persistent horizon throughout Europe and America.

"A brief reference must here be made to the papers published by that excellent geologist and naturalist, the late Thomas Belt, F.G.S., in 1867 and 1868, on new trilobites from the Upper Cambrian rocks of North Wales, and on the Lingula Flags or Ffestiniog group of the Dolgelly District, with figures and descriptions of four species of *Olenus* (non-*Conocoryphe*) and four species of *Agnostus* from Dolgelly. In 1888 I was so fortunate as to be able to record the first discovery of trilobites (*Conocoryphe viola*) in the Longmynd Group, Penrhyn quarries, Bethesda, near Bangor, in North Wales.

"The remarkable fauna of the *Olenellus* or Lowest Cambrian zone, originally discovered in America by Dr. Emmons in 1844, was first recognised in Europe by the late Dr. Linnarsson in 1871, in the basal zones of the Cambrian near Lake Mjösen in Norway, but its typical genus *Olenellus* was then referred by him to the allied but more recent genus *Paradoxides*. This referenc

was corrected by Prof. Brögger in 1875; and the various brilliant papers on the Primordial formations by this author have given the *Olenellus*-fauna a marked and peculiar interest. In 1882 Linnarsson next made known the existence of the *Olenellus*-fauna in Scania, at the base of the Swedish Cambrian. In 1886 the same fauna was detected by Mickwitz in the Lower Cambrian of Russia (Esthonia), and this Russian fauna was figured and described in detail by Dr. F. Schmidt, of St. Petersburg. In 1887 Dr. Holm reported the existence of the *Olenellus*-fauna in the Cambrian of Lapland, where it was first detected by Mörstell in 1885. Thus the existence of this remarkable fossil group, the oldest well-marked fauna recognised by geologists in the Lower Cambrian, had already been demonstrated, in 1888, in three main regions, namely: (1) in the region of the Rocky Mountains; (2) in the region of North-eastern America; (3) in the region drained by the Baltic Sea. Up to 1888 no recorded account of the discovery of *Olenellus* from the British Isles had been published, the oldest fauna described being the overlying *Paradoxides*-zones or Middle Cambrian formation.

"The first recognisable traces of *Olenellus* in Britain were discovered by Prof. Lapworth in 1885. Further collections were made in 1887 and 1888, on the flanks of Caer Caradoc, Shropshire, and the species was named, in honour of Dr. Charles Callaway, *Olenellus Callavei*. Later on it was figured and described in the *Geological Magazine* for 1891.

"In August 1891, Sir A. Geikie announced, at the British Association meeting in Cardiff, the discovery of *Olenellus* by Messrs. Peach and Horne, in blue-black shales, a few feet below the "Serpulite Grit" of the Cambrian rocks of North-west Scotland, in the Dundonnell Forest of Ross-shire. The description of "the *Olenellus*-zone of the North-west Highlands" formed the subject of a most valuable paper by Messrs. Peach and Horne, read before the Geological Society on February 10, 1892, and a new species of *Olenellus* is described and named *O. Lapworthi* by these authors. Mr. B. N. Peach, F.R.S., communicated a second paper, "Additions to the Fauna of the *Olenellus*-zone of the North-west Highlands," on June 20, 1894; in which, in addition to *O. Lapworthi*, he describes and figures *O. Lapworthi* var. *elongatus*, *O. reticulatus*, *O. gigas*, *O. intermedius*, and *Olenelloides armatus*.

"'The Fauna of the Lower Cambrian or *Olenellus*-zone' forms the subject and title of an admirable monograph by Mr. C. D. Walcott, F.G.S., which, with the exception of the subsequent discovery of an *Olenellus*-fauna in the Lower Cambrian of the Scotch Highlands (already referred to), gives us a very complete and up-to-date account of this interesting and oldest fauna. About eighteen widely distributed localities are shown on the map of North America from British Columbia to Labrador, and as far south as Texas; whilst in Europe we have Spain, North and South Wales, the Scottish Highlands, Norway, Sweden, Finland, Bohemia, Bavaria, Podolia, Sardinia, Petchoraland, and the Ural Mountains. Omitting trails, burrows, and tracks, the *Olenellus*-fauna has yielded fifty-five genera of organisms, fifteen of which are Trilobites.

"We may now add yet another locality in which this remarkable fauna occurs, as proved by the presence of the remains of *Olenellus* and the pteropod *Salterella*; namely, in Western Australia, where it was discovered by Mr. Hardman in 1886.

"I must here refer to the discoveries of the limbs of trilobites. In 1870 the late E. Billings, the Palæontologist of the Geological Survey of Canada, brought before the Geological Society and described a specimen of *Asaphus platycephalus*, from the Trenton Limestone of Ottawa, Canada, exhibiting remains of eight pairs of limbs, corresponding with the eight free and movable segments of the body, and showing the hypostome still attached to the doublure of the anterior border of the cephalic shield; traces of two appendages under the caudal shield were also visible. On that occasion I exhibited a specimen of *Asaphus* from the same locality and horizon, showing evidence of a small 7-8-jointed palpus lying at the side of the hypostome apparently in its original position. After some remarks on the superficial character of trilobites, I added:—'The prominence of the hypostome in the trilobita reminds one even more strongly of the genus *Apus* than of the isopods, and it is quite reasonable to expect in the trilobita a more generalised type of structure than that which marks the modern representatives of the class.'

