THURSDAY, AUGUST 24, 1893.

WATER AND ICE AS AGENTS OF EARTH SCULPTURE.

Fragments of Earth Lore: Sketches and Addresses, Geological and Geographical. By James Geikie, D.C.L., LL.D., F.R.S., &c., &c. (Edinburgh: John Bartholomew & Co. London: Simpkin Marshall, Hamilton, Kent & Co., Limited, 1893.)

THESE collected papers form a fairly connected work on the origin of the present surface features of the world at large, and of Scotland in particular. The first is a well-put plea for the more intelligent and far-sighted method of teaching geography, and is followed up by four articles on the geographical features of Scotland, which are of a somewhat advanced and special character, and lead directly to the exposition of the author's views on glacial action. That forms the subject matter of the next eight papers, supplemented by a geographical essay in which he discusses some aspects of the question of earth movements, which are obviously closely connected with the theoretical explanations of climatal change. On the whole, perhaps, another form would have been better; for the advice as to the teaching of geography will hardly be necessary for the same readers as those who, with their local field club, are prepared to follow the author through the Western Islands; while those who wish to examine once more the arguments for the special views on the ancient glaciation of the country which he advocates, would have found the information more usefully arranged for them, if worked into a manual. The style of the articles is sufficiently didactic to have readily lent itself to this form.

The book provides for the author an inventory of his own literary properties, and of some others, in which he has a joint claim, owing to his having independently arrived at the same conclusion as other observers. It provides for him also an opportunity of qualifying statements which further investigation has shown to require modification. In which respect the reader is equally benefited, as he would certainly prefer to receive the results of our author's mature judgment on the subject.

We appeal to him as a leader in geographical science, and one who has abundant facility of expression, not to encourage the absorption of too many words out of our current language for use as technical terms. Such names as *chain* and *range* should be simply descriptive of form, that is of actual continuity, or of contiguity with a linear arrangement, regardless of the origin of the features.

Among the most interesting geographical descriptions given is that of the "drowned lands," or areas which have been moulded into their present form by subærial action, and then submerged with all their hills and valleys (pp. 21, 367, and more fully in art. xiv). We shall know more about this as we get more soundings and the study of oceanography advances.

The feature of greatest importance in the study of geology and geography is the *plain of marine denudation*, the level at which the sea arrests the agents of subærial waste, and at which the wind waves carry on the work. This is the datum from which the amount of rock removed by denudation must be measured: this is the index that tells us how long the great forces of elevation and depression balanced one another: this marks the long drawn-out nodes in the undulations of the earth's crust.

Our author might have dwelt longer on this ground, when giving his views as to how the successive portions of the earth were brought within reach of the denuding agents to which he chiefly refers their sculpture.

Most of the papers are controversial, or they are written so as to strengthen those positions on which some disputed theory has been built up, and are so turned as to allow the author frequently to point the moral which he chiefly aims at inculcating.

We feel quite glad of the genial warmth of the volcanic fires which ushered in the Devonian, and are hardly willing to admit the existence of ice at this age in the Cheviot area. Yet there is no reason why the surrounding mountains may not have been high enough to nourish glaciers, but the shape and condition of the stones included in the conglomerates at the base of the red rocks are hardly sufficient to *prove* this, especially when the ghosts of scratches have in other cases been shown to be due to movements in the rock, which caused the included fragments to be crushed against one another.

After a long interval we read in the history of the Cheviots of Scandinavian ice which over-rode everything, and of the successive interglacial periods when that ice receded only to advance again with hardly less intensity, but we do not know how our author explains its apparently smaller eroding power, seeing that it failed to remove even the peat and silt which had accumulated in the interval.

As an example of the kind of evidence which is occasionally admitted in support of the former extension of land ice we may cite his reference of the implement-bearing gravels of East Anglia to the floods discharged at the foot of the melting ice-sheet.

The argument that the gravels are eighty feet above the sources of the *existing* streams after ages of denudation does not go for much where the level of the outburst of springs has varied within the memory of man; while the flint implement-bearing gravels creep up the hills in terraces with abundant material derived from the boulder clay which covers the tops of the hills all round, but never overlaps those gravels. The shells in the gravels are, with few exceptions, of the same species as those now inhabiting the neighbouring streams, and those exceptions belong to more southern forms. There very likely are marine gravels capping some hills, but they are certainly not correctly referred to as those "with ancient flint implements," &c., in East Anglia.

Although he frequently mentions "the now discredited iceberg theory," he does not often refer any of the drifts to their "random and eccentric action," but explains some of the difficulties of the distribution of erratics by the intercrossing of currents within the ice-mass. Whether or not any particular group of boulders or mass of drift was carried by icebergs or not, it is too much to say that there are no reasons for considering icebergs capable of polishing and striating rock surfaces (p. 219). If we allow that glacier-ice charged with stones and mud can

erode its base, surely miles of the very same mass of ice, with the same mud and stones, when broken off and driven by wind and current on a shelving shore, must grind and polish the floor on which it is driven.

It is difficult to follow the explanation offered of the pushing up of shells belonging to temperate climates by the great ice sheet, or the wrenching off of large masses of rock underneath the ice, except on the supposition that all this was done during the *first* advance of the ice over the sea bottom, and over a surface irregularly fretted by subærial action. When once the sea-bed had been swept, no more such life would be there till the ice receded; and, when the crags had once been planed down, there could be no more jagged rock for the ice to break off and carry along. Moreover, it does not seem to have been observed that the flints so universally distributed through the marine gravels, such as those of Moel Tryfaen, are rusty gravel flints, and that there is no long interval without them all round the southern and central portions of the British Isles.

The point, however, to which our author seems to attach greatest importance is the occurrence of interglacial periods. He describes successive sheets of boulder clay, each of which is the accumulation of a separate and distinct ice flow. He points out that the fauna and flora found in beds interstratified in these clays are suggestive of alternations of cold and damp conditions with those indicative of a warm and genial climate. In Scotland and Scandinavia the gradual disappearance of the latest ice-sheets was, he says, marked by a partial submergence, but a great submergence he does not believe in, and, after describing the grand series of moraines which stretches across the northern states of America into the British possessions, says that "no one who has traversed the regions I refer to is at all likely to agree with Sir W. Dawson's view that the American mounds, &c., are the shore accumulations of an ice-laden sea."

We regret the somewhat assured manner in which the views of those who differ from our author are dismissed. Sir William Dawson traversed the regions referred to by him (p. 190) and arrived at a different conclusion; and there are some who have not confined themselves so exclusively to the subjects on which our author has made himself a name, who yet do not deserve to be excluded from the list of geologists because they do not agree with him on every point. It would be well also if he would strike out from any future edition all references to "the trained observer" and "the experienced eye," as his readers cannot help recalling many instances where trained observers have differed in interpretation, and where, the position having been shifted, even the experienced eye has seen things differently at different times.

Though our author could not in these essays discuss fully the various points which must be fixed before any theory can be considered as fairly established, he has indicated the lines of reasoning on which he would rely.

His position seems to be that there are known to recur such astronomical combinations as by a general lowering of the snow line would be sufficient to account for glacial conditions with such distribution of land and water as for instance prevail at present; that with unfavourable geographical arrangement no glaciation is possible; that the greater part of the results observed were produced by land ice, icebergs playing quite a subordinate part, and marine currents of any considerable volume and velocity being quite exceptional; that within each period of possible glaciation there were alternations of conditions of greater or less intensity corresponding to established astronomical cycles, and that the evidence of these were to be seen in certain beds intercalated in the drift. He admits, but explains away, the absence of evidence of the regular recurrence of such effects throughout the previous geological ages.

The geographical theory which he principally combats may be briefly summed up thus: There have been through all time terrestrial movements of wider or narrower extent which have carried portions of the earth's surface to depths below the lowest known abyss, and raised portions through distances greater than the highest mountain peak; the depression and elevation of extensive areas or ridges must, with sufficient precipitation, deflect ocean currents and produce such snowfields as would feed the largest glaciers or ice-sheets required in explanation of the drifts, boulders, and accompanying phenomena; there is evidence of movements on a grand scale since the period of great cold and similar movements have been going on up to a quite recent date, and these, if extended over a longer time, would produce all the effects required.

In the course of these addresses our author is frequently led to speculate upon the causes and some of the effects of earth-movements, and we find (*e.g.* pp. 129, 267, 342) such a good case made out every now and then for the geographical theory that we cannot help feeling that the difference between the two schools is not irreconcileable but this is a vast question which cannot be settled till many possibilities have been considered.

The various theories referred to have been built up on such a number of observations and hypothetical explanations that it is impossible to discuss them in one volume of essays, still less in a short review of that volume.

All the more, however, because the subject involves so many matters of controversy, do we welcome the publication of the latest views of one who is so skilled an observer as our author, and so competent to watch the progress of research in regions beyond that which he has especially studied.

WATER BACTERIA.

Diagnostik der Bakterien des Wassers. Von Dr. Alexander Lustig. Zweite sehr vermehrte Auflage. 128 pp. (Jena: Gustav Fischer, 1893.)

THIS is, we believe, the first attempt made to gather together in a compact form the various descriptions of bacteria which from time to time have been isolated from water by different observers. In those cases where the water investigator is concerned only with the number of microbes present in any given water, the task of mere enumeration is such that, however anxious to do so, it is almost impossible to take an intelligent interest in the nature of the microbes present, beyond a superficial glance at their more striking characteristics. But even this is sufficient to indicate what numbers of different

kinds of microbes are present in water, whilst on a closer examination the list of varieties is very much more extended. Having regard to their superficial differences, then, Lustig, following the example set by Eisenberg in his "Bakteriologische Diagnostik," has mapped out two classes of microbes—those which liquefy and those which do not liquefy the gelatine—which are again divided up into micrococci and bacilli respectively. The tabulated account appended to each micro-organism includes its microscopic appearance, behaviour in gelatine-plate and tube-cultures, on agar-agar and potatoes, relationship to pathogenic properties, temperature, together with other special tests which have from time to time been employed, as well as the authority for its discovery in water.

In addition to the above classification, those bacteria which are known to be pathogenic to man and animals respectively are separately grouped, whilst those bacilli resembling the typhoid bacillus are brought together for purposes of comparison. The latter should prove a useful assistance in the separate diagnosis of the typhoid bacillus, for as it is by no means specially characteristic either in its macroscopic or microscopic appearances, there are many forms which may readily be mistaken for it on an ordinary water-plate.

We do not quite understand why Lustig has not rendered the cholera spirillum a similar service. There exist many spirilla in water which bear the most striking resemblance to Koch's comma spirillum, but which subsequent searching tests have proved to be distinct. Koch himself only a few weeks ago stated that no less than a dozen different vibrios had been isolated in his laboratory alone, from various waters which he examined last autumn during the cholera epidemic, none of which were the cholera spirillum, whilst other investigators have identified and described spirilla bearing the closest resemblance to the original comma spirillum.

Amongst the organisms pathogenic to man found in water we miss the tetanus bacillus. This organism was detected by Miquel in the rivers Seine snd Marne, and G. Roux states that he found it in large numbers in the sediment of the filter beds belonging to the water-works supplying Lyon with river Rhône water, whilst Lortet alleges that he discovered it in mud obtained from the bottom of the Dead Sea. In a future edition the anthrax bacillus must also be included, since it has recently been detected in the sediment at the bottom of a well, to the water of which an outbreak of anthrax amongst a flock of sheep was traced.

In the preface to the German edition Baumgarten writes: "Grössere Reihen von 'Wasserbakterien' sind schon früher von anderen Forschern (Frankland, Maschek, Adametz, W. Zimmermann, Tils) auf Grund eigener Beobachtungen und Untersuchungen beschrieben worden. Diese sowie *alle sonstigen*, verstreut in der Literatur . . . ist Lustig's Verdienst vereinigt zu haben." It is obvious that in a guide of this kind the list should be as complete as possible, and it is, therefore, surprising to find many important and quite unaccountable omissions. For example, none of the interesting phosphorescent bacilli obtained from sea-water by Forster, Fischer, and Katz are described, neither is any mention made of the organisms isolated by Russell from sea-water.

Amongst other organisms conspicuous by their absence may be mentioned the *bacillus thermophilus* originally found in large numbers in river Seine water by Miquel, the anærobic bacillus, *B. amylozyme* obtained by Perdrix from the same water, the *bacille rouge de Kiel* so carefully studied by Laurent, the "peach-coloured bacterium" of Lankester, whilst Roscoe and Lunt's sewage organisms, and Tataroff's large collection of bacteria isolated from the Dorpat water are entirely overlooked.

The descriptions appended are often provokingly incomplete, and this greatly militates against the value of the book in assisting in the identification of a particular organism, whilst in some cases the details are not always correct.

The book was originally written in Italian, so possibly during the translation into German errors and misprints may have crept in which were not present in the original, but it is none the less troublesome to find wrong references occasionally given, whilst the description of the same organism twice over, which occurs more than once, ought surely to have been guarded against. As an example of this we may mention a bacillus found by Claessen (mis-spelt Claesten) in unfiltered river Spree water, and described on p. 62 as the *Indigoblauer bacillus*, whilst on p. 70 we find it figuring again as bacillus, *Berolinensis indicus!*

In order to bring the descriptions up to a level with those in Eisenberg's "Bakteriologische Diagnostik," even (and as the volume before us deals solely with water-microbes, they might not unreasonably be expected to be fuller) careful revision will be required, and the evident signs of haste which at present characterise its pages conscientiously removed.

Such an array of different water microbes, to each of which is given a "local habitation and a name," might well make the reader say with the "Ancient Mariner," "Water, water, everywhere, Nor any drop to drink;" but it is reassuring to find that out of the 181 varieties found in water, only six are stated by Lustig to be pathogenic to man. G. C. FRANKLAND.

POPULAR METEOROLOGY.

Katechismus der Meteorologie. Dritte Auflage, gänzlich umgearbeitet. Von Prof. Dr. W. J. Van Bebber. (Leipzig: J. J. Weber, 1893.)

THE object of the author of this little book is to present as briefly and intelligently as possible the fundamental principles of meteorology, in a manner which will enable the public to form for themselves an independent judgment on the meteorological conditions prevalent at the moment, and to make the knowledge so obtained available for the purposes of daily life. The author, who is well and favourably known as a popular writer on meteorology by his *Lehrbuch*, thinks that this eminently practical object can be best effected by placing his information in a catechetical form; a method of conveying instruction which appears to find great favour in Germany. This particular work is already in its third edition, and is the sixtieth of a series which in its entirety probably comprises more than twice that number of works devoted to the culture of science, art, and indus-

try, and all forming part of the "Illustrierte Katechismen." This form, however, is not one that commends itself generally to the writers of English text-books, at least in modern times. It is believed that the fascinating style of the ingenious Miss Mangnall endeared her writings to an earlier generation, but the peculiar form of which she was so admirable an exponent has not found many imitators. But the case seems to be different in Germany, to judge by the number of works and editions in this catechetical series, to which we have referred. The author contends that the form of the work is suitable, and in his recent revision he has preferred to retain it. But if the questions in a slightly altered shape were made to fill the place of marginal notes, and the information were presented in a continuous readable form, it would, to an English eye at least, be preferable to that adopted, which has all the appearance of a collection of conundrums without their interest. But apart from this question of form, there are two reasons why we are inclined to dissent from the judgment of the author. Meteorology has hardly crystallised into that definite shape in which a cut and dry answer can be given to every definite question. The author seems to take some praise to himself that every hypothesis has been most carefully excluded. But this is a very doubtful merit. It has the immediate effect of excluding much that gives a charm and interest to the study, and without a knowledge of which one can hardly be said to be instructed in meteorology. Working hypotheses, recognised as such, have a distinct value, especially in a science where much is, of necessity, tentative and experimental. The other objection which might be urged against the style arises from the fact that, in the present instance at least, it does not lend itself readily to the description of diagrams. Perhaps this explains why the book is not more profusely illustrated. It was doubtless felt that diagrams did not greatly add to the clearness of description.