"In 1881, after many years of untiring labour, Charles D. Walcott furnished most conclusive proofs of the existence of appendages to the cephalic, thoracic, and abdominal divisions of *Calymene*, *Ceraurus*, and *Acidaspis*. His researches have been carried on by the method of making thin transverse and longitudinal sections of rolled-up specimens. He has shown that the ventral body-wall of the trilobites was bounded inferiorly by a thin chitinous membrane, which was attached to the lower margin of the dorsal exoskeleton all round. This ventral membrane was supported by calcified arches, which gave attachment to the appendages beneath. He further established the existence of a row of articulated cylindrical limbs, on each side of the middle line. Walcott described the thoracic appendages in *Calymene* as slender six-jointed walking-legs (endopodites) with a single pointed termination, the basal segment giving rise to a branch appendage (exopodite). On each side of the throracic cavity he also described a row of bifid spiral appendages, of the nature of gills, and he suggested that branchiæ were attached to the bases of the thoracic limbs as well. The abdominal or pygidial rings carried appendages, a pair to each segment, but they do not appear to have differed from the thoracic limbs, save in size. The mouth is situated behind the hypostome, and has four pairs of jointed manducatory organs, the bases of which are modified to serve as jaws; the hindmost pair being the largest, and expanded at the distal extremity into a swimming-organ.

"The correctness of Billings's views, as to the nature of the thoracic limbs of *Asaphus platycephalus*, was further confirmed by the finding of a specimen of *Asaphus megistos*, in the Ordovician rocks of Ohio, which shows the under surface with its appendages, described by Dr. I. Mickleborough. This specimen shows two pairs of maxillipeds or jaw-feet, eight pairs of walking-appendages, corresponding to the eight pairs of free thoracic segments, each limb having about six joints. The under side of the coalesced segments of the abdomen (pygidium) reveals a series of from twelve to sixteen similar paired appendages, diminishing rapidly in size from before backwards to the extremity. A broad median groove extends along the under side of the thorax and abdomen, and probably represents the space once occupied by the sternites or, possibly, the straight intestinal canal, observed by Barrande in some trilobites from Bohemia. Traces of supposed branchial filaments have also been observed in this specimen, apparently attached to the thoracic legs.

"No further addition had been made to our knowledge of the appendages of triobites until July 1893, when Mr. W. D. Matthew, a student of Columbia College (N.Y.), communicated the result of his examination of several specimens of *Triarthrus Beckii*, obtained by Mr. W. S. Valiant from the 'Hudson River Shales' (Ordovician), near Rome, New York. After recording the extent of our previous knowledge derived from the important researches of C. D. Walcott, he proceeds to describe the additions which the specimens from Rome have supplied. These trilobites are found in a soft, fine, black shale, and are perfectly well preserved. The most noticeable character is the presence of long, slender, many-jointed whip-like appendages attached to the front of the head, closely resembling the flagellate antennæ of other crustaceans. These originate beneath the anterior border of the head-shield, and are as long again nearly as the glabella itself. Mr. Matthew also was able to detect a series of walking or swimming-legs, one a narrow, jointed, cylindrical leg, the other thin, broad, fringed with a comb-like structure similar to the gills of many crustacea.

"The next communication is from Mr. C. E. Beecher, of New Haven, Conn., 'On the Mode of Occurrence and the Structure and Development of *Triarthrus Beckii*.' The material gathered for the Yale University (by the aid of Prof. Marsh), near Rome, New York, is probably some of the best which has been obtained, and has been carefully examined and described by Mr. Beecher.

"In their present condition the specimens from Rome contain very little calcite, nearly the entire calcareous and chitinous portions of the trilobites being replaced by a thin film of iron pyrite. To this cause is doubtless due the preservation of delicate organs and structures which would otherwise have been destroyed.

"The specimens thus preserved occupy an extremely restricted vertical distribution, but within this range they are nearly all complete, and preserve their appendages. They are of all ages, from larval forms up to full-grown individuals, whilst the adjacent strata contain a rather sparse fauna in which the trilobites are generally fragmentary and without appendages. The author believes that, in the majority of beds in which trilobites are

found, the remains met with represent the exuviæ of living animals that have cast their shell, rather than the tests of dead individuals. In this particular deposit the appendages are apparently in the position which they occupied during life, and not such as would be assumed in the cast-off shells of recent crustacea.

"Mr. Beecher mentions another interesting point, namely, that nearly all the specimens are found with the back down, which is explained by suggesting that, although they lived with the ventral side downwards, the gases in the viscera produced during decomposition were sufficient to overturn the animal and allow it to be buried by the accumulation of the fine sediments in the position in which it is now found.

"The appendages of *Triarthus* appear now to be very well made out. The antennæ, as seen in a number of specimens, were simple multiarticulate flagella, which Walcott has shown extend backwards to the lateral margin of the hypostome, so that they occupy exactly the same position as do the first antennæ in recent *Apus*.

"Two small appendages, like simple palpi, with broad basal joints, which may represent the maxilla, are seen in one of Walcott's specimens, and there were probably four pairs of similar cephalic appendages, besides the simple flagellate antennæ, more or less modified to serve as mouth-organs.

"Each segment bears a pair of biramous appendages originating at the sides of the axis, as in other trilobites. The anterior legs are the longest, and the others gradually become shorter towards the pygidium. Each limb consists of two nearly equal branches, the 'endopodite' and 'exopodite,' which may be correlated with the typical crustacean primitive limb, and are well displayed in the adult *Mysis*; in the biramose natatory-feet of the zoea of the common shore-crab (*Carcinus*); and retained in the appendages of the abdomen of the adult lobster (*Homarus*). Practically, these biramose limbs are reproduced along the entire series of free segments. The appendages belonging to the pygidium closely resemble the branchigerous feet of *Apus*, and may evidently be correlated with typical phyllopod limbs.

"The first point insisted upon by all systematic zoologists—long before the finding of appendages had thrown so much new light upon our investigations—was that the great variability in the number of the segments in trilobites was a feature which distinctly connected them with the phyllopoda. Bernard considers of greater importance still the gradual diminution of the size of the segments posteriorly, which remarkable feature the trilobites share with *Apus*. I would also call attention to the fact that those earlier trilobites which best exhibit this large number of segments, such as *Olenellus*, *Paradoxides*, &c., are likewise remarkable for the simplicity and exact similarity of their segments, being a serial repetition of one another, and even the coalesced segments forming the head-shield share the same resemblance with the free posterior thoracic and abdominal ones. Bernard has given expression to the idea most aptly when he writes (*op. cit.* p. 412):—"The adult is but the grown, not metamorphosed, larva—grown by the continual development of segments from before backwards, until at a certain stage this process becomes fixed, and we have the adult *Apus* with a number of fixed rudimentary segments. This fixation of a number of undeveloped segments is visible also in many trilobites.

"In the earlier forms (as *Olenellus*) these rudimentary posterior segments still remain free; but, as a rule, they are coalesced to form the plate-like pygidium so characteristic of the trilobites.

"Turning to the appendages, the simple multisegmented flagellate antennæ are extremely characteristic of the crustacea, being met with in lowly copepods and highly-developed decapods.

"The biramose paired limbs are quite a primitive type, like the segments to which they are attached, exceedingly simple, yet characteristic, and with the exception of the antennæ and the four succeeding pairs of appendages, which are modified to serve as mouth-organs (maxillæ and maxillipeds), the whole series are simple biramose natatory or walking-feet, such as persist still in adult *Mysis* and many other recent crustacea.

"The eyes in trilobites closely resemble those of other anthropods, but vary somewhat in position, and also in development, in some genera the eyes being altogether absent, as in *Ampyx*, *Ceraurus*, &c., whilst in others, like *Æglina*, they are enormously exaggerated in size. In some genera the eyes are hyaline, the faceted surface being covered with a fine transparent layer, whilst in others the facets appear prominently on the surface. It is suggested by Bernard that the minute pore observed in the head, near the compound eye in several genera (*Trinucleus*, *Acidaspis*, *Calymene*, *Ampyx*, *Griffithides*, *Phillipsia*, &c.), may be analogous to the pore in the head-shield of *Apus*, and be the opening into the water-sac covering the eyes; and whilst in some genera of trilobites this water-sac may have existed, it may have degenerated in others, leaving the eye in contact with the outer cuticle, which covered it like a thin transparent membrane. In none of the trilobites have larval eye-spots been observed.

"Dr. Lang held the view (in 1891) that if a fifth pair of cephalic limbs were found comparable with the anterior antennæ, trilobites might then be regarded as primitive entomostraca, to be derived from the same racial form as the phyllopoda.

"Walcott is of opinion that the trilobita formed a distinct branch, which diverged at a very early date from the phyllopoda, and having expended its vital energy in Palæozoic times it disappeared. He adds: 'Probably two thousand species and one hundred or more genera are known from Palæozoic strata. With this great differentation the initial vital energy of the group became impaired, and the trilobita died out at the close of Palæozoic time.

"I willingly adopt the view that the trilobita are ancestrally connected with *Limulus*; that *Limulus* may be related through *Hemiaspis* with *Eurypterus*; but all the intermediate forms have not yet been met with. That some ancestral Eurypterid must have given rise to *Scorpio* cannot, I think, be doubted; but it must have been in pre-Silurian times, for Peach and Lindström's *Palæophonus* had already appeared in the Upper Silurian of Lanarkshire and Gotland as a terrestrial pulmonated form, while a similar land-scorpion had been discovered by Whitfield in the Silurian of America.

"The Phyllopoda deserve consideration from a geological standpoint, a representative of *Apus* (*Protocaris Marshii*) having been met with in the Lower Cambrian of Vermont, U.S. Some of the living genera are naked (*Branchipus* and *Artemia*), but in most the front portion of the body is protected by a shield-like carapace (*Apus*), or it may be enclosed, as in *Estheria*, in a bivalve shell. The fossil remains of bivalved phyllopods, *Estheria* and *Leaia* were described by Prof. T. Rupert Jones as far back as 1862 in the Palæontographical Society, where he defines nineteen species ranging from the Old Red and Carboniferous upwards.