The contents of the book are generally such as one would expect to meet in an elementary work on meteorology. There are, however, some exceptions, in which the author enters upon subjects which we are apt in this country to include under the wider title of physiography. After dealing with the temperature of the atmosphere, its daily and annual variations, the peculiarities of isotherms, &c., we have an account of barometric records and variations of atmospheric pressure with theories of the wind. Under this heading are treated such subjects as land and sea breezes, local winds, such as monsoons, and movements of the atmosphere affecting small areas. The transition to such subjects as the Gulf Stream and ocean currents is easy if a little unexpected, but the author soon returns to topics more immediately connected with meteorology properly so called. The subject of evaporation, and the deposition of moisture in its various forms, is sufficiently dealt with, and if there is nothing new in this chapter it is clear and satisfactory, and the same can be said for the few concluding questions on electrical and optical phenomena. A few remarks might have been added with advantage on the aurora, but possibly the author was afraid of hypotheses.

The most readable and the most interesting portion of the book is undoubtedly that connected with the behaviour of storms, and the formation of weather charts with a view to weather prediction. Here the catechist has practically to stand aside. In about twenty pages we meet with only eighteen distinct questions, and the tale is therefore practically told without that annoying form of interruption. And it is very well told. We feel that the author has shaken himself free from his self-imposed fetters, and is doing himself justice, and we can only regret that the earlier portion of the work is not marked by a similar freedom.

OUR BOOK SHELF.

The New Technical Educator: an Encyclopædia of Technical Education. Vol. I. (London, Paris, and Melbourne: Cassell and Co., Limited, 1893.)

THE subjects dealt with in vol. i. are as follows:—Drawing for Carpenters and Joiners, Cotton Spinning, Cutting Tools, Dyeing of Textile Fabrics, Electrical Engineering, Drawing for Engineers, Photography, Plumbing, Practical Mechanics, Projection, The Steam Engine, Steel and Iron, Technical Education, Watch and Clock Making, and Woollen and Worsted Spinning.

Taken as a whole, all these subjects are well written and illustrated copiously, several full-page plates being given. The frontispiece is coloured, and represents the scene in the Bessemer department of a steel works at night, during the process of a "blow." A very good idea is given of the wonderful pyrotechnic display.

The steam-engine is treated very much from the "heat" point of view.

Under the head of Plumbing much useful information is to be found, particularly the making of joints and bends in pipes of lead and other metals. It is usual, when making a bend in a wrought-iron lap-welded pipe, to endeavour to keep the weld on the inside of the bend, when possible, for obvious reasons. This is purely a practice which every gasfitter or plumber would naturally follow, and its omission from the paragraph is to be regretted.

The articles on electrical engineering are excellent as far as they go. The illustrations are clear and to the point; one or two of the earlier ones, however, would be improved by the addition of the lines of force.

Prof. R. H. Smith takes charge of the articles on "Cutting Tools"; needless to say they are well written, with examples taken from every-day practice in the works. The introduction of milling machinery into the engineering works of the country is comparatively of recent date, yet this method of machining work is rapidly coming to the front, and milling machinery is taking the place of the planing, slotting, and shaping machine for duplicate and general work. One great drawback to this method of working is the cost of the milling cutters; these are very expensive to make, and sometimes during the process of hardening and tempering they very often crack in the body or some of the teeth fly off. On the other hand, the quality of the work done by the milling machine is better than that from an average planing machine, less hand labour being required to finish the work.

The articles on technical education are most instructive; they cover a good deal of ground, generally taking a sensible and moderate view of the question. In the first article on this subject, the author, Mr. Henry Cunyngham, says that the object of technical education is to make good industrial workmen, and then goes on to name what are the qualities which go to make up a good

workman. There is no possible doubt that apprentices to trades require facilities to study the technics of their trades, and that these facilities ought to be found in every manufacturing town, besides which, both parents and employers should make it a duty to see that the opportunities are not thrown away. On the other hand, the fact should not be lost sight of, that it is only possible to follow practice, *i.e.*, practical work, in the works.

The following chapters on this subject are by different authors, and deal with the progress of technical education in this country and abroad, then we have an elaborate description of polytechnics by Mr. Quintin Hogg, and the last chapter gives a fair idea of technical education in the colonies. All these chapters together give the reader much information about this all-important subject.

Although it has not been possible to note more of the contents of this volume, yet we can say that it is one of a series of most useful books, and if subsequent volumes are kept up to the standard of Vol. I. they will constitute a valuable Encyclopædia of Technical Education. N. J. L.

Wetterbüchlein. Von wahrer Erkenntniss des Wetters. By Leonhard Reynman. (Berlin: A. Asher & Co., 1893.)

THIS is the first number of a series of reprints of rare books relating to meteorology and terrestrial magnetism, edited by Prof. G. Hellmann, and, owing to the support of the German Meteorological Society and to a large amount of gratuitous labour on the part of Dr. Hellmann, the works, of which only a very limited number will be printed, are to be issued in a very cheap but elegant form, and will no doubt be much valued by students of those subjects and by persons interested in early literature. The *Wetterbüchlein* is the oldest purely meteorological work printed in the German language. The first edition was published in 1505, but inquiries made by Prof. Hellmann of 115 libraries in Europe have failed to discover a single copy, and of the second edition printed in 1510 only one copy can be found, viz. the one in Dr. Hellmann's library, of which a facsimile is now reprinted, together with an introduction of forty-two quarto pages, giving a most interesting and masterly account of this work and of all the other editions excepting two, of which no copy can be found. The *Wetterbüchlein*, which ran through seventeen editions in fourteen years, was exceedingly popular in its day, and contains in fourteen chapters a large number of weather prognostications, some of which are of an astrological character, but by far the greater part are based on optical and natural phenomena. The chapters are naturally of unequal value, but some of them contain results of importance deduced from a large number of actual observations. Many of the chapters have been traced by Dr. Hellmann to be based upon proverbs known to the old classical writers, and the author has also quoted freely from a work by Guido Bonatti, an Italian astrologer, which was printed in 1491, and from one by Firmin de Bellevall, a French writer, which appeared in 1485; but no clue can be found as to the origin of a chapter entitled "Das wetter zu wissen durch die vier quart des jars / als Liechtenperger setzt." If any of our readers can discover the origin of this section we shall be glad to hear of it. The *Wetterbüchlein* was, to a great extent, reprinted in various editions of the "Bauern-Practick," which appeared in the sixteenth century and had a much greater sale. It also found its way to this country, an almost literal translation appearing in "The Boke of Knowledge of Thynges Vnknown ...." published in London in 1585.

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.*]

Prenatal Influences on Character.

THE popular belief that prenatal influences on the mother affect the offspring physically, producing moles and other birth-marks, and even malformations of a more or less serious character, is said to be entirely unsupported by any trustworthy facts, and is also rejected by physiologists on theoretical grounds. But I am not aware that the question of purely mental effects arising from prenatal mental influences on the mother has been separately studied. Our ignorance of the causes, or at least of the whole series of causes, that determine individual character is so great, that such transmission of mental influences will hardly be held to be impossible or even very improbable. It is one of those questions on which our minds should remain open, and on which we should be ready to receive and discuss whatever evidence is available; and should a *primâ facie* case be made out, seek for confirmation by some form of experiment or observation, which is perhaps less difficult than at first sight it may appear to be.

In one of the works of George or Andrew Combe, I remember a reference to a case in which the character of a child appeared to have been modified by the prenatal reading of its mother, and the author, if I mistake not, accepted the result as probable, if not demonstrated. I think, therefore, that it will be advisable to make public some interesting cases of such modification of character which have been sent me by an Australian lady in consequence of reading my recent articles on the question whether acquired characters are inherited. The value of these cases depends on their differential character. Two mothers state that in each of their children (three in one case and four in the other) the character of the child very distinctly indicated the prenatal occupations and mental interests of the mother, though at the time they were manifested in the child they had ceased to occupy the parent, so that the result cannot be explained by imitation. The second mother referred to by my correspondent only gives cases observed in other families which do not go beyond ordinary heredity.

"I can trace in the character of my first child, a girl now twenty-two years of age, a special aptitude for sewing, economical contriving, and cutting out, which came to me as a new experience when living in the country amongst new surroundings, and, strict economy being necessary, I began to try and sew for the coming baby and for myself. I also trace her great love of history to my study of Froude during that period, and to the breathless interest with which my husband and I followed the incidents of the Franco-German war. Yet her other tastes for art and literature are distinctly hereditary. In the case of my second child, also a daughter (I having interested myself prior to her birth in literary pursuits) the result has been a much acuter form of intelligence, which at six years old enabled her to read and enjoy the ballads which Tennyson was then giving to the world, and which at the age of barely twenty years allowed her to take her degree as B.A. of the Sydney University.

"Before the third child, a boy, was born, the current of our life had changed a little. Visits to my own family and a change of residence to a distant colony, which involved a long journey, as well as the work which such changes involve, together with the care of my two older children, absorbed all my time and thoughts, and left little or no leisure for studious pursuits. My occupations were more mechanical than at any other time previous. This boy does not inherit the studious tastes of his sisters at all. He is intelligent and possesses most of the qualifications which will probably conduce to success in life, but he prefers any kind of outdoor work or handicraft to study. Had I been as alive then as I am now to the importance of these theories, I should have endeavoured to guard against this possibility; as it is, I always feel that it is perhaps my fault that one of the greatest pleasures of life has been debarred to him.

"But I must not weary you by so many personal details, and I trust you will not suspect me of vanity in thus bringing my own

children under your notice. Suffice it to say that in every instance I can and do constantly trace what others might term coincidences, but which to me appear nothing but cause and effect in their several developments.

"I will pass on to quote a few passages from letters written to me by two highly intelligent mothers, whom I asked to give me their experiences on this subject, if they had any.

"Mrs. B—— says: 'I can trace, nay, have traced (in secret amusement often), something in every child of mine. Before the birth of my eldest girl I took to ornithology, for work and amusement, and did a great deal in taxidermy too. At the age of three years I find this youngster taking such insects and little animals as she could find, and puzzling me with hard questions as to what was inside them. Later on she used to be seen with a small knife, working and dissecting cleverly and with much care and skill at their *insides*. One day she brought me the tiniest heart of the tiniest lizard you could imagine, so small that I had to examine it through a glass, though she saw it without any artificial aid. By some means she got a young wallaby and made an apron with a pocket inside which she used to call her "pouch." This study of natural history is still of interest to her, though she lacks time and opportunities. Still, she always does a little dissecting when she gets a chance.'

"I never noticed anything about P—— for some years. Three months before he was born a friend, whom I will call Smith, was badly hurt, and was brought to my house to be nursed. I turned out the nursery and he lay there for three months. I nursed him until I could do so no longer, and then took lodgings in town for my confinement. Now after all these years I have discovered how this surgical nursing has left its mark. This boy is in his element when he can be of use in cases of accident, &c. He said to me quite lately, 'How I wish you had made a surgeon of me.' Then all at once the light flashed in upon me, but, alas! it was too late to remedy the mistake.

"Before the birth of the third child I passed ten of the happiest months of my life. We had a nice house, one side of which was covered with cloth of gold roses and bougainvillea, a garden with plenty of flowers, and a vineyard. Here we led an idyllic life, and did nothing but fish, catch butterflies, and paint them. At least, my husband painted them after I had caught them and mixed his colours. At the end of this time L—— was born. This child excels in artistic talent of many kinds, nothing comes amiss to her, and she draws remarkably well. She is of a bright, gay disposition, finding much happiness in life, even though not always placed in the most fortunate surroundings. Before the birth of my next child, N——, a daughter, I had a bad time. My husband fell ill of fever, and I had to nurse him without help or assistance of any kind. We had also losses by floods. I don't know how I got through that year, but I had no time for reading. N—— is the most prudent, economical girl I know. She is a splendid housekeeper and a good cook, and will work till she drops, but has no taste for reading, but seems to gain knowledge by suction."

If the preceding cases are fully and accurately stated they seem to afford grounds for further investigation. Changes in mode of life and in intellectual occupation are so frequent among all classes, that materials must exist for determining whether such changes during the prenatal period have any influence on the character of the offspring. The present communication may perhaps induce ladies who have undergone such changes, and who have large families, to state whether they can trace any corresponding effect on the character of their children.

ALFRED R. WALLACE.

Habits of South African Animals.

THE following extracts from a letter just received from Mr. R. R. Mortimer, of Hanover Road, Cape Colony, contain some observations which will, I think, be of interest to naturalists, and therefore worth recording in the pages of NATURE.

ALFRED R. WALLACE.

"Since reading 'Darwinism,' powers of observation have unconsciously been gained by me. Day by day nature has some phenomena quite new to me, which phenomena would probably never have been observed by me if I had not had the good fortune to have digested the principles of the Darwinian Theory so obviously explained by you. From the time of reading the book till now I have observed peculiarities of organic beings in this part of the world. These observances I will relate: (1) The first observation I particularly remember was in regard to a peculiar action of a small bird, indefinitely termed by Colonials, snipe. What their specific or proper name is I cannot say, since the title of naturalist is not claimed by me. These snipe in question, or individuals of the variety, made their nests on mounds of dung which were practically the accumulated refuse of old sheep kraals. The shape of the nest was simply a hole scooped out on top of a mound. The colour of the refuse was a variegated dark brown and black. The eggs of such birds fully corresponded in colouration with the environment or surroundings. As a means of concealment, the colouration of the eggs was perfect. It required an extreme amount of careful inspection and search to detect the eggs in a nest on such mounds. When you came across the nest, you would find it was perfectly open and uncovered by any material; therefore you would presume the owners of the nest distinctly relied upon the colouration of their eggs to defy detection. But if by chance you detected a nest, and the owners *were* present, by holding yourself perfectly immovable and stationary, one bird would immediately approach its nest, and gradually cover it by scooping dust over the eggs with the action of its feet.

"This recourse to hiding its nest from view is only adopted on extreme occasions, when their sense-action gives them the knowledge that the enemy present has perceived its contents, or the nest itself.

"There must be a double selective agency in this mode of concealment at work.