"The most ancient of these shield-bearing crustaceans, originally placed with the phyllopoda and having a single modern analogue (*Nebalia*), have now, by general consent, been removed and placed under the order Phyllocarida, a name suggested by Dr. A. S. Packard in 1879. The fossil forms referred to this order were originally studied and noticed by M'Coy, Salter, Barrande, Clarke, and have subsequently been fully described by Prof. T. Rupert Jones and myself.

"Metschnikoff, who studied the embryology of *Nebalia*, considered it to be a 'phyllopodiform decapod.' Besides the resemblance to the decapods, there is also a combination of copepod and phyllopod characteristics. The type is an instance of a generalised form, and is of high antiquity, having made its appearance in Cambrian times, when there lived (if we regard the relative size of most crustacea, and especially that of the living *Nebalia*) gigantic forms. Such was the Silurian *Ceratiocaris ludensis*, which was probably more than two feet in length.

"The modern *Nebalia* is extremely small, about ¼ inch in length, but a newly-described species, *Nebaliopsis typica*, Sars, measures as much as 1⅜ inch, with the body compressed, and the carapace bivalved, as in *Limnadia*, one of the genuine phyllopods. There is a large movable rostrum overhanging the head; stalked eyes; the cephalic portion carries two pairs of antennæ and three pairs of special mouth-organs (mandibles and maxillæ); the thoracic segments bear eight pairs of short, leaf-like respiratory-feet, which are followed by six pairs of (abdominal) simple swimming-feet, four being large and two rudimentary, while the last two segments (seventh and eighth) are destitute of appendages, the body terminating in an elongated phyllopod-like caudal fork. Compared with *Nebalia*, the fossil forms give evidence of an articulated rostrum; traces of antennæ; the presence of a pair of strong mandibles; of a large expanded shield in some, and of a folded or bivalved carapace in others; of the presence of seven or eight body-segments, sometimes carrying branchigerous appendages, the terminal segment carrying a central caudal spine and two lateral shorter ones. It seems highly probable that the old giant pod-shrimps (*Ceratiocaris*, *Dithyrocaris*, &c.), whose remains occur in the Palæozoic rocks from the Cambrian to the Carboniferous, are represented by the

minute living *Nebalia*, and that these early forms may have given rise to, and have been the forerunners of, the modern Malacostraca. 'In *Nebalia*,' says Claus, 'we probably have to do with an offshoot of the phyllopod-like ancestors of the Malacostraca, which has persisted on to the present time.'

"The genus *Estheria* existed in the fresh and brackish waters of the Devonian Period, in Livonia, Caithness, and Orkney, and also in Nova Scotia and Scotland. It flourished in the European area at several of the Upper Carboniferous stages, and was well represented in the Secondary and Tertiary rocks; it is also living, and has a world-wide distribution.

"The Phyllocarida seem in some cases to afford examples of persistency of type, and in others of local or temporary specialisation. One of the oldest known is the Cambrian *Hymenocaris*, a prototype of the recent *Nebalia*. *Caryocaris* of the Arenig series possibly belongs to the same group; and the Upper Silurian *Ceratiocaris* carries the form to a high degree of perfection; but until we meet with the *Nebalia* of to-day we have no tangible links in this series in intermediate geological times. Walcott's Cambrian *Protocaris* is quite susceptible of being regarded as a predecessor of the living *Apus*. The Carboniferous *Dithyrocaris* and its allies stand probably in the relation of genealogical links. But much more research among these interesting lower crustacean fossils is required before their phylogenetic relationship can be fully elucidated.

"The Ostracoda, which have the entire body enclosed in a shell or carapace composed of two valves united along the back by a membrane (represented by such forms as *Cypris*, *Cypridina*, *Candona*, *Beyrichia*, *Primitia*, &c.), are chiefly dwellers in shallows, and occur both in fresh and salt water; they are usually of minute size; but there are deep-sea types which attain comparatively large dimensions (an inch long). They are met with in rocks of almost all ages from the Cambrian upwards. To speak of them here is to recall the nearly life-long labours (from about 1840) devoted to their elucidation by Prof. T. Rupert Jones, who has described many hundreds of these primitive crustacea from rocks of every British formation as well as from very many foreign countries.

"Great as are the transformations which these organisms have witnessed in the long cycles of geological change from Lower Cambrian to modern time, they present, nevertheless, a general facies, and (like the genus *Lingula* amongst the brachiopoda) must be looked upon as one of those persistent types which possess enormous power of multiplication, so that entire beds of rock may be said to be composed of their microscopic tests. The living species also possess exceptional powers of endurance and provision for the preservation of their lives in periods of drought, often retaining their vitality in a dormant state perhaps for years; thus they have persisted through all the vicissitudes of geological time, represented by the entire succession of the stratified rocks; 'all things changing, but themselves unchanged.'

"None of the older Ostracod genera exist now; but some of the existing forms of the Cyprididæ, Cytheridæ, and Cytherellidæ are fully represented by predecessors in the Palæozoic rocks. The wonderfully well-preserved *Palæocypris Edwardsii*, discovered by Dr. C. Brongniart, enclosed in transparent silica, displaying the soft parts of the animal as perfect as in life, from the Coal Measures of St. Etienne, is evidence of the existence of Cyprids in that far-off time.

"I have endeavoured to depict in a diagram (p. 115) the evolution of the Arthropoda in geological time.

"In concluding this brief excursion over the abysses of Palæzoic time, I have only been able to bring under your notice a few isolated points of interest in the crustacean fauna which lie in the depths of these ancient deposits. They may, however, serve to show that this group of lowly existences is not destitute of interest for the biologist. There may also be a possibility of connecting these isolated observations so as to show their bearing upon the greater question of the development of life.

"In order, however, to do this effectively I must ask you to accompany me next year in a second excursion over the newer Palæozoic and Kainozoic seas, where, nearer land and in shallower waters, we shall find a still greater variety of life-forms to study.

"Two conclusions may be drawn from our observations, namely, (1) that the ancient faunas of the earth were far more widespread, more simple and more uniform than are our recent faunas; and (2) if, as the researches of geologists seem to indicate, other sedimentary rocks exist, *older* than the Lower Cambrian, then we may hope to gather evidence of still earlier and more simple forms of life than are met with in the '*Olenellus*-zone.' We are fully justified in concluding that such must actually have existed, because we find in the Lower Cambrian evidence of a quite considerable fauna belonging to several divisions which, although lowly in themselves, are nevertheless already so clearly differentiated one from the other as to prove to us that we are still, both biologically and chronologically, very far removed from the commencement of life on the earth."

SCIENTIFIC SERIALS.

American Journal of Science, May.—On the colour relations of atoms, ions, and molecules, by M. Carey Lea. Part 1. The colour or absence of colour of an element is a function of its atomic weight. No element having ions coloured at all valencies can belong to the same natural group with elements having colourless ions only. The entire class of elements with colourless ions is divided into nine great natural groups, as follows:—H, F, Cl, Br, I; Li, Na, K, Rb, Cs; Ca, Sr, Ba; Sc, Y, La; Be, Mg, Zn, Cd, Hg; B, Al, Ga, In; C, Si, Ge, Sn, Pb, Th; N, P, As, Sb; O, S, Se, Te. This first great division of the elements includes all those whose ions function as anions, and also part of the cathions. Intermediate between the two chief divisions are eleven transitional elements, viz. Ti, V, Cu, Nb, Mo, Ag, Ce, Ta, W, Th, Bi. These have ions which at some valencies are coloured and at others colourless. These are cathions only. With atomic weights ranging from 1 to 47 the atoms are colourless; 52 to 59 coloured; 65 to 90 colourless; 103 to 106 coloured; 112 to 139 colourless; 145 to 169 coloured; 192 to 196 coloured. Elements whose place in the numerical series falls between these periods have both coloured and colourless atoms. The six heaviest metals at the end of the series are alternately coloured and colourless.—Argon, Prout's hypothesis, and the periodic law, by Edwin A. Hill. A very interesting question connected with the discovery of argon is what will be the effect of these researches upon Prout's hypothesis? It is possible that argon has been an unsuspected cause of error, which, when properly allowed for, will show the ratio of H to O to be almost exactly 1 to 16. This would make so many atomic weights even or half multiples of H as to render probable the generation of the elements from a common form of matter by the continued addition of some one or more constant increments of mass.—Relation of the plane of Jupiter's orbit to the mean plane of 401 minor planet orbits, by H. A. Newton. The secular perturbation of the orbit of a minor planet by Jupiter is such that the inclination of the orbit plane is not greatly changed, but the node has a constant motion. Whatever may be the distribution of the poles of these orbits at one epoch, the tendency of the secular perturbation by Jupiter is to finally distribute them symmetrically around the pole of Jupiter's plane. The present inclination of the mean plane to Jupiter's plane is 0°·43.