"As far as my knowledge goes, our so defined snipe generally frequent localities where water is present. Now the *same* variety in question do make their habitat on banks of rivers, or where water is to be found; yet here have I noticed individuals of the same variety diverge from the specific character, take up a new area, if even only temporarily, where their eggs can be laid with more safety. It is an indisputable fact that the colouration of the snipe eggs is in union and harmony with the environment as a means of protection, yet here we find individuals of the same variety possessing the last possible resort of concealing its eggs—namely, covering them over with a material so as to defy any minute detective powers.

"Surely the struggle for existence must, in this case, be extremely severe, and the principle of natural selection in full activity.

"(2) Having had practical experience in farming with ostriches, and their domestication, I may say a few words on them.

"Ostriches have, so to say, no means of indirectly concealing their eggs; but the only means of concealing their nest is by their personal presence. The hen does her share of sitting in the daytime, her drab-coloured plumage being in harmony with the surroundings. The cock replaces her on the nest at evening time, sitting throughout the night, and generally on to 8 a.m., his black plumage corresponding with the shades of night; therefore you have some difficulty, sometimes very great, in detecting the nest of an ostrich.

"In addition to this remarkable adaptation of sexual colouration, the cock takes the *rôle* of a guard patrolling up and down some distance off the nest. When he perceives that mischief is bent upon the eggs by the approach of a person, he almost invariably charges him, and, woe betide if the person is destitute of some means of defence. To deliberately go up to a nest in the presence of its lord without some weapon or means of protection is considered by Colonials to be the height of foolishness and ignorance.

"But invariably again, on the other hand, when you have succeeded so far in reaching the nest, and handling its eggs, the cock quiets down.

"He loses all his viciousness, falls down alongside the nest, gives vent to, apparently, appeals for mercy, by continuously flapping his wings against the ground and giving forth sounds by means of his beak, of a peculiar dull clicking character.

"Domestication has made ostriches feel less fear for human beings, at the same time giving a more vigorous character to their viciousness.

"Some two years ago, among a troop of ostriches that were brought down to the farm where I was gaining my experience, there was one ostrich, a male bird in every respect in its external character and colouration of plumage. It was to *all* possible appearance a cock, and yet it had been seen on two occasions

to be paired by a true cock ostrich. This particular ostrich was a hen, although she had every appearance of being a cock. What explanation could you give as regards this incongruity?

"(3) About six months ago I found a peculiar bird's nest suspended from the root of a mimosa tree which overlapped a bank of ground. Before going further, I must first tell you that previous to the occasion in question I noticed the same peculiar form of nest, but it seemed so utterly impossible at the time that it could be a nest, since its structure and mode of suspension had the exact characteristics of a certain structural spider's web, that I passed it by. But on the second occasion, to make absolutely sure that I had not made a mistake, I went up and cut the nest off, with a certain length of the root to which it was attached. Imagine my surprise, when I saw that it was really a bird's nest with two eggs. Now this nest was a *perfect* facsimile of a common spider's web and home, found in the locality where I was at the time staying.

"Since it was a marvellous imitation of an insect's habitat, there must have been some corresponding necessity for such imitation. Either the nest must have been designed and constructed, so as to delude enemies by which the species was liable to be attacked, or, it was so imitated, that the materials of which the nest was made should serve as a bait, and allow the parent birds to be able to feed their young without the necessity of having to leave the nest, and so be unable to protect their young for the time being. The materials from which the nest was made were practically webs abandoned by their original owners. It was an instance of perfect imitation."

Astronomical Photography.

THE announcement (NATURE, August 10), that it is in contemplation to raise a sum exceeding £2000 for the establishment of a special photographic telescope at the Cambridge Observatory, leads me to ask whether astronomers have duly considered the facilities afforded by modern photography. At the time of my early experience of the art, thirty-five years ago, it would have been thought a great feat to photograph the Fraunhofer lines in the yellow or red regions of the spectrum, although even then the statement so commonly made that chemical activity was limited to the blue and ultra-blue rays was quite unwarranted. With the earlier photographic processes the distinction was necessary between telescopes to be used with the eye or for photography. In the former case the focal length had to be a minimum for the yellow rays, in the latter for the blue rays of the spectrum.

But the situation is entirely changed. There is now no difficulty in preparing plates sensitive to all parts of the spectrum, witness the beautiful photographs of Rowland and Higgs. I have myself used "orthochromatic" plates in experiments when it was desirable to work with the same rays as most influence the eye. The interference bands of sodium light may be photographed with the utmost facility on plates sensitised in a bath containing cyanin.

The question that I wish to ask is whether the time has not come to accommodate the photographic plates to the telescopes, rather than the telescopes to the plates. It is possible that plates already in the market may not exactly meet the requirements of the case, but I feel sure that a tithe of the sums lavished upon instruments would put us in possession of plates suitable for object glasses that have been designed for visual purposes. There would be no difficulty even in studying the requirements of a particular instrument, over or under corrected as the case might be.

A doubt may arise whether plates so adjusted would be as sensitive as those now in use. Probably Captain Abney, or some other authority, could give the required information. For some astronomical purposes a moderate loss of sensitiveness could hardly be of much consequence; for others doubtless it would be a serious matter. RAYLEIGH.

Terling Place, Witham, August 15.

The Discussion on Quaternions.

I HAVE followed with much interest the discussion on quaternions which has with more or less intermission been going on in NATURE for a long time.

It has always appeared to me that the student of physical science would better employ his time by studying the "Ausdehnungslehre" to which some of your correspondents have referred than by studying quaternions.

The wonderful work of Grassman is contained in a moderate-sized book in remarkable contrast to the two terrific volumes of Hamilton, which even Prof. Tait admits that he has not read entirely. The fact that the ausdehnungslehre could be mastered in a mere fraction of the time that would have to be devoted to the mastery of quaternions, is not however the important point.

The ausdehnungslehre seems to afford a symbolism more fitted for the expression of many recondite conceptions in physics, than anything which quaternions has to offer. Even the "Nabla" does not insinuate itself into Nature's secrets more cunningly than does the "Inneres Produkt."

Perhaps I may give an instance, which if elementary will at all events illustrate the extraordinary directness with which the different kinds of "product" reach the heart of a physical conception.

Think of a mechanical system of any kind which possesses but a single degree of freedom, think of any system of forces whatever applied to that system, and consider the question of equilibrium. The possible movements of the system form twists about one screw chain, the system of forces form a wrench upon another screw chain. Equilibrium will subsist if, and only if, the "Inneres Produkt" of the two screw chains is zero. Suppose any system whatever possessing n degrees of freedom. Dynamics teaches that mutually destructive twist velocities can be imparted to any $n + 1$ screw chains about which the system can twist. Does any conceivable symbolism assign those twist velocities more beautifully than the ausdehnungslehre? Each twist velocity is the "Kombinatorisches Produkt" of all the screw chains to which it does *not* correspond.

The aptitude of other conceptions of this grand calculus for physical problems could be as readily exemplified. But I forbear. Why has not some one ere this translated into English "Die Ausdehnungslehre von Hermann Grassman" 8vo, pp. 388, Berlin 1862? ROBERT S. BALL.

Observatory, Cambridge, August 18.

A Curious Optical Phenomenon.

DR. LAUDER BRUNTON has asked me to give you an account of a very curious phenomenon witnessed from the top of Gausta mountain (height 6000 Norwegian feet) in Telemarken, south of Norway.

We were a party of two ladies and three gentlemen on the summit of this mountain on August 4.

On the morning of that day the sky was passably clear; at noon there was a thick fog. Between six and seven o'clock in the afternoon (the wind being south to south-west) the fog suddenly cleared in places so that we could see the surrounding country in sunshine through the rifts. We mounted to the flagstaff in order to obtain a better view of the scenery, and there we at once observed in the fog, in an easterly direction, a double rainbow forming a complete circle and seeming to be 20 to 30 feet distant from us. In the middle of this we all appeared as black, erect, and nearly life-size silhouettes. The outlines of the silhouettes were so sharp that we could easily recognise the figures of each other, and every movement was reproduced. The head of each individual appeared to occupy the centre of the circle, and each of us seemed to be standing on the inner periphery of the rainbow. We estimated the inner radius of the circle to be 6 feet.

This phenomenon lasted several minutes, disappearing with the fogbank, to be reproduced in new fog three or four times, but each time more indistinctly.

The sunshine during the phenomenon seemed to us to be unusually bright.

Mr. Kielland-Torkildsen, president of the Telemarken Tourist Club, writes to me that the builder of the hut on the top of Gausta has twice seen spectacles of this kind, but in each case it was only the outline of the mountain that was reflected on the fog. He had never seen his own image, and he does not mention circular or other rainbows. A. WILLE.

Christiania, August 15.

Supposed Suicide of a Rattlesnake.

THE letter of Mr. E. S. Holden, of the Lick Observatory, in your issue for August 10, describing how a rattlesnake struck

its fangs into itself, when confined in a gallon jar containing water, which was inverted at intervals in order to drown it, is open to question as to its conclusion that it was a case of "deliberate suicide," for the following reasons:—

(1) That it was after "the snake ceased any attempt to rise to the surface of the water in the jar," that the blow was struck. The snake then being wholly beneath the water, would die from drowning, and not from the self-inflicted wounds caused by its poisoned fangs.

(2) That it has been proved by experiment by Dr. Weir Mitchell that the venom of the rattlesnake is of no effect upon itself, when introduced into any wound in its body. I speak from memory of an article which appeared in the *Atlantic Monthly* some few years ago. That self-insertion of the poison would make any difference is not likely.

Drowning (by the act of others) and not self-poisoning (or suicide) I take to be the cause of death in the case described.

Halifax, August 15. W. H. WOOD.

Numerous Insects Washed up by the Sea.

THE phenomenon referred to under the above heading in your issue of August 17 may be in part accounted for by the fact that on August 7, at many spots in the neighbourhood of Godalming (S.W. Surrey), the air was thick for several hours with swarms of winged ants. The direction of the wind was from the north-west, force moderate. Assuming the like to have taken place at other places, it is quite possible that large numbers of ants may have been carried out to sea and drowned from this region of Surrey and Hampshire.

Hunstanton, August 19. OSWALD H. LATTER.

THE FUNGUS GARDENS OF CERTAIN SOUTH AMERICAN ANTS.

ONE of the most interesting papers that has appeared during the present year, whether considered from the point of view of general biology or of mycology, is that which has recently been published by Herr Alfred Möller, nephew of Dr. Fritz Müller.[1] The work was carried out at Blumenau during the years 1890–92, and presents a clear and thorough investigation into the habits of the leaf-cutting ants and their remarkable custom of cultivating and feeding upon certain fungi. The work is introduced by a quotation from Thos. Belt's "Naturalist in Nicaragua," where the author, speaking of the leaf-cutting ants, states: "I believe . . . . that they are in reality mushroom growers and eaters." This statement Möller fully proves in the work before us. The first portion, forming the bulk of the work, is given up to the consideration of the fungus gardens of the leaf-cutting ants, and is divided into ten sections.

1. *The species of the leaf-cutting ants and their activity outside of the nest.*—Belt's description[2] of the Nicaraguan ants is quoted, and the differences between them and those of Blumenau are pointed out. The chief point of difference is that the latter form very narrow streets, travelling only in single file, and that their nests occur both in the forest and in the open. The commonest species is *Atta* (*Acromyrmex*) *discigera*, Mayr, whose workers are never more than 6·5 mm. long. Almost as common is *A. hystrix*, Latr., whose workers reach a length of 9 mm. Rarer than these are *A. coronata*, Fabr., and a doubtful form, which Möller terms *Atta IV.*

A minute description is given of a street of *A. discigera*, which was 26 metres long and about 1·5 cm. wide and high, roofed in in parts wherever possible. It led to a number of small Cupheas, whose leaves the ants were cutting. In the street could be seen a procession of loaded ants going towards the nest, and others empty-handed, going in the opposite direction. Some of the large workers run up and down the road unloaded, and act as road-menders if any accident happens to a part of the track. Other very small workers, which do not cut leaves, may also be seen carried upon the backs or even upon the loads of the actual leaf-cutters. An ant carrying a peculiarly shaped piece of leaf was watched from end to end of the track, and travelled the 26 m. in 70 minutes. The load was twice as heavy as itself.

The other species of the Atta have very similar streets. *A. hystrix* appears to work only at night.

The jaws of the ants are very strong, with serrated edges, and clash together laterally. The ant begins at the edge of a leaf, and cuts out a piece in about five minutes, revolving on one of its hind legs as a centre. When the piece is almost freed, the ant goes on to the main portion of the leaf, cuts through the last piece uniting it with the severed portion, drags up the latter, balances it on edge between its forelegs, and then, grasping it with its jaws, lifts it up above its head, so that the centre of gravity of the load is above the ant itself. It then marches off, down the stem, to the base, over the ground to the end of the street, and along this to the nest, travelling at a very uniform speed, and never letting go its load. The weight thus carried was found, on an average, to be twice that of the ant; but many were found carrying heavier loads, even as much as ten times their own weight! A street of *A. coronata* was watched for fifteen minutes, during which time 217 ants passed, carrying 3 grammes of leaves.

2. *The Nests of the Ants, and the Fungus Gardens.*—The nests of *A. hystrix* and *A. discigera* are usually below the surface of the soil, but covered, wherever necessary, with a thick mass of withered pieces of leaves and twigs, &c. They may be as much as 1½ metres in diameter. In the nests of all four species there is found, filling up the interior, a curious grey spongy mass, full of chambers, like a coarse sponge, in which the ants may be seen running about, and in which, here and there, occur eggs, larvæ, and pupæ. This is the fungus garden, termed by Belt "ant-food." It is separated from the roof and lateral walls of the nest by a clear space. The walls and roof are much thicker in winter than in summer; one nest examined had a roof 25 cm. thick and wall 40 cm. Photographs are given in the original paper, showing the appearance of the mushroom garden.

3. *Investigation of the Gardens. The Kohl-rabi clumps.*—The garden consists of two parts, differently coloured, but not very sharply marked off from one another. The older part is yellowish-red in colour; the newly-built portions, forming the surface of the garden, are of a blue-black colour. It is this part which is of the greater importance to the ants.

The garden is found, on examination, to consist of an immense conglomeration of small round particles of not more than ·5 mm. in diameter, of a dark green colour when quite fresh, then blue-black, and finally yellowish-red. They are penetrated by, and enveloped in, white fungus hyphæ, which hold the particles together. These hyphæ are similar throughout the nest.

Strewn thickly upon the surface of the garden are seen round white bodies about ·25 mm. in diameter; they always occur in the nests, except in the very young portion of the gardens. They consist of aggregations of peculiar swollen hyphæ, and are termed by Möller the "Kohl-rabi clumps." The hyphæ swell out at the ends into large spherical thickenings, about 10–24 μ in diameter (the ordinary hyphæ are 5–8 μ thick), filled with richly vacuolated protoplasm like the ordinary hyphæ. These clumps of "Kohl-rabi" are only found on the surface of the garden, and form the principal food of the ants. A microscopic examination of the particles of which the garden is composed shows that they contain remains of leaves; bits of epidermis, stomata, spiral vessels, &c., occur in them.