American Meteorological Journal, May.—The cause of cyclones, by Prof. A. Woeikof. The article deals chiefly with two points mentioned in a former paper on this subject by Mr. Dines. Dr. Woeikof considers that the balloon ascent from Munich on December 11, 1890, showed that, while there is no cooling of the free air in calm anticyclonic weather, the radiation of the surface of the snow cools the surrounding air, even on an isolated mountain. With regard to the suggestion that the latent heat set free by condensation is sufficient to cause a storm, he points out that the heat set free by copious condensation in India does not produce storms.—Meteorological problems for physical laboratories, by Prof. C. Abbe. Few physical laboratories have conveniences for studying aero-dynamics, but the author, with the assistance of Prof. C. F. Marvin, gives a list of thirty-seven subjects for experimental investigation which demand attention from meteorological students.—Long range weather forecasts, by Prof. H. A. Hazen. The author puts forward a series of crucial tests of weather forecasts, more particularly with the view of showing the fallacy of the predictions based on the positions of the moon, planets, &c.—There is also an article by F. B. White on topographic influence on the winds of the weather maps, which frequently show erratic winds, having no dependence on the barometric gradients charted with them.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, May 10.—Captain W. de W. Abney, President, in the chair.—Mr. Herroun read a paper on the iodine voltameter. After referring to the usual methods of determining the value of the small currents used in calibrating galvanometers and other apparatus for measuring small currents, and discussing the errors to which they are subject, the author gave his reasons for selecting iodine. He did this since, with the exception of mercury in the mercurous state, iodine has the largest electro-chemical equivalent, and in addition, by titration with sodium thiosulphate, it is possible to determine the quantity of iodine liberated with a greater accuracy than can be obtained by weighing a deposit of copper or silver with the balance. The solution employed in the voltameter contains 10 to 15 per cent. of zinc iodide. If care is taken to leave a small piece of metallic zinc in this solution, no free iodine is liberated on keeping, unless the solution is exposed to a strong light for some time. The anode consists of a plate of platinum at the bottom of a tall and fairly narrow beaker. The wire leading the current to the anode is encased in a glass tube, so that the iodine is only liberated at the bottom of the beaker, where, on account of its great density, it tends to collect. The kathode consists of an amalgamated zinc rod, which, to prevent loose particles of zinc falling down into the iodine, is surrounded by a piece of filter-paper or vegetable parchment. In an electrolysis lasting for as long as two hours, none of the iodine is found to diffuse up to the part of the solution near the zinc kathode. Where, on account of the extreme feebleness of the current employed, it is necessary to allow the electrolysis to continue for longer than two hours, a U-tube is used with two small plugs of asbestos at the bend, the anode being in one limb and the kathode in the other. With this form of voltameter, even after the current has flowed for several days, no signs of iodine have been found in the limb containing the kathode. On account of the production of electric convection currents, the iodine voltameter does not seem to be quite so suitable for the accurate measurements of strong currents. After the current is stopped the zinc electrode is immediately removed, the solution stirred, and the amount of iodine liberated determined by titration with sodium thiosulphate. The author finds that a convenient strength of the thiosulphate solution is one in which one c.c. corresponds to the amount of iodine liberated by five coulombs of electricity. This solution contains 12·8375 grms. of pure recrystallised sodium thiosulphate per litre. It is possible to perform the titration to within 0·1 c.c., which corresponds to 0·5 coulomb, or, if the electrolysis lasts one hour, to 1/7200 ampere. In a comparison made with a silver voltameter, the current as deduced from the silver was 0·0264 ampere, and that deduced from the iodine 0·0266. The author considers that part of the difference may be due to the effect of oxygen dissolved in the solution of silver nitrate. Prof. Carey Foster considered this process for measuring currents a most valuable one. The idea of using a volumetric method for measuring currents was to him new. He did not, however, see the advantage of using a substance with a high electro-chemical equivalent if a volumetric method was going to be employed to estimate the quantity of the substance liberated. It would be possible to use a chloride, though in this case the titration would probably be less accurate. Prof. Silvanus Thompson said he thought the method would be very valuable, but he would like to know if any error was likely to arise if too great a current density was employed. The number the author had assumed for the atomic weight of silver (108) was only approximate; if the more accurate value (107·7) were used, the agreement between the results obtained with the silver and iodine voltameters would be improved. Mr. Trotter asked what was the largest current that could be accurately measured. Mr. Enright said he had used porous diaphragms in iodine voltameters, and found that the iodine collected in the positive compartment, while the water was driven over into the negative compartment. With strong currents it was possible to get almost pure iodine left in one compartment. Mr. Watson thought that, since the value for the electro-chemical equivalent of iodine used by the author was deduced from Rayleigh's value of the electro-chemical equivalent of silver, and that Rayleigh's experiments were performed in air, the difference obtained with the silver and iodine voltameters could hardly be due to the cause suggested. Mr. Elder warned the members that volumetric measurements were not so accurate or easy as they seemed. He particularly mistrusted a solution of sodium thiosulphate, since he had found a solution of this substance to change even in twenty-four hours. The difficulty of accurately reading the burette might be overcome by weighing the burette and its contents before and after the titration. The author in his reply said that with the size of electrodes he used (about 9 sq. cm. surface) 0·1 ampere was the maximum current it was safe to use. The only substance likely to be produced by too great a current density was periodate, which, since it was insoluble, would immediately be noticed. The influence of the dissolved oxygen was only appreciable with small currents where the electrolysis lasts some time, while in Rayleigh's experiments large currents were employed. The chairman, while returning thanks to the author for his paper, mentioned that in his experience he had found zinc salts to be very untrustworthy.—Mr. A. Sharp read a paper entitled a new method in harmonic analysis. The author, in this paper, applies the principle of the form of harmonic analysis for giving direct readings of the amplitude and epoch of the various constituent harmonic terms, previously described by him, to the performance of harmonic analysis without the use of an instrument. The kinematic principle is as follows: Let the curve to be analysed be drawn with a scale of abscissa such that the period is 2π. Let a wheel w roll on the paper and be connected with a tracing-point P in such a manner that as P moves uniformly in the x direction the axis of the wheel w turns uniformly counter clockwise in a horizontal plane, and the distance rolled through during any short interval is equal to the corresponding displacement of the tracer P in the y direction. The curve traced out by w the author calls the roller curve, and from the vector joining the initial and final points of this curve the amplitude and epoch can be determined. Suppose the periodic curve consists of a portion of the curve $y=a_0+a_1x+a_2x^2+ +a_mx^m$ repeated over and over again. Then, if the tracer is taken round this periodic curve you get a rolled curve which may be called the first rolled curve. If now the curve whose ordinates are $\frac{dy}{dx}$ is traced out, the roller curve obtained is the evolute of the first, and so on for $\frac{d^2y}{dx^2}$, &c. The author gives two worked examples, and compares the values of the coefficient obtained with those given by the harmonic analyses of the Guilds Central Technical College. Prof. Henrici said he had not received the paper in time to thoroughly master it, but he thought that, at any rate for curves where no discontinuity occurred, the relation found by the author between the roller curves was always true, the last evolute being a point, and the one before that a circle. The interesting point was whether the method was capable of being used for practical purposes, for it occupied a place with respect to harmonic analysis similar to that occupied by Simpson's rule in planimetry. Prof. Silvanus Thompson asked if the author had devised a form of mechanism capable of fulfilling the kinematical conditions given at the commencement of the paper. The author in his reply said he had devised such a mechanism, and that it was described in his previous paper. In addition he had since invented a more practicable form which he had patented. The chairman said the Society ought to congratulate itself on the large number of important papers dealing with harmonic analysis and planimetry that had lately been communicated.