4. *The Importance of the Garden to the Ants.*—If a nest be broken into and the garden scattered the ants collect

[1] "Die Pilzgärten einiger südamerikanischer Ameisen." Heft 6 of Schimper's "Botanische Mittheilungen aus den Tropen." (Jena: G. Fischer, 1893.)

[2] "Naturalist in Nicaragua," p. 71.

it as quickly as possible, especially the younger parts, taking as much trouble over it as over the larvæ. They also cover it up again as soon as possible to protect it from the light. A nest, 1 metre × 50 cm. was opened, and in twenty-four hours the ants had put on a new roof 10 cm. deep. They also carry the nest with them upon their migrations

5. *The Use of the Garden: its Construction and its Tendance observed in Captivity.*—Some ants' nests were placed under a bell jar and supplied with leaves; they made no use of them and presently died. If they were supplied with a piece of "garden," they rebuilt it and covered it so far as they could. It was seen to shrink from day to day, the ants bringing out the old pieces and adding them to the wall; finally it was exhausted and the ants died. Others were starved for five days, and then supplied with a bit of garden; they at once began to eat the Kohl-rabi clumps. It was found by this means that each species of Atta will eat the Kohl-rabi of the other three as well as its own. Finally, by supplying the ants with bits of garden, a damp sandy floor, and fresh leaves, they were induced to build in captivity. The dish in which they worked was covered by a glass lid, and when this was covered with a dark cloth or otherwise kept dark, the ants built under it without covering the garden. In this way the whole process was observed. An ant bringing in a piece of leaf proceeds to cut it into halves, repeating the process till it has got a very small piece left, which it holds between its fore feet and turns round, crushing it in its jaws until the whole is reduced to a round ball of pulp about ·25 mm. thick. This it then takes and adds to the garden. So well is the kneading performed that no single cell remains uninjured, and it was observed that the hyphæ of the fungus grew through and round one of these particles within a few hours. Belt supposed that this process was performed by the small workers above-mentioned, but it is not so, as we have just seen. The small workers perform the function of weeding the garden, and this is so well done that a portion of it removed and grown in a nutrient solution gives a perfectly pure culture, not even containing bacteria!

6. *Development of the Fungus after removal of the ants; the conidia, "pearl-hyphæ," and strand-swellings. Result of the artificial culture of the Fungus.*—If a portion of garden be left to itself in darkness, the ants having been removed, aerial-hyphæ develop in a thick mass several centimetres high, with many anastomoses; the Kohl-rabi clumps are used up in the process, apparently supplying material for it. The formation of conidia now takes place all over the mass. From a hypha there buds out a lateral projection, which bears branches arranged roughly in whorls: upon these are again borne whorls of small club-shaped branches, from whose ends are abstricted rows of conidia, whose diameter is 2 μ; there are, as a rule, not more than ten in a row. Occasionally the formation of the strings of conidia occurs not only on the final branches, but also on those of the preceding order. After the conidia are formed the mass collapses (about the fifth day).

About the third day a careful search reveals among the ordinary hyphæ a few which are covered, as with rows of pearls, with small spherical lateral protuberances. These "pearl-hyphæ" arise from the ordinary ones. The cavity of the "pearl" is in direct communication with that of the hypha itself, and contains protoplasm. In connection with these there occurs a second type of conidia formation, distinguished by Möller as the "weak" formation. There is no preliminary branching, the conidia being abstricted from the ends of the pearl hyphæ, or plain hyphæ in connection with them. The end of the hypha swells up and bears the conidiophores. The chains generally consist of at least twenty conidia.

Still a third form of hypha is to be found. Sooner or later there are observed on the garden thick white strands, which on examination are found to consist of hyphæ, which look like rows of beads, or yeast-chains, and are much bent, branched, and twisted. From these there arise pearl hyphæ, or we may find pearls upon these hyphæ themselves. These peculiar hyphæ arise first of all as "pearls" on ordinary hyphæ, and then a process of budding goes on, just like that which gives rise to yeast chains. The "pearls" might be looked upon as homologous with these lateral swellings of hyphæ, but there is also another view, that they represent rudimentary conidiophores. It has been seen above that the conidiophores in the "strong" conidia formation are not always confined to the ends of the hyphæ, but may at times appear further back, and it is suggested that originally they were borne anywhere upon the hyphæ, and subsequently restricted to the tips, the "pearls" then representing rudimentary conidiophores. The "pearl" hyphæ and weak conidia formation are usually found in connection with these swollen strands, and on one or two occasions a connection was found with the strong conidia formation.

When a few ants were left with a large piece of garden, they did their utmost to prevent the formation of these aerial hyphæ, &c., biting them off as they appeared, but gradually the fungus gained the upper hand of them. Proceeding now to the results of culture in nutrient solutions, the strong conidia germinate and give rise to hyphæ which ultimately bear strong conidia again. Never did the "weak" form appear, but very often from the main hypha there were given off lateral branches, some of which developed into rows of beads, like the hyphæ described above, and others swelled up at the ends just like the Kohl-rabi. The cultures being pure, these formations could not be pathological, produced by bacteria, as is sometimes the case.

Similarly the weak conidia gave rise only to conidia like themselves. Pearl-hyphæ were occasionally formed, and rarely the peculiar hyphæ like rows of beads.

When one of these forms was grown in one culture drop, and bent over into another drop, in which the other form was, the two anastomosed freely, showing that they belonged to the same plant.

When a portion of Kohl-rabi is grown in the solution it gives rise to ordinary hyphæ, which ultimately produce a new crop of Kohl-rabi. On one occasion it gave rise to pearl-hyphæ and weak conidia.

To sum up, the fungus has two conidia forms, which develop upon the garden in the absence of the ants. The mycelium shows a strongly marked tendency to the formation of swellings and protuberances, which appear in a different form, more or less distinctly marked. One of these, which has probably reached its present form under the cultivation and selection of the ants, is the Kohl-rabi.

7. *Discovery of the Highest Fructification of the Fungus.*—It being evident that the fungus was either a Basidiomycete or Ascomycete, attempts were made to obtain its principal fructification by cultivation, but in vain. A fortunate discovery, however, was made of a nest which had a huge red Amanita-like fungus growing out of it. This was found to belong to the genus *Rozites*, and the species was named *R. gongylophora*. The development of the basidia, &c., is given in detail, but need not be gone into here. Cultivation of the spores showed that this was indeed the fructification of the Kohl-rabi-forming fungus.

10. *Plants attacked by Leaf-cutting Ants.*—These were found to be very numerous, and no rule could be formulated as to the operations of the ants. On one day they would strip one plant and the next day leave it untouched, or *vice versâ*. An interesting case was observed in the cold weather. An army of leaf-cutters was found stripping a Cecropia, though the latter was inhabited at the time by its protecting ants! The latter appeared to be too numbed by the cold to go out and fight.

THE GARDENS OF THE HAIRY ANTS.

While working at the preceding it was discovered that somewhat similar fungus gardens occur in the nests of *Apterostigma*. Four species were studied. All have the same fungus, belonging apparently, however, to a different genus from *Rozites*. These hairy ants live in decaying wood and have small gardens 4-8 cm. in diameter, built of bits of wood-fibre, beetle-dung, &c. The chief point of interest is that though all have the same fungus yet all have not cultivated and selected the Kohl-rabi to the same degree. *A. Wasmanni*, Forel, has a well-developed type with large spherical swellings on the ends of the hyphæ. The others have Kohl-rabi of a much lower type, the hyphæ being only slightly swollen into a club shape, and they are not aggregated into regular groups.

It was, as usual, found impossible to obtain by artificial culture the highest fructification of the fungus, so its systematic position is still undetermined.

THE GARDENS OF CYPHOMYRMEX.

This genus of ants is closely related to the two preceding, and the two species examined (*C. auritus*, Mayr, and *C. strigatus*, Mayr) are also fungus-growers. Both form nests like those of Apterostigma, and use similar material in the garden. The two species have the same fungus, but *C. strigatus* obtains far finer Kohl-rabi than *C. auritus*, just as we have seen to be the case with the species of Apterostigma. It is thus pretty evident that the large size of the best Kohl-rabi must be due to selection and cultivation on the part of the ants.

The concluding pages of the work are taken up by a discussion of the mycological results of these investigations, for which reference must be made to the original. The work is illustrated by beautiful plates, and forms as a whole one of the most fascinating contributions to botanical literature that have been made for many years.

JOHN C. WILLIS.

A FEW REMARKS ON INSECT PREVALENCE DURING THE SUMMER OF 1893.

WE are hearing a great deal just now of unusual amount of insect presence, and there appears no reason to doubt that such is very much the case, although for scientific use we need much more of reliable report than we possess as to what kinds of insects are noticeably more present than in seasons of ordinary meteorological conditions, and also we need observations as to what kinds may be unusually absent.

So far as my own acquaintance with the subject (which is mainly in reference to amount of presence of crop insects) allows me to judge, these unusually large amounts where they occur—for the superabundance does not affect all kinds—may be attributed to weather influence acting either directly on the development of the insects themselves, or so affecting the state of their crop-food-plants as to induce the conditions which we know well by the agricultural experience of many years are favourable to establishment of infestation.

The important preliminary as to there having been really such a definite deficiency in rainfall as to amount to what may be called "a drought" over England and Wales, we have stated shortly in the *Monthly Meteorological Magazine*, of Mr. G. J. Symons, F.R.S., No. cccxxxi, p. 98, as follows :—"Assuming that the twenty-four stations fairly represent England and Wales, we find that in March the rainfall was only one-third of the average, in April one-sixth, in May three-quarters, and in June two-thirds." Mr. Symons further points out that "this, of course, is taking the country as a whole ; at many individual stations the results would be much more striking, *e.g.* at Bodmin in the three months" (March to May) "only one fifth of the average fell."

Amongst insect attacks especially subject to increase by stunting of growth, or over-maturation of sap of their food plants, are those of the Aphides or Plant Lice, which have been—so far as my own contributors' reports show—unusually early and prevalent this year. They were forwarded on mangolds from Devonshire almost as soon as there could be said to be good accommodation for attack on the leafage, and turnips and cabbage leafage, damson early in the season, and larch later on the borders of England and Scotland, were some of the tree and food plant habitats which were exceptionally afflicted. These prevalences agree with the rule of Aphis life laid down by Mr. G. B. Buckton, F.R.S., our great authority on Aphis life. In drawing attention to the abnormally rapid increase of Aphides under some circumstances, he accounts for it by maturity (*i.e.* power of reproduction) taking place earlier in the life stage where from various causes inducing want of supply of nutriment, structural changes occur consequently on these in the larvæ of the Aphides subsequently born. (See "Brit. Aphides," by G. B. Buckton, F.R.S., vol. i. p. 72).

Besides the above reasons for increase, we have also the negative reason of absence of destruction by good drenching rains to wash off and often to drown the enemy. One of my correspondents wrote me that he had been doing this or that, but the best help was the welcome rain.

The above may be taken as a type of one way in which weather influence acts ; in the case of wasps, which popularly represent much of insect presence to the world at large, we have another set of influences.

Our recent drought began in March. In many years we have the most variable weather at this season, and the queen wasps, the foundresses of the coming colonies, being tempted from their winter localities of hybernation by a day or two's warmth, are caught, it may be, by heavy rain, or by snow, or by frost, and perish. This year weather was more favourable to them, and we had not the drenching rains which in an ordinary year put an end to many an embryo nest with its few grubs, whether in ground or hedge. The first commencement, formed of a tiny piece of paper, in shape like an umbrella, with beneath it a pendant ending in a club formed of a few cells, each with its egg or young maggot tenant, is delicate in the extreme. If the cavity in which it is placed in the ground is flooded, its destruction is certain, or if in storms the foundress cannot return to feed the young family they must perish.

In the case of wasps, probably weather influences, which affect amount of any particular kind of food are as, little troublesome as to any insect. All who at all study their habits are aware that flesh, fish, insects to a large amount, and fruit to utter rapacity of consumption, are constantly utilised by them for their own special support or that of the maggot family. To what extent the adult wasps may feed on other than vegetable matter I cannot say, but dissection and examination of the undigested food in the blind pouch of the food canal of the larval wasp has shown this to consist of remains both of animal and vegetable matter ; in the record before me chiefly of insect *débris*. Their varied kind of food and their wonderful adaptability of instinct in making adverse circumstances suitable for the household needs, make the wasp family when once established, most prolific pests.

The great prevalence of what are called surface caterpillars, that is, the larvæ of various kinds of Agrotis at the roots of various kinds of field crops, gives an example of increase of presence of the Lepidoptera, under circumstances favourable to the development of the imago from the chrysalis, and subsequently to the pairing of the moths and successful egg deposit. In wet and chill weather, when the moths hang about torpidly, a certain proportion of them get drenched, so that their wings are of little service ; the larvæ are injured in different ways, or disease induced, much influencing amount of presence.

In the past season such attacks as that of the great caterpillars (four inches or more in length) of the Lappet Moth, the *Gastropacha quercifolia* scientifically, to apple leafage; or again, the presence of caterpillars of the little *Pyralis glaucinalis* might reasonably be supposed to be influenced by weather. In the first case, the great size of the larva feeding on the leafy twig exposes it much to alternations of weather, and in the second, where, as in the samples sent me, the infestation was located in the outer part of fodder stacks, the penetration of wet which might soak the filmy cocoons with their developing contents, would cause conditions very different to the long-continued appearances of the present summer.

To go through the different orders of insects, specially represented, or the different dates and amounts of their appearance on the crops, would be too long here, but I can safely say that whilst the drought lasted I had constant applications regarding insect appearances, including a much greater variety than usual of kinds little observed in ordinary years, and in some cases unusual amount of presence of our common kinds.

Various representatives of the Acarina, as the currant, pear, and plum Phytopti were of course largely noticed, as also the Phytopti (or gall mites) of the hazel buds, of which the galls loaded the hazel boughs in this neighbourhood early in May to a degree I have never before seen. The kind of (so-called) "red spider" (*Bryobia prætiosa*) which ordinarily is chiefly found on ivy, extended its injurious presence so widely to gooseberry leafage as to necessitate careful, and happily successful, measures to get it under.

Why, with all this, various crop insect attacks were less reported than customarily remains uncertain. Corn Aphides as yet have not been complained of. Possibly this is by reason of the heat hardening the ears so that they were in a condition to withstand attack before the Aphides arrived on the heads to endeavour to pierce into them with their suckers. In countries where the climatal conditions can be counted on, this point (of arranging date of crop so as to protect itself from attack) is one of the regular methods of prevention. Another infestation which threatened to be very troublesome, but of which the second brood did not make any noteworthy appearance in various places, is that of the mustard beetle. Why this should be so I am as entirely at a loss to explain as the crop inspector who reported the state of things to me.

Various other absences of attack remain also unexplained, but are duly noted for possible future service in agricultural entomology.