Malacological Society, May 10.—Prof. G. B. Howes, President, in the chair.—On behalf of Miss de Burgh specimens were shown illustrating the variation of *Columbella mercatoria*, Linn.—Mr. Da Costa exhibited a collection of univalve mollusca from Lakes Tanganyika and Victoria Nyanza, and pointed out the entirely different characters of the molluscan fauna of these two lakes.—On behalf of Mr. C. S. Cox were exhibited living specimens of *Glandina* from Italy.—Mr. E. A. Smith exhibited an almost complete collection of the land and freshwater mollusca of St. Vincent, W.I.—Mr. E. R. Sykes exhibited specimens of *Achatinella variabilis*, Newc, and allied forms, from the Island of Lanai. The following communications were read:—Notes on *Trochonanina* and other genera of the land mollusca, with reference to the animals of *Martensia Mozambicensis*, Pfr., and other species, by Lieut.-Colonel H. H. Godwin-Austen.—Report on the land and freshwater shells collected by Mr. H. H. Smith at St. Vincent, W.I., by E. A. Smith.—Note on the larval oyster, by M. F. Woodward.

Victoria Institute, May 6.—Dr. Chaplin in the chair.—A paper on the so-called *Pithecanthropus* of Dr. E. Dubois was read by Prof. E. Hull, LL.D., F.R.S., after which a paper by

Sir J. W. Dawson, C.M.G., F.R.S., on the physical character and affinities of the Gaunches, or extinct people of the Canary Islands, illustrated by photographs, was read. In it the author reviewed the historical facts as to the Canary Islands and these inhabitants, the characters of the crania found, and the weapons, ornaments, &c., and described the conclusions he had arrived at with reference to the relationship of the Gaunches to ancient peoples of Western Europe and Africa, and their possible connection with the colonisation of Eastern America.

Royal Microscopical Society, May 15.—Mr. A. D. Michael, President, in the chair.—Mr. J. Swift exhibited an improved form of the Nelson microscope-lamp, fitted with mechanical movements; and also a Wales microscope which had been fitted with the new mechanical stage.—Mr. T. Comber read a paper on the development of the young valve of *Trachyneis aspera*. The subject was illustrated with lantern photographs exhibited upon the screen.—Miss Ethel Sargant's paper, "On the first nuclear division in the pollen mother cells of *Lilium martagon*, &c.," was communicated by Dr. D. H. Scott.

PARIS.