So far as I can gather from contribution of my own correspondents, or other accessible sources of information, I should consider that such extra amount of insect presence as has occurred, has been owing to weather influence. We have had earlier and more numerous development of many kinds, and also in the case of various common crop insect pests, the hardness of the soil, and other conditions incident to drought, which made it totally impossible to bring either stimulating dressings, or mechanical measures to bear, necessitated our permitting increase to go on unchecked in some cases, and in some, though the caterpillars just below the surface of the ground necessarily did not themselves multiply, their unattainable legions swelled the numbers of observable pests, and probably will supply us a plentiful brood of moths for further continuation of species.

There does not appear to be any reason from previous circumstances, or from importations, to consider that we were suffering from other than the ordinary attacks, which, in a changeable climate like ours, must be changeable in their amounts; at least, so it appears to me from such an amount of report as I possess.

ELEANOR A. ORMEROD.

THE GREAT HEAT OF AUGUST 8 TO 18.

AN extraordinary wave of high temperature passed over this country between the 8th and 18th of this month, which has also been remarkable on account of the continuance of the heat during several consecutive days. High temperatures were experienced in all parts of the United Kingdom, but more especially in the southern and eastern portions of the country. The following table shows their distribution as represented by the stations included in the *Daily Weather Report*:—

Stations.	Days with temperature of 75° or more.	Days with temperature of 80° or more.	Days with temperature of 85° or more.	Days with temperature of 90° or more.	Days with temperature of 75°-90° or more.	Maximum temperature.	Date.
Leith	5	—	1	—	6	85	15
North Shields ...	3	2	—	—	5	83	18
York	5	4	1	—	10	86	18
Loughborough ...	1	4	5	1	11	91	18
Liverpool	4	2	1	—	7	85	17
Parsonstown	5	2	—	—	7	82	14 and 16
London	—	4	4	3	11	93	18
Oxford	4	2	5	—	11	89	17 and 18
Cambridge	3	2	4	2	11	92	18
Jersey	4	4	3	—	11	89	17

A glance at this table shows that at Loughborough, Oxford, Cambridge, London, and the Channel Islands the temperature reached or exceeded 75° on every day of the period in question, the maxima reaching 91° at Loughborough on the 18th, 89° at Oxford on the 17th and 18th, 92° at Cambridge on the 18th, 93° in London on the 18th, and 89° at Jersey on the 17th.

At Greenwich the temperature exceeded 80° on each successive day from the 8th to the 18th inclusive, the highest readings being 93° on the 16th, 94°2 on the 17th, and 95°1 on the 18th. The last reading has only been exceeded twice at any time of the year during the last half-century, viz., 96°6 on July 22, 1868, and 97°1 on July 15, 1881. The highest reading in the sun during the eleven days in question was 146°2 on the 18th, but this temperature was slightly exceeded in June last. Mr. Symons states that, on the 18th instant, the thermometer at his station at Camden Town registered 93°6, which has only once been exceeded during thirty-six years (1858-93), viz., on July 15, 1881, when it read one degree higher; the present is the only year with a maximum shade temperature above 90° for three consecutive days. On the night of the 17th instant the minimum temperature in South London was as high as 72°, being rather above the average maximum temperature for the month of August, and the daily mean, as deduced from the maximum and minimum readings in the *Daily Weather Report* for the 18th, was 82°·5; this mean value is probably the highest on record since trustworthy observations have been taken. In a valuable paper recently read by Mr. Ellis before the Royal Meteorological Society, the average mean temperature at Greenwich for that day is given as 62°5.

On the Continent the highest readings quoted in the *Daily Weather Report* were 102° and 106° at Rochefort in France on the 13th and 14th instant, while the maximum readings there reached or exceeded 90° on seven consecutive days. In the South of France the temperature exceeded 80° on each day of the period in question, 100° being recorded at Biarritz on the 17th.

The Weather Charts published by the Meteorological

Office during this period show that the conditions were mostly anti-cyclonic, both over this country and the Continent, with the exception of a depression in the south-west, which caused some sharp thunderstorms on the 9th and 10th. On the 18th another depression appeared off our north-west coasts, causing a gale in those parts, while strong winds and lightning occurred generally, with heavy rain in the west. These conditions checked the excessive heat; on the 19th the maximum temperature in London was 15°, and at Paris 25°, lower than on the previous day.

A SENSITIVE SPHEROMETER.

THE ordinary spherometer has three arms carrying three fixed points, with a point moved by a screw in the centre. This form is an improvement on the original spherometer invented by Andrew Ross, and for which the Society of Arts gave him a silver medal in 1841.

A description of Ross's instrument is given by Holtzapffel, vol. iii. p. 1271 of his work on "Turning and Mechanical Manipulation," extracted from vol. liii. of the Transactions of the Society of Arts. This instrument could measure to $\frac{1}{1000}$ of an inch, and by estimation half this amount. An ordinary spherometer, with a screw of $\frac{1}{100}$ of an inch pitch and head divided to hundredths, will measure to $\frac{1}{10000}$ of an inch.

I pointed out in vol. l. page 145, of the Memoirs of the Royal Astronomical Society that the sensitiveness of the ordinary spherometer was much increased by placing the screw not in the centre, but in one of the arms in place of one of the fixed points; this at once increased the sensitiveness of the screw in proportion to the distance of the screw from the nearest fixed point, and this fixed point from a line joining the other two fixed points.

The improvement I wish to bring before those interested in spherometers by this note, is the extension of this principle, for by carrying the middle point much nearer the line joining the other two, a proportionate increase of sensitiveness is obtained.

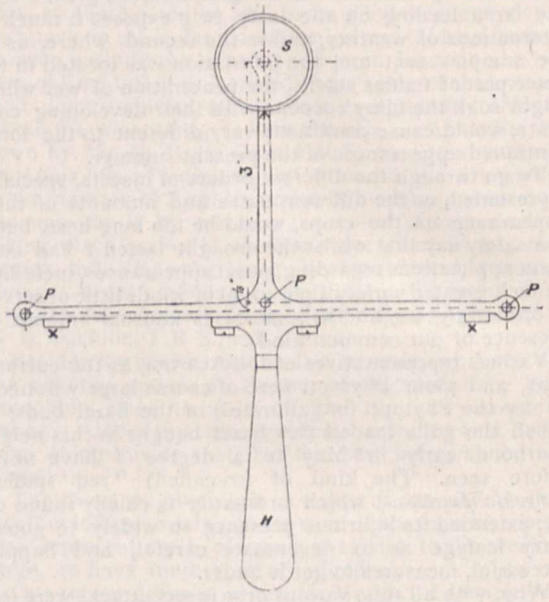
In the case of an instrument I have made on this plan I have increased the sensitiveness thirty times, the distance from the middle point to the screw being three inches, and the distance of the point from the line of the other two being $\frac{1}{10}$ of an inch; with a screw of one hundred threads to the inch and a head divided to hundredths, the ordinary form of instrument will read to $\frac{1}{10000}$, but on the plan I give, the same screw will measure $\frac{1}{300000}$ of an inch.

There is an additional advantage in this form, that the curvature of a part nearly in a line is measured, so that cross measures can be taken.

The form of the instrument is not symmetrical, and it requires to be balanced, so that when the screw is raised it will be possible to estimate the frictional contact of the outside points when the middle one is taking the weight. This balancing is easily done by adding a handle to the part opposite the arm carrying the screw; in practice it is found that this handle is of the greatest value in keeping the heat of the hand from the instrument, as even with the ordinary instrument, holding it for a short time in the hand alters the readings materially.

It is of great advantage to have on the arms carrying the two outer pins two pieces of wood or ivory projecting not quite as much as the measuring points, so that by tilting the instrument up these two pieces come first into contact with the surface to be measured, then by gradually raising the handle the points are brought gently into contact. The figure is a plan of this spherometer, and shows the position of the three fixed points P P P with reference to the measuring screw S, and the position of the balancing handle H with reference to the unsymmetrical arm carrying the measuring screw; X X are the projecting pieces already mentioned.

The movement of the screw being so large for a slight curvature, this instrument is more particularly useful for measuring the slight curvatures of so-called plane mirrors,



PLAN

for which, indeed, it was designed. To make it available for measuring differences between parts of a curved surface of considerable curvature the middle pin should be a screw capable of movement to, and clamping, in a position, that will allow the measuring screw to work.

A. A. COMMON.

JEAN DANIEL COLLADON.

DANIEL COLLADON, the celebrated physicist and engineer, died on June 30, at Cologny, near Geneva.

Colladon was born at Geneva, December 15, 1802. He belonged to a Protestant family from Berry, which removed from France, in the middle of the sixteenth century, on account of religious persecutions, and found refuge in Calvin's town. Many a distinguished magistrate came from this family, amongst others the learned juris-consult, Germain Colladon.

While still quite young Colladon proved to be wonderfully intelligent, and had a remarkably observant mind.

He went through the College and then the Academy of Geneva, which at that time had, among its professors, A. P. de Candolle, M. Aug. Pictet, Th. de Saussure and Prevost. His liking for science could not but develop itself in contact with these eminent men, whose esteem he soon gained.

At the age of ten years he made friends with Charles Sturm, who became a noted mathematician, and was on later occasions his fellow-worker. His inventive nature and talent for experimental inquiry turned itself above all to physics and its mechanical applications.

He was just twenty-two when he received from the Society of Science of Lille a first prize for the invention of a new photometer. At twenty-three he went to finish his studies at Paris. He lived there for about ten years, leading a simple life, almost entirely devoted to work.

He was received in a most flattering manner for such a young man by the pleiades of celebrated men, which the

to a height of more than 17000 feet. Dr. Gregory has explored the glaciers and the head-streams of the Tana, and the watersheds between the Tana and Athi rivers.

THE death is announced of Prof. G. W. Coakley, who for thirty-three years occupied the chair of mathematics and astronomy in New York University. He was born on the island of St. Bartholomew on February 22, 1814, entered Rutgers College in 1832, and graduated in 1836. In 1843 he was made professor of mathematics and astronomy in St. James's College, Indiana, where he remained until 1860, when he accepted the same professorship in New York University, filling the chair vacated by Prof. Loomis, who had gone to Yale University. He held this chair in New York University until his death, and was engaged in active teaching until his 77th year.

A REUTER'S telegram from Halifax, Nova Scotia, states that a terrific hurricane swept over the Maritime Provinces on August 21, and was the worst that has occurred since the great storm thirty years ago. In Halifax a vessel was sunk in dock, trees were uprooted, and the electrical systems were wrecked.

ON August 25 Prof. J. Victor Carus, the editor of the *Zoologische Anzeiger*, will celebrate his seventieth birthday. In honour of the occasion, the current number of that journal contains a remarkably fine portrait of the renowned zoologist.

THE Board of Agriculture notify that arrangements have recently been made by which the latest issues of the Ordnance Survey maps on the 1 in. and 6 in. scales have been made available for inspection by the public at the offices of the Board, at 3, St. James's Square. Changes in the boundaries of boroughs, of local government districts, and of parishes will be recorded on the 6 in. maps as soon as possible after they have been authorised, and a complete set of the index maps and indices of all Ordnance Survey maps and publications will be kept in hand for reference. It is believed that the facilities for inspection thus afforded will be found to be of general public utility.

THE *Times* gives some details received from Japan with regard to the recent volcanic eruptions in the Fukushima district, in the mountains of which Bandaisan, where there was a destructive eruption a few years ago, is the chief. The disturbances began with an earthquake early in the afternoon of June 4, which was followed by an eruption of Azuma-Yama the next morning. Other peaks in the neighbourhood became active, and the showers of stones and ash did much damage, especially to the mulberry trees of the district. It was decided to investigate the mountains, and two members of the geological bureau of the Agricultural Department were despatched from the capital for the purpose. They ascended Azuma-Yama very early on the morning of June 6 with the view of making observations in the immediate vicinity of the craters, and the same night reported to the authorities in the capital that, when they ascended, volcanic ash was falling and strong puffs of black cloud were escaping from time to time. They were able to make a circuit of the craters, from one of which dense volumes of vapour and ash were being emitted and from another heated air only. Whenever part of the sides gave way and fell in, the volume of vapour increased and a rumbling noise was heard. Heated fragments of rock were thrown out from time to time. On the morning of June 7 two students of the University of Japan and two engineers ascended the volcano. A violent eruption occurred while the party were approaching the crater. A dense column of gas arose, and was accompanied by a shower of rock fragments. After the explosion it was found that the two engineers had been overcome by the fumes. Attempts were made to rescue them, but they unfortunately failed. It was not until the following day that the neighbourhood of the crater could be searched and the bodies recovered.

THE *Journal* of the College of Science, Imperial University, Japan, Vol. V. Part IV., contains a paper by Prof. B. Koto "On the Cause of the Great Earthquake in Central Japan, 1891." Prof. Koto has examined a great line of fault which traverses a distance of 112 kilometres from the Kisogawa to the city of Fukui, through the Neo valley, cutting the hills, mountains, and plains alike with remarkable regularity and sharpness. He is of the opinion that the entire region on one side of the line of fault moved downwards in October, 1891, and was also shifted horizontally towards the north-west for from one to two metres along the plane of dislocation, thereby causing the earthquake.

MR. J. D. MCGUIRE has, during the last two years, been endeavouring to reproduce aboriginal methods of work, chiefly in stone, with tools of stone, wood, and bone, such as are found in village sites in America and Europe, as well as with tools found in graves, and those used by races living in savagery. He describes his experiments in a paper "On the Evolution of Working in Stone," that appeared in the *American Anthropologist* for July. The experiments show that the art of grinding and battering stone must have preceded that of chipping, and that neolithic implements which are supposed to have taken years to fashion were really but the work of a few hours.

WRITING in the *Journal* of the Polynesian Society, Miss Teuira Henry, of Honolulu, says that a strange ceremony used to be practised by the heathen priests at Raiates, but can now only be performed by two descendants of priests, Tupua and Taero by name. This ceremony consisted in causing people to walk in procession over a hot earth-oven, without any preparation upon their feet, whether barefooted or shod, yet upon their emergence they did not even smell of fire. The ovens are frequently thirty feet in diameter, and are filled with roots of the *ti*-plant (*Dracaena terminalis*) and short pieces of *ape*-root (*Arum costatum*). It is hoped that some one will endeavour to solve the mystery of the feat while those men who practise it still live.

THE U.S. National Museum have published a report by Mr. Romyn Hitchcock on "The Ancient Burial Mounds of Japan," illustrated by ten excellent plates, mostly reproduced from original photographs. Mr. Hitchcock visited Japan with Mr. W. Gowland, who has spent several years in the study of the Japanese mounds. One of the earliest modes of burial in Japan was in artificial caves, hewn out of the solid rock on hillsides. It has been said that the early Japanese were cave-dwellers, but Mr. Hitchcock thinks this is very doubtful, for the reason that natural caves are not found where the history of the people begins, in Idzumo and Yamato. The examination of both natural and artificial caves indicates, at any rate, that the Japanese have not been cave-dwellers since their migration to Japan. Four distinct methods of burial have prevailed in Japan at different periods, which are distinguished by Mr. Hitchcock as follows:—(1) Burial in artificial caves. (2) Burial in simple mounds of earth. (3) Burial in mounds with rock chambers, or dolmens. (4) Burials in double mounds, or imperial tumuli. The chronological sequence of these different modes of burial is a matter of speculation, but, in all probability, the caves preceded in time the rock-built dolmens. No inscription remains, however, to enable ethnologists to solve the origin of the custom of cave-burial. A variety of articles were obtained from the mounds by Mr. Hitchcock, notably vessels of pottery of various shapes, illustrations of which accompany his report. The forms and style of decoration of these vessels are very rude; in fact it is pointed out that the decoration is much less elaborate than that found on the older pottery of the shell-heaps and pits of Yezo, and usually designated as Aino pottery. As Mr. Hitchcock remarks, it is difficult to explain the curious

anomaly that the early pottery of a people who are famed at the present day for their productions in this kind of handiwork, should be inferior to the earlier productions of their predecessors, who have since absolutely lost the art of making pottery of any kind.

IT was Lœffler who most successfully exhibited in stained preparations the cilia or organs of locomotion attached to some micro-organisms. As is well known, these appendages will not stain in the usual manner, and special methods have to be adopted. Moreover, they are so delicate and easily broken or detached that the greatest care and skill have to be exercised in their demonstration. Lœffler's method consists in using a mordant, to which a certain proportion of either an acid or alkali is added, the nature as well as the proportion of the latter varying with the particular microbe under investigation. To ascertain the exact quantity required in each case is of course a very tedious process, but recent investigations have shown that the acid or alkaline reaction of the mordant may be neglected, and that equally successful specimens can be prepared when this precaution is altogether omitted. A very simple modification of Lœffler's method devised by Nicolle and Morax is published in the *Annales de l'Institut Pasteur*, July 1893, p. 554. These authors dilute a small quantity of a recent culture in water, and run a fraction of it on to cover-glasses and allow it to dry. Lœffler's fuchsin ink or mordant is then applied, heated over a small flame until it begins to steam, and then washed. This process is repeated three or four times, after which the preparation may be stained with an ordinary aqueous solution of violet and examined in the usual manner. It is stated that by thus substituting the application of the mordant three or four times for the once recommended by Lœffler, equally good results were obtained without the addition of either an acid or alkali.

AN elaborate investigation into the chemical and bacterial condition of the river Elbe at Magdeburg has been recently carried out, and the results are published in the part issued in July of the *Arbeiten a. d. Kaiserlichen Gesundheitsamte*, vol. viii. 1893. The Elbe at the intake of the Magdeburg waterworks contained on November 10, 1891, as much as 34·3 parts of chlorine per 100,000. This large proportion of chlorine sinks into insignificance when contrasted with the 130·3 parts per 100,000 present in the Saale one kilometre above its junction with the Elbe. The Saale receives the drainage from numerous potash and other works, and the waste water from one of these was found to contain as much as 656·4 parts of chlorine per 100,000, so that the brackish state of both these rivers is easily explained. Ohlmüller, who is responsible for the report, states that unless the intake of the Magdeburg water-works is removed to a more suitable spot there is every probability of the Elbe water becoming undrinkable, in spite of the exhaustive and careful filtration to which it is submitted before distribution, in consequence of its brackish taste. But another consideration also enters into the question of the desirability of this water for dietetic purposes, for the saline condition of a given water acquires a new significance since the important discovery that the cholera organism thrives luxuriantly and multiplies abundantly in water and other media containing a high percentage of salt. That the water of the Elbe remains brackish even when it reaches Hamburg was shown by chemical analyses made of this water during the cholera epidemic last year, and Percy Frankland states (*British Medical Journal*, July 29, 1893, p. 251) that he found 31·3 parts of chlorine per 100,000 in the sample which he examined. Hueppe, in his report on the Hamburg epidemic, mentions especially the salt taste which the water had. That other bacteria can also flourish in this brackish water is exhibited by the large numbers present in the Saale, there being as many as 40,440 in 1 c.c. of water abstracted about one kilometre above the point where this river joins the Elbe.

HERR A. HASEMANN suggests, in the current number of the *Zeitschrift für Instrumentenkunde*, a novel suspension for pendulums which appears to merit some further investigation. In the ordinary suspension of a knife-edge turning on a plane, a high magnification would show us a flattened cylinder working in a depression in the plane due to the elastic yielding of the material. This introduces friction and the sliding action discovered by Defforges. Herr Hasemann proposes to rest the knife-edge upon another, or rather to give both the knife-edge and its support a semi-cylindrical form. In that case the junction of the two surfaces is a plane, and for the same angle of swing the displacement of the surface of contact is much smaller. In the experiments undertaken to test this arrangement, the difficulty anticipated with regard to stability was found to be very much less than one might be led to suppose.

LORD KELVIN'S new series of electrical measuring instruments are described by Mr. Andrew Meikle in the *Electrician*. The chief representatives of this class of instruments are the recording electricity meter and the dial voltmeter. In the former, which is chiefly intended to measure the energy consumed in electric-lighting circuits, the whole current is sent through a stout coil consisting of a few turns of a copper spiral. Within this coil is suspended a vertical electromagnet made of a soft iron core wound with wire conveying a subsidiary current of $\frac{1}{10}$ ampere, which is 25 per cent. more than is sufficient for saturation. The position of this electro-magnet within the coil is recorded by an intermittent counting mechanism worked by a cam. The large dial voltmeter made for the Edison Electric Illuminating Company, of New York, depends upon the pull of a solenoid upon a suspended electromagnet as in the first instrument, but here the electromagnet is wound with 30,000 turns of fine copper wire, the current under investigation being conveyed to the coil by the spiral springs by which it is suspended. The resistance of the electromagnet coil is 1500 ohms, and the core is saturated by $\frac{1}{25}$ ampere. Electromotive forces of 60 volts and upwards are therefore measured free of residual errors. Attached to the electromagnet is a ratchet which is geared into a pinion wheel on the shaft carrying the pointer, thus giving the instrument a great resemblance with the aneroid barometer. A rod carrying two discs is screwed into the lower end of the electromagnet, and the discs, working in thick oil in a dash pot, serve to damp vibrations due to sudden changes of electromotive force. The diameter of the dial is about thirty inches.

M. D'ARSONVAL, we learn from *Électricité*, has been making experiments on the electric excitability of muscles after death, and recently sent some results of his observations to the Academy of Sciences. General opinion on this point agreed that the excitability disappeared very soon after the death of the animal, which is true only so long as one depends upon the shortening of the muscle for an indication of its sensibility. But this method is not sensitive enough to indicate disturbances of very small amplitude. For this purpose M. d'Arsonval has for many years used a special modification of the microphone, which he has named the *myophone*, and which, when it is connected with the muscle under experiment, gives a sound some time before any contraction is apparent, especially if the muscle is stretched by a spring. By this means it may be proved that nervous excitability may last for many hours after death. As an instance, the achilles tendon of a rabbit may be attached to the myophone, and the sciatic nerve excited by a current broken some 50 to 100 times per second. Besides proving that the death of a nerve is much less rapid than was

hitherto supposed, these experiments also show that nerve may act on muscle without producing actual contraction, but only some simple molecular vibration.

WE have received a catalogue of the library of the Akademie der Naturforscher, prepared by Dr. Oscar Grulich.

THE City and Guilds of London Institute for the advancement of technical education has issued its programme of the technological examinations for the session 1893-94.

"SYMONS'S BRITISH RAINFALL" for 1892 has been published. It contains, in addition to the rainfall statistics gathered from more than three thousand observers in Great Britain and Ireland, several articles upon various branches of rainfall work.

A LECTURE on "Cholera Prospects and Prevention," recently delivered by Dr. Thorne Thorne, F.R.S., to the technical teachers of the National Health Society, has just been published by the Society. The teachers and the Society must benefit by putting themselves under such an excellent adviser as Dr. Thorne is upon hygienic matters.

THE autumn session of popular science lectures at the Royal Victoria Hall, Waterloo Bridge-road, will open on Tuesday, September 5, with a lecture on "What I saw of New Zealand and the noble Maori," by Capt. Chas. Reade, R.N. The three other lectures of the month will be given by Prof. Malden, and will be as follows:—September 12, "Picturesque Ireland;" September 19, "Australia;" September 26, "The World's Fair and Chicago."

THREE more volumes of the comprehensive Aide-Mémoire series, published by Gauthier-Villars and by Masson have been received. One, by M. Laurent Naudin, is on the manufacture of varnishes. It is divided into two parts, dealing respectively with the physical and chemical properties of the materials used, and with the actual processes involved, in varnish manufacture. M. G. Laverque is the author of a volume on turbines, which is also divided into theoretical and practical parts. The third volume is by M. A. Hébert, and deals with the means of detecting the adulteration of alcoholic drinks.

THE Journal of the Marine Biological Association (vol. iii., No. 1) contains lists of the *Nemertines* of Plymouth Sound, by Mr. T. H. Riches, and the *Turbellaria* of Plymouth Sound and the neighbourhood, by Mr. F. W. Gamble. Dr. Benham contributes a paper on the post-larval stage of *Arenicola marina*, and Mr. E. W. L. Holt continues his description of the North Sea investigations carried on by him at the Marine Fisheries Society's laboratory at Cleethorpes. Mr. J. T. Cunningham contributes two interesting articles on the immature fish question, and the coloration of the skins of flat fishes.

THE United States National Museum has issued in separate form the report of Dr. J. P. McMurrich on the Actiniæ collected by the U.S. Fish Commission steamer, *Albatross*, during the winter of 1887-88. The reports deals with the Edwardsiæ, Protactiniæ, Hexactiniæ, and Cerianthea. Dr. McMurrich will give the results of his studies of the Zoantheæ in a future report. Other recently-received excerpts from the Proceedings of the U.S. National Museum include a "Description of some Fossil Plants from the Great Falls Coal Field of Montana," by Mr. W. M. Fontaine, and a paper "On the Occurrence of the Spiny Boxfish (Genus Chilomycterus) on the Coast of California," by Prof. Carl H. Eigenmann.

AN improved mode of preparing the ammonium salt of persulphuric acid, NH_4SO_4 or $(NH_4)_2\ S_2O_8$, is described by Dr. Elbs, of Freiburg, in the latest number of the *Journal für Praktische Chemie*. The potassium, ammonium and barium salts of persulphuric acid were obtained two years ago by Dr. Marshall, of Edinburgh, in large well-developed crystals as described in our note of Vol. 44, p. 577, and since the publication of Dr. Marshall's memoir M. Berthelot, who first pointed out the existence of the acid and its anhydride, has published an account of his further experiments upon the subject, fully confirming the results obtained by Dr. Marshall, and adding further details. M. Berthelot's latest form of electrolytical apparatus for the preparation of the persulphates by the electrolysis of solutions of the ordinary sulphates in sulphuric acid consisted of a double cell, the inner portion being constructed of porous porcelain. Into this inner porous cell of about 150 c.c. capacity was placed a concentrated solution of ammonium or potassium sulphate in dilute sulphuric acid, while the outer cell was filled with more of the dilute acid. M. Berthelot appears to have considered it essential to employ an anode of small surface in the inner cell, a piece of stout platinum wire being preferred; but a kathode of large surface was considered requisite in order to diminish the resistance of the arrangement, and a large plate of platinum was employed for this purpose. A current of three amperes was allowed to pass through the apparatus for fifteen to twenty hours, when a yield of about forty to forty-five grams of ammonium persulphate, corresponding to a yield of sixteen *per cent.* of the theoretically possible, was obtained. With the improved form of apparatus and under the conditions described by Dr. Elbs, it is possible to obtain an average yield of sixty-five *per cent.* of ammonium persulphate, the amount having even reached eighty-five *per cent.* in one experiment. As anode or positive pole a spiral of platinum wire is employed, and as kathode or negative pole a piece of sheet lead bent into a cylindrical form and surrounding the inner porous cell. The outer liquid consists of equal portions by volume of water and oil of vitriol, and the inner liquid is a saturated solution of ammonium sulphate in sulphuric acid diluted with eight times its volume of water. The apparatus is cooled during the passage of the current by a bath of pounded ice. If cold spring water is available, however, the cooling may conveniently be effected by substituting for the leaden cylinder in the outer vessel a worm of leaden tubing, through which the cold water is driven. The current of two to three amperes is only permitted to traverse the apparatus for three or four hours, when the contents of the inner cell are filtered through glass wool, which retains in the funnel the crystals of ammonium persulphate produced. The crystals are drained on porous plates, and the filtrate is again saturated with sulphate of ammonia, returned to the inner cell, and again electrolysed. There is no advantage in prolonging the experiment to twenty hours, inasmuch as the formation of persulphate occurs much more slowly after a time. After the first experiment, when a considerable quantity of ammonium persulphate remains in solution, one hundred parts of water at the ordinary temperature dissolving sixty-five parts of the salt, about forty grams of crystals are obtained in each operation of three to four hours. In order to recover the persulphate remaining dissolved after the conclusion of the preparations it is convenient to precipitate it as the potassium salt by the addition of a solution of carbonate or acetate of potassium. Potassium persulphate is much less soluble than the ammonium salt, one hundred parts of water, under the same circumstances as mentioned in the case of the latter salt, only dissolving two parts of the potassium salt. It would thus appear to be most advantageous to prepare the soluble ammonium salt as the starting-point for a study of the persulphates, and the method described by Dr. Elbs renders the operation both simple and cheap, and affords it in comparatively large quantities in a short period of time. The product may be purified from traces of admixed ordinary sulphate by first recrystallising a small portion, and subsequently washing the main quantity

with the solution of the pure crystallised salt. Recrystallisation of the whole is attended with a considerable loss. The crystals are quite permanent, however, when stored in dry bottles with well-fitting stoppers.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include the Anthozoan *Gephyra Dohrnii*, the Æolid *Amphorina cærulea*, the Cirrhipede *Scalpellum vulgare*, and the Brachyura *Ebalia tumefacta* and *Achæus Cranchii*. The floating fauna continues to be rich in trochophore larvæ of various types, as recently recorded; the larva of *Polygordius* was last week taken in addition. Among Protozoa, *Noctiluca* has become more plentiful; but the week has been especially marked by the presence of Radiolaria of several species in numbers altogether unprecedented in our experience. Other signs of an Atlantic element in the floating fauna of late are furnished by the continued abundance of the Siphonophore *Muggiæa atlantica*, both colonies, eudoxomes and larvæ, and by the capture of two specimens, sexually mature, of *Doliolum Tritonis*. The Hydroids *Aglaophenia pluma* and *myriophyllum* and the Nudibranch *Æolidiella Alderi* are now breeding.

THE additions to the Zoological Society's Gardens during the past week include a Mona Monkey (*Cercopithecus mona*) from West Africa, presented by the Misses Price; a Yellow-cheeked Lemur (*Lemur xanthromystax*) from Madagascar, presented by Miss Annie Gervers; a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. J. W. Harris; a Short-toed Eagle (*Circaëtus gallicus*) from Morocco, and six Little Bitterns (*Ardetta minuta*) from Europe, presented by Lord Lilford; a Black-headed Gull (*Larus ridibundus*) from Brit. Isles, presented by Mrs. H. S. Wardrop; an Indian Kite (*Milvus govinda*) from Eastern Asia, presented by Mr. A. Savory; four Tortoises (——) from Formosa, presented by Mr. P. Aug. Holst; a Golden Cat (*Felis moormensis*) from Sumatra, a Slender-billed Cockatoo (*Licmetis tenuirostris*) from South Australia, and six Avocets (*Recurvirostra avocetta*) from Holland, deposited; six Avocets (*Recurvirostra avocetta*) from Holland, a Common Tern (*Sterna hirundo*) from Holland, a Japanese Ape (*Macacus speciosus*) from Japan, and a —— Hawk Eagle (*Spizaëtus* ——) from India, purchased.