Academy of Sciences, May 20.—M. Marey in the chair.—The decease of M. C. Ludwig, correspondent of the Medicine and Surgery Section, was announced by the President. M. Ludwig will be chiefly remembered for his work on blood pressures and circulation, on artificial circulation, and on the physiology of the nervous system.—Reduction to sea-level of the values observed for gravity at the surface of the earth (Coast and Geodetical Survey), by M. G. R. Putnam. A translation of some passages of this work is given by M. H. Faye, in which it is shown that Faye's correction causes anomalies to more nearly disappear than Bouguer's correction. M. Faye then discusses the probable form of the earth's crust, and shows the bearing of his discussion on the theories of geologists.—New researches on the thermochemical relations between aldehydes, alcohols, and acids, by MM. Berthelot and Rivals. A *résumé* is given of the known thermochemical data connecting aldehydes with corresponding alcohols and acids.—Existence of phosphorus in notable proportion in oysters, by MM. A. Chatin and A. Müntz. Not only has phosphorus been found in the shells of different kinds of oysters in the form of tricalcic phosphate, but organic phosphorus has been found in oyster flesh in quantity, more in Portuguese oysters (*Gryphea angulata*) than in French natives (*Ostrea edulis*).—Classification of the chemical elements, by M. Lecoq de Boisbaudran. A theoretical paper discussing the author's system of classification and the genesis of elements from a primordial matter.—On the spectroscopic analysis of gases obtained from various minerals, by Mr. Norman Lockyer.—On the reducing properties of sodium alcoholates at a high temperature, by MM. A. Haller and J. Minguin. The results of heating together in sealed tubes at about 200° C. are given for: desoxybenzoïn and sodium ethylate in absolute alcohol; benzophenone and sodium ethylate; anthraquinone and sodium ethylate, amylate, and butylate respectively.—On stereoscopic projections and the "stereojumelle," by M. Moëssard.—Studies on the activity of the diastole of the ventricles, on its mechanism, and its physiological and pathological applications. An abstract of a memoir by the author, M. Léon Germe.—A comparison between the spectra of the gases from cleveite and the spectrum of the solar atmosphere, by M. H. Deslandres. A list of wave-lengths of lines observed in the spectra of gases from cleveite is compared with a similar list of lines observed in the solar chromosphere spectrum (see p. 56). Twenty lines in the former list are recorded and thirteen lines in the latter list are shown to have the same wave-length, extending through the luminous and ultra-violet portions of the spectra. Two *permanent* chromosphere lines, 587·60 and 447·18, correspond to two of the principal gas lines, 587·60 (D_3) and 447·175. There now remain but two such chromosphere lines always obtainable, which do not correspond to lines obtained in terrestrial spectra.—On the isomeric transformations of mercury salts, by M. Raoul Varet. It is shown that black amorphous HgS disengages +0·24 Cal. in changing to the red amorphous variety, and yields a further +0·06 Cal. in becoming red crystalline HgS.—Action of nitrogen peroxide on the halogen salts of antimony, by M. V. Thomas.—Heats of formation of benzoyl chloride and toluyl chloride, by M. Paul Rivals. The substitution of the group (COCl) for a hydrogen in benzene or toluene results in an increase in the heat of formation of + 58 Cal. and + 55·3 Cal. respectively.—Study of senecionine and senecine, by MM. A. Grandval and H. Lajoux. Two alkaloids have been prepared from *Senecio vulgaris*. Senecionine appears to have the composition $C_{18}H_{26}NO_6$, and does not possess very marked reactions. Senecine appears to possess much more definite reactions with the usual alkaloid reagents.—On phenylsulpho-orthotoluidine and some of its derivatives, by M. Ch. Rabaut. In conclusion, attention is drawn to the resistance of this substance to oxidation and to its great stability in presence of dilute acids and heat, notwithstanding its amide character.—Analysis of a mummy bone, by M. Thezard.—On a leucomaine extracted from urine in cases of Angina pectoris, by M. A. B. Griffiths and C. Massey. A new poisonous base, causing death in two hours, of which the composition is given as $C_{10}H_9NO_4$.—On some improvements in the preparation and study of thin plates of sedimentary calcareous rocks, by M. Bleicher.—On the anomalous divisions of ferns, by M. Adrien Guébhard.—The catastrophes of Titel in the Banat and of Mendoza (Argentine Republic), by M. Ch. V. Zenger. Arguments are adduced to show a connection between these seismic phenomena and sun-spot appearances on the sun.—The use of crude petroleum for prevention of incrustations in boilers is advocated by M. G. Liévin.

BOOKS AND SERIALS RECEIVED.

BOOKS.—The Telephone Systems of the Continent of Europe: A. R Bennett (Longmans).—The Theory of Light: Prof. T. Preston, 2nd edition (Macmillan).—Dental Microscopy: A. H. Smith (Dental Manufacturing Company).—A Reader's Guide to Contemporary Literature: W. S. Sonnenschein (Sonnenschein).—A First Book of Electricity and Magnetism: W. P. Maycock, 2nd edition (Whittaker).—The Way about Middlesex (Iliffe).—The Way about Hertfordshire (Iliffe).—An Elementary Treatise on Elliptic Functions: Prof. A. Cayley, 2nd edition (Bell).—La Pluie en Belgique: A. Lancaster, Premier Fasc. (Bruxelles, Hayez).—Nature in Acadie: H. K. Swann (Bale).—The Linacre Reports, Vol. 2: edited by Prof. E. Ray Lankester (Adlard).

SERIALS.—Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Zwanzigster Band, 4 Heft (Leipzig, Engelmann).—Zeitschrift für Wissenschaftliche Zoologie, lix. Band, 2 Heft (Leipzig, Engelmann).—The Evergreen, Spring (Unwin).—American Naturalist, May (Philadelphia).—Papers read before the Engineering Society of the School of Practical Science, Toronto, No. 8, 1894-5 (Toronto).—Good Words, June (Isbister).—Sunday Magazine, June (Isbister).—Longman's Magazine, June (Longmans).—Chambers's Journal, June (Chambers).—Century Magazine, June (Unwin).—Journal of the College of Science, Imperial University, Japan, Vol. vii. Part 4 (Tōkyō).—Journal of the Institution of Electrical Engineers, No. 117 (Spon).

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