OUR ASTRONOMICAL COLUMN.

THE CORDOBA DURCHMUSTERUNG.—Mr. John Thome, the Director of the National Argentine Observatory, is to be congratulated upon the publication of the Cordoba Durchmusterung Catalogue, containing the brightness and position of every fixed star down to the tenth magnitude comprised in the belt of the heavens between 22° and 32° of south declination. The results are a continuation of the Durchmusterungs of Argelander and Schönfeldt from their southern limit. In the present volume 179,800 stars are catalogued, but altogether the places of 340,380 stars have been determined down to − 42°. The observations for this great catalogue were begun in 1885 and ended early in 1891. They reach the enormous number of 1,108,600, and were made entirely by Mr. Thome and Mr. R. H. Tucker. The area over which the observations have extended is 6075 degrees of a great circle, hence the mean density of stars is 56·2 stars per square degree. The corresponding mean density for Argelander is 15·2, and for Schönfeldt 18·5. The density varies considerably, however, in different parts of the sky, and ranges from 70 to 160 stars per square degree in the Milky Way. Mr. Thome says that a series of twelve maps, each embracing two hours of right ascension and twenty degrees in declination, has been constructed upon the scale adopted by Argelander, and will be issued during next year with the second volume of the catalogue, containing stars within the belt from 32° to 42° south declination. The construction of these maps, and the preparation of a catalogue like that of which the first part has just reached us, involves an enormous amount of labour. Indeed, it is difficult to understand how, amidst the vicissitudes to which an observatory in the Argentine Republic must be subject, and with such a meagre staff as that under Mr. Thome's direction, it has been possible to do so much excellent work.

THE RORDAME-QUÊNISSET COMET.—On July 11 the Rordame-Quénisset comet (*b* 1893) was photographed at Goodsell Observatory, and a fine photogravure reproduction of one of the views forms the frontispiece to the August number of *Astronomy and Astro-Physics*. In a letter that appears in the same journal, Prof. J. E. Keeler describes the spectroscopic observations of the comet made at Alleghany Observatory. On July 10 the three usual carbon bands were seen, connected by a narrow continuous spectrum from the nucleus. Each band appeared to terminate sharply on its less refrangible side, where also the brightness was greatest. No direct comparison of spectra could then be made, so the positions of the bands were estimated. A photograph of the comet spectrum in juxtaposition with the solar spectrum obtained from the moon was procured on July 19. Upon the photograph could be seen a hazy band at λ 472 and another terminated by a line on the less refrangible side at λ 388, and fading away towards the more refrangible end of the spectrum. Between these two bands others were suspected, but could not be made out with sufficient accuracy for a determination of wave-length. A comparison of the spectrum of the comet with that of a spirit lamp on July 20 showed that the bands were coincident in the two spectra. The brightest comet band—that in the green—appeared to have a second maximum coincident with the second maximum of the corresponding carbon fluting

A SIMPLE EQUATORIAL MOUNTING.—M. J. Jarson describes in *L'Astronomie* for August a simple, if not new, means by which small telescopes can be moved equatorially, thus permitting an observer to keep objects in the field of view without constantly moving the telescope in altitude and azimuth. Applying this method, for instance, to a small telescope mounted on a small vertical tube, tripod fashion, such as those generally used at seaside resorts, the following account may show the simplicity of the arrangement. On the stand of the telescope a bar of wood or of iron is fixed horizontally, in which is a hole sufficiently large to pass a cord. The position of the hole is determined by the rule that the line joining the centre of motion of the telescope in declination to this hole makes an angle with the horizontal bar equal to the latitude of the place of observation. By connecting the object-glass end of the telescope to this hole, by means of a chain or cord, any celestial object can be followed in the heavens by simply keeping the cord tight and moving the telescope. A weight fastened to the eye end secures the tightness of the cord. The telescope will then describe an arc of a circle in the heavens, and not a straight line as formerly. For different objects it is obvious that one must vary the length of the cord; but for making prolonged studies of any particular one possessors of small instruments will find this a most useful arrangement.

A REMARKABLE SOURCE OF ERROR.—Dr. E. Von Rebeur-Paschwitz, in No. 3177 of the *Astronomische Nachrichten*, publishes some interesting curves traced by a horizontal pendulum during the prevalence of certain slight earth tremors occurring on different occasions and at different places. Traced photographically on sensitive plates moving with a velocity of twenty-four inches per minute, these tremors show a striking similarity to those observed by Prof. Milne in Japan. It appears that the surface of the earth is occasionally subjected to wave motions analogous to those disturbing a sheet of water, and often persisting with great regularity for several hours. Their connection with steep barometric gradients is probable, although that does not appear to be the only condition. In any case, the tremors appear in the presence of strong winds, at least in the neighbouring country, and they travel with at least the velocity of 2 km. per second. The influence of these tremors upon observations of polar distances, and upon spectro-photographic work, is sufficiently obvious to render it desirable that all observatories should be fitted with automatic instruments for registering these disturbances, and arrangements should be made for their study and comparison.

THE APEX OF THE SUN'S WAY.—In a letter to the editor of the *Bulletin Astronomique*, Prof. H. G. van de Sande Bakhuyzen says that he has determined the apex of the movement of our system from all Bradley's stars of which the distances from the pole of the Milky Way are less than 50°. In

the calculation, he made use of the method employed by L. Struve in his memoir on the determination of the movement of the solar system, in order that the two results might be strictly comparable. Prof. Bakhuyzen has also repeated the calculations, using stars in the same part of the heavens as the above, but with proper motions not exceeding 0″·075. The first method gave, as the position of the apex,

R.A. = 264°, Decl. = 30°.

The result obtained by the second calculation was—

R.A. = 290°, Decl. = 24°.

The position found by L. Struve was—

R.A. = 273°·3, Decl. = 27°·3.

Prof. Bakhuyzen is at present occupied in determining the apex from stars of small proper motion in the Milky Way.

THE ORIGIN OF NEW STARS.—In the current number of *Die Natur* Prof. G. Hoffmann surveys the various new stars discovered since Tycho Brahe's Nova Cassiopeiæ, and the different theories advanced to account for their appearance. He is inclined to endorse the views of Prof. Seeliger, according to which the sudden brightness is produced by a heavenly body entering a "cosmic cloud" consisting of sparsely distributed matter. Prof. Hoffmann thinks that all new stars may be regarded as essentially of the same type as the variables of long period.

THE MINUTE STRUCTURE OF PLANT HYBRIDS.[1]

DR. MACFARLANE'S paper will not fail to impress biologists by the suggestiveness of some of his speculations and with the importance of his observations. Nor are his conclusions limited to the plant hybrids, which he discusses, but they apply, though with certain limitations, to all organisms resulting from sexual reproduction.

Of course, in the case of hybrids, the parental characters are often very different, and can therefore be easily recognised in the offspring, whence the examination of their characters, including, of course, their minute anatomy, becomes important to all who are interested in the problems of reproduction. For in the case of fusion of reproductive cells of the same species, where the parental characters differ often very slightly, it is difficult, and at times impossible, to distinguish whether the characteristics of the male or female parent predominate, or whether a complete blending has taken place. Theoretically perhaps we should expect this blending of characters, but our everyday experience brings to our mind so many instances of almost unadulterated inheritance of paternal or maternal characteristics, that we are somewhat prejudiced against a conclusion to which Dr. Macfarlane's observations on hybrids lead him, and which ought equally to apply to normal offspring.

The study no doubt presents many difficulties, which are, it is true, recognised by the author, but do not seem to him insuperable. First and foremost we have the variability of what are usually termed true species; and the author is careful to point out that "for hybrid investigation one should be acquainted with the parent individuals and the conditions under which they were grown, or try to choose an average specimen for study." But in either case errors may creep in. For if one of the parents has varied abnormally, though some of the offspring will inherit such a variation, others may revert to the more normal condition of their grandparents or great-grandparents. If, on the other hand, we choose the average specimen, we are entirely in the dark as to any special variation of the parental form. Nothing short of selecting normal individuals as parents and examining all or a large number of the hybrid offspring would afford sufficient basis for such conclusions, as the author deduces from his less complete observations. But Dr. Macfarlane does not even state in each case whether his observations are taken from the parents themselves, or only from average specimens.

The conditions of growth, too, enormously affect some of the characters which the author has chosen for comparison. The character of leaves for instance, especially as regards their transpiratory functions, can be completely altered by the treatment of the young plant. If, therefore, the number of stomata per unit of surface are to be of any value for comparison of forms, both the parents and the offspring must be raised under similar conditions. If this is not the case we should expect the offspring to resemble in this particular that parent which was grown under conditions most similar to itself. Nor does the author fail to find such a case. *Hedychium Sadlerianum* approaches very nearly in the number of stomata on the lower surface the condition of one of its parents, *H. coronarium;* but we are told nothing as to the condition under which the parents or offspring were reared, and the tendency to "sway towards one parent" is explained by the assumption that it is "a morphological adaptation in the hybrid for physiological work, or in the truest sense a case of physiological selection."

Having thus briefly stated some of the difficulties besetting the problem, we may state that all his observations and measurements, down to the size of the plastids and starch grains, lead the author to the conclusion that plant hybrids, at least seed hybrids, are, both in their minute structure and in their general life-phenomena, intermediate between their parents.

This complete blending is, to say the least, very extraordinary, and we are tempted to question whether the author has investigated a sufficient number of individuals of each hybrid. Surely the variability of hybrids would be sufficient to supply any investigator with numerous examples which were not intermediate. The unanimity of the observations published make it imperative that some further investigations should be undertaken with regard to the variability of hybrids, a factor to which sufficient prominence is not given in the present paper.

Darwin insists both in his "Forms of Flowers" and also in his "Cross and Self-fertilisation of Plants," upon the correspondence between the crossing of distinct species and legitimate unions of dimorphic and trimorphic heterostyled plants. Yet from Dr. Macfarlane's paper we must conclude that in some respects at least there is no correspondence.

For Darwin states that though "the shape of the stigma and the length of pistil both vary, especially in the short styled form, I have never met with any transitional states between the two forms in plants growing in a state of nature." Now the difference in these forms extends also to anatomical details, such as the size of the pollen-grain and the size of the stigmatic hairs; and yet the offspring will all resemble either one or the other parent, and thus differ radically from all the hybrids which Dr. Macfarlane has examined, all of which represent forms intermediate between the two parents. Dr. Macfarlane has of course come across some exceptions, but we are not told whether they are merely individual variations approaching one or other of the parents, such as we should expect to find, or whether in the production of the hybrid there was always a tendency to approximate the male or female form. Whichever be the case, the author is of the opinion that the number previously asserted to diverge towards one of the parents has been considerably overestimated.

The author's contribution, however, to the investigation and discussion of graft hybrids is extremely valuable, and we cannot help wishing that he had found more similarity in the characters of graft and seed hybrids. We feel convinced, though we should not like to impugn the evidence brought forward, that the latter does not represent the average condition of the structure of plant hybrids, but that there must be more variation in their characters than the author has found in the specimens he was enabled to examine, especially more variation towards one or other of the parent forms, though we should not expect it to be so pronounced as in the case of graft hybrids. F. E. W.

COMPULSORY LAWS OF ERROR IN DRAWING.

Digest of the Phenomena, with Examples.

THE object of the following paper is to present the facts in the briefest and, it is hoped, the plainest possible manner, for the purpose of calling attention to phenomena connected with the art of drawing, or depicting form in outline. It is to prove that error made in such drawing comes under the dominion of natural law, or compulsion, and is not the result of individual misconception of truth. The phenomena are altogether distinct

[1] "A Comparison of the Minute Structure of Plant Hybrids, with that of their Parents, and its Bearing on Biological Problems." By Prof. J. Muirhead Macfarlane. (Transactions of the Royal Society of Edinburgh, vol. xxxvii. part i. no. 14.)

from intellectual aptitude, the intelligent and the dull being equally liable to commit the errors in the forms which will hereafter be specified.

Consideration will first be given to the existence of *general laws*, of which there appear to be three, so strongly marked as to stand clearly distinguishable as including in themselves the minor manifestations. These laws are as follows :—

(1) There is a general law making us fundamentally incapable of drawing in perspective. It is a radical condition—not of ignorance of the laws of perspective but of active negation of them. It is a natural necessity to show by the arrangement of lines the exact contrary to true perspective. It is persistent, and exists long after correct knowledge of the true arrangement of the lines is acquired, and the error is always liable to appear on any occasion of forgetfulness—that is to say, when drawing is not done with the true principles immediately in remembrance in the mind. It is perceivable in the form of direct *divergence* of lines (parallel in nature) which in perspective should *converge* to their vanishing point.

(2) Another general law is a natural incapacity to erect a proper perpendicular for an object unless the same occurs close on the line of direct sight (forward). If the perpendicular be situate laterally, and especially if it be short, it is liable to a deflection. This deflection occurs in the following manner :—If the same be on the right hand the line inclines from its top towards the central line of sight (forward) ; its foot is therefore nearer this central line than its top. On the left hand the phenomena are directly reversed. This error occurs whether the perpendicular be the obvious physical corner line of a solid or whether it be the integral (invisible) line of any such solid or of a drawn figure.

(3) The next general law is less distinct, but still abundantly provable on test. It affects those lines which, being in right angles to the observer, lie laterally to him ; that is to say, if a line of the surface (horizontal) of a figure occur on the right or left hand, at a little distance, the line is not drawn with perspective inclination to the *vanishing point* in front of the observer, but is *drawn as a perpendicular*, or, as is evident, in such a manner as would be the true fact of its direction, void of the influence of perspective. Thus, if a square lie two or three feet to right or left of the draughtsman, those two sides of it which are the sides rectilinear, not sides parallel to the base of the picture-plane, are drawn as two perpendiculars, while they should be converging lines towards a point which leads them diagonal-wise across the paper.

These brief particulars are intended to give an account of the primary, or general, laws. All other manifestations are deducible from them—that is, in every case where a special aspect of a figure draws out its special error, this is seen to have its origin in one or other of these three primary laws. From this point I now proceed to illustrate with examples selected from three figures—the cube, the pyramid, and the hexagon—instances of special error. Other geometrical figures may at a future period be likewise illustrated, but the intention is in this paper only to broach the subject.

The Cube.

It is in all cases assumed the object lies on a table before the observer.

Position 1.—Let the cube be placed on the right or left, and with two planes parallel to the picture-plane, two in right angles.

Error 1.—The perpendiculars will be inclined as radiants upwardly.

Error 2.—The 3 perspectives visible will diverge.

Error 3.—Or these will be neutralised of perspective, and the true perpendiculars be inclined.

Position 2.—Let the cube be situate anglewise on the direct line of sight.

Error 1.—All 6 perspectives to right and left diverge.

Error 2.—Or the top is drawn as a *square*.

Position 3.—Poise the cube on an edge, so that one plane, resting exactly balanced on its corner, is in the direct front, and parallel to picture-plane.

Error 1.—The perspectives (3) will diverge.

Error 2.—The square of the front plane will be confused as rhomboidal.

Position 4.—Still having the cube poised on an edge, let it be turned so that three faces are seen at one time, and it presents perspectives in 9 lines.

Error 1.—All the perspectives, in groups of 3 each, for each plane, will diverge.

The Pyramid (*Square*).

Position 1.—Let the pyramid lie exactly in front, parallel to the picture-plane.

Error 1.—The two parallel edges of the square base, extending in right angles from the eye, will diverge.

Error 2.—The further side of the pyramid will thus be longer than the nearer side.

Position 2.—Let the pyramid lie on the same spot, but with an angle presented, so that the sides of the square extend in equal angles.

Error 1.—If the view of it should be isometrical, or the pyramid *flattish*, the perspectives will be shown diverging.

Position 3.—Place the pyramid point downwards towards the observer, in front, and with one side for a base.

Error 1.—The two parallel retiring lines of the inclined *real base* will show divergence.

Error 2.—Consequently, the further line of base will be longer than the nearer and upper of this sloping square.

Position 4.—Place the pyramid so that it still lies on a side for a base, but in front, and the apex and the central point of a side of the real base are on a line parallel to picture-plane.

Error 1.—The apex, which should thus lie horizontally *even* with the central point of that line of real base, which touches the ground, will be shown *below* that line. The true relation to central point given is never seen.

Error 2.—Such perspectives as occur will diverge.

The Hexagon.

Position 1.—Place a solid hexagon upright in the exact front of observer, with two planes parallel to picture-plane.

Error 1.—All perspectives of the parallel sides will diverge.

Error 2.—Consequently, the two parallel lines (integral) which connect opposite angles of the hexagon will lose *their* perspective.

Position 2.—Place the hexagon on a side, so that its lines, then horizontal, are parallel to picture-plane and the object is in a lateral situation, or not in front.

Error 1. The end, which is now a plane in right angles, will show the integral connecting lines between top and bottom angles *leaning*, because these are essentially perpendicular ; therefore the perpendicularity is distorted. (General law 1.)

Error 2.—The line (integral) connecting the two angles midway between top and base line of this plane, and which should be of course *parallel* to these, and partaking of their perspective, will have a course diagonal to them, always deflected downwards.

Error 3.—The lines which indicate the further, or unseen plane of hexagon will show exact conformity to this error ; also diverging perspective.

Position 4.—Place the hexagon again laterally, with its end as a front plane, and a side on the ground, the direction of the object being in a due rectilinear line.

Error 1.—The perspective bias will be lost (general law 3) and the lines traced as perpendiculars.

Error 2.—Or these will indicate divergence in place of convergence.

Error 3.—The plane parallel to picture-plane, and essentially void of distortion, will be nevertheless distorted.

Position 3.—Place the hexagon, still resting on a side, so that its lines take a diagonal line with regard to a line parallel to the picture plane, and it must be in front.

Error 1.—The displacement of the integral perpendiculars will occur in the end planes, as in Error 1 of Position 2.

Error 2.—The Error 2, in Position 2, will be repeated.

Error 3.—The perspectives will diverge.

ARTHUR L. HADDON.

THE DEPARTMENT OF SCIENCE AND ART.

THE fortieth Report of the Department of Science and Art has just been issued, and is of a highly satisfactory character. From it we learn that in 1892 there was a very large increase, not only in the number of students and classes, but also in the number of schools or separate institutions in which science is taught. The number of classes in different branches of science in 1892 was 10,352, as against 8,568 in the preceding year, and

the number of pupils under instruction showed the remarkable increase of 32,002, the totals for 1891 and 1892 being respectively 148,408 and 180,410. The number of examination papers worked was 203,347, and the number of individual examinees 108,858, so there was an average of nearly two papers for each student. The greatest number of papers, 29,051, was worked in mathematics. In physiography, 21,944 papers were written, and in theoretical inorganic chemistry, 21,578 papers. The lowest number of candidates were presented in mineralogy and nautical astronomy, the number of papers worked in these subjects being 119 and 141 respectively. With regard to the extent to which local authorities are devoting funds for the purposes of science, art, technical, and manual instruction, it is reported that "Of the forty-nine councils of counties in England (excepting Monmouth), forty-two are now giving the whole of the residue to technical education, while the remaining seven are giving a part of the amount; and of the sixty-one councils of county boroughs, fifty are devoting the whole of the residue to the same purpose, and ten are devoting a part of it, no decision having yet been arrived at in the case of Great Grimsby (which it may be mentioned was only constituted a county borough on April 1, 1891). Of the councils of the sixteen counties and county boroughs of Wales and Monmouth, to which the Welsh Intermediate Education Act, 1889, applies, fifteen are applying the whole of the residue to the purposes of intermediate and technical education, and one a part of it. Contributions are also made out of the rates under the Technical Instruction Act, 1889, in the case of seven counties and county boroughs in Wales and Monmouth. As regards Scotland, so far as returns have been received, the whole of the residue fund is being applied to technical education in the case of twenty counties (out of thirty-three) and sixteen burghs and police burghs (out of 187), while six counties and thirty-nine burghs and police burghs are giving part of it to the same purpose. Of the remainder, the majority of the local authorities are devoting the residue to the relief of rates, and a small proportion of them have under consideration the question of applying the money to technical education."

In conclusion, it is pointed out that "the opportunities afforded to people engaged in all branches of industry for acquiring a knowledge of much which is closely connected with their daily work, but which cannot be obtained in the factory or workshop, are constantly increasing. The municipal schools, which are steadily growing in number and efficiency in all parts of the country, must be of great service in this connection. Further, in proportion as local interest is developed, and employers show that they value sound scientific instruction and art teaching, the effectiveness of these schools will be promoted But whether the income of these schools be derived mainly from local or Imperial sources, it is essential that the course of instruction adopted shall be well adapted to the needs of the town or district. The more fully the educational welfare of the students takes the first place, and the mere earning of Government grants the second place in the new Municipal schools, the more certainly will they fulfil their object."

It is clear from this that the Department desires to stamp out the system whereby science classes are "farmed" by teachers. The acquisition of knowledge is rightly regarded as the proper goal, not the mere obtaining of a certificate. The technical instruction committees of some of the county councils would do well to bear this and the following admonition in mind: "Without a sound foundation of general education, the highest scientific training cannot be imparted; without a sufficient supply of teachers with adequate salaries, who are not overworked, and who not merely know their subject, but know how to teach it, a considerable part of the money expended on the encouragement of new forms of education must be wasted."

EUROPEAN LABORATORIES OF MARINE BIOLOGY.

MARINE laboratories are now recognised as essential to the progress of biology. The facilities they offer the collector and the investigator cannot be overrated, and it would be an excellent thing if institutions could be conducted on similar lines in every branch of science. Mr. Bashford Dean, in the *American Naturalist* of July, gives an illustrated description of marine laboratories in Europe, which is so interesting that a large portion of it is here reprinted. The description of the Marine Biological Station at Plymouth is omitted owing to the fact that a detailed account has already appeared in these columns (vol. xxxviii. p. 198, 1888). Mr. Dean prefaces his report as follows:—

"In every country the marine laboratory has become a need of the student of biology. During his winter studies in the university it serves to provide him with well-preserved material, often with living forms which he may himself prepare according to his wants; in summer it gives him opportunity to see and collect his study types, and utilise with profit and without physical discomfort abundant material relating to his studies. To the investigator the marine laboratory has become, in the broadest sense, a university. He may there meet the representative students of far and wide, fellow-workers, perhaps, in the very line of his own research, and must himself, unknowingly, teach and learn. He finds out gradually of recent work, of technical methods which often happen most pertinent to his present needs. He may carry on his work quietly and thoroughly; his works of reference are at hand; he has the most necessary comfort in working—the feeling of physical rest, untroubled by the rigid hours of demonstrations and lectures.

"The importance of the work of the marine laboratory has been keenly appreciated in foreign countries, and it is noteworthy how large a number of the original researches is at present conducted at, or upon material from, these distributing centres of biology. At the present day the entire coast line of Europe has become dotted with zoological stations great and small, grown out of the resources granted by societies, private individuals, or governments—perhaps by the combined efforts of all. It is a matter of great interest to note how thoroughly the marine laboratory system abroad had become a part of every grade of biological work. The student in a small university in the interior of France receives his first lessons from material sent regularly from Roscoff or Banyuls. He examines *living* sponges, hydroids, lucernarians, pennatulids, beroës, *Loxosoma*, *Comatula*, and *Amphioxus*. In Munich, hundreds of miles from the sea, is another example. Prof. Richard Hertwig, by the aid of material from Naples, demonstrates the larval character of ascidians, or the fertilisation of the egg of the sea urchin. Every group of European universities seems to have centralised its marine biological work in a convenient locality, and this branch of their needs is supported—and is well supported—even in countries whose financial resources are most limited. The importance of this work is felt to such a degree that it is not from reasons unselfish that universities have united in their support of a station like that of Naples. This has become literally an emporium cosmopolitan, bringing together side by side, perhaps not unnaturally, the best workers of many universities whose observations upon the best material, sharpened by discussion and criticism, are certainly tending to become the most accurate and the most fruitful in their direction and results.

"It is most singular that foreign countries are unquestioningly liberal in the support of *pure* biology, and in the work of marine stations the tendency is becoming less and less on the part of money-givers to ask how many fish will be hatched to become food material. Public interest has been gradually coming to be directed to the general laws and the problems of life and heredity. This has well been a hopeful sign, and the European biologists are not backward in emphasising the importance of their studies. Prof. de Lacaze-Duthiers does not hesitate even to propitiate the practical Cerberus, reminding him how often 'facts have been found at every step of science which were valueless at their discovery, but which, little by little, fell into line and led to applications of the highest importance—how the observation of the tarnishing of silver, or the twitching leg of the frog, was the origin of photography and telegraphy—how the purely abstract problem of spontaneous generation gave rise to the antiseptics of surgery.'"

Beginning with the marine laboratories of France, Mr. Dean says:—

"The extended sea-coast has ever been of the greatest aid to the French student—along the entire northern coast the channel is not unlike the Bay of Fundy in the way it sweeps the waters out at the lunar tides. The rocks on the coast of Brittany, massive boulders, swept and rounded by the rushing waters, will, at these times become exposed to a depth as great as 40 feet. This is the harvest-time of the collector; he is enabled to secure the animals of the deep with his own hand, to take them carefully from the rocky crevices where they would ever have avoided the collecting dredge. From earliest times this

region has been the field of the naturalist. It was here that Cuvier, during the Reign of Terror, made his studies on marine invertebrates which were to precede his "Règne Animal." The extreme westernmost promontories of Brittany have, for the last half-century, been the summer homes of Quatrefages, Coste, Audouin, Milne-Edwards, and de Lacaze-Duthiers. Coste created a laboratory at Concarneau, but this has come to be devoted to practical fish culture, and is, at the present day, of little scientific interest. It is owing to the exertions of Prof. de Lacaze-Duthiers of the Sorbonne, that the two government stations of biology have since been founded. The first was established at Roscoff, in one of the most attractive and favourable collecting regions in Brittany, and has continued to grow in importance for the last twenty years. As this station, however, could be serviceable during summer only, it gave rise to a smaller dependency of the Sorbonne in the southernmost part of France, on the Mediterranean, at Banyuls, which had the additional advantage of a Mediterranean fauna.

"To these French stations should be added that of Prof. Giard, at Wimereaux near Boulogne, in the rich collecting funnel of the Straits of Dover; that of Prof. Sabatier at Cette, not far from Banyuls, a dependency of the University of Montpelier; that of Marseilles, and the Russian station at Ville-Franche, near the Italian frontier. An interesting station in addition, is that at Arcachon near Bordeaux, founded by a local scientific society, and having at its command the collecting resources of a small inland sea, famous for its oyster culture. Smaller stations are not wanting, as at the Sables d'Olonne.

"At Roscoff the laboratory building looks directly out upon the channel. In its main room on the ground floor, work-places are partitioned off for a dozen investigators; this on the one hand leads to a large glass-walled aquarium-room, while on the other opens directly to adjoining buildings which include lodging quarters, a well-furnished library, and a laboratory for elementary students. Surrounding the building is an attractive garden, which gives one anything but a just idea of the barrenness of the soil of Brittany. From the sea-wall of the laboratory one looks out over the rocks that are becoming exposed by the receding tide. A strong enclosure of masonry serves as a *vivier* to be used for experiments as well as to retain water for supplying the laboratory. The students are, in the main, those of the Sorbonne, and are under the direction of Dr. Prouho, their *maitre de conférences*. They are given every opportunity to take part in the collecting excursions, frequently made in the laboratory's small sailing vessels, among the rocky islands of the neighbouring coast. Strangers, too, are not infrequent and are generously granted every privilege of the French student. Liberality is one of the characteristic features of Roscoff. The stranger who writes to Prof. de Lacaze-Duthiers is accorded a work-place which entitles him gratuitously to every privilege of the laboratory—his microscope, his reagents, even his lodging-room should a place be vacant. It seems, in fact, to be a point of pride with Prof. Lacaze that the stranger shall be welcomed to Roscoff, and upon entering the laboratory for the first time, feel as much at home as if he had been there a week. He finds his table in order, his misroscope awaiting him, and the material for which he had written displayed in stately array in the glass jars and dishes of his work-place. So, too, he may have been assigned one of the large aquaria in the glass aquarium-room—massive stone-base stands, aërated by a constant jet of sea water. He finds a surprising wealth of material at Roscoff, and his wants are plentifully and promptly supplied.

"At Banyuls, the second station of the Sorbonne, the buildings are less imposing than those of Roscoff. It is a plain, three-storey building facing the north, at the edge of the promontory which shelters the harbour of Banyuls. The vivier is in front of the station, behind is a reservoir cut in the solid rock—receiving the water of the Mediterranean, and distributing it throughout the building. On the first floor is a large aquarium-room lighted by electricity, well supplied with tanks, and decorated with statuary given by the Administration of the Beaux-Arts. The bust of Arago occupies an important place, as the laboratory has been named in his honour. The wealth of living forms in the aquaria shows at once by variety of bright colours the richness of southern fauna. Sea lillies are in profusion, and are gathered at the very steps of the laboratory. The work-rooms of the students are on the second floor, equipped in a manner similar to those of Roscoff. The director of this station is Dr. Frédéric Guitel. It is usual during the holidays at fall or winter, for the entire classes of the Sorbonne to spend several days in collecting trips in the neighbourhood. The region, with its little port, is famous for its fisheries, and one in especial is that of the Angler, *Lophius*.

"The station on the Straits of Dover, at Wimereaux, has earned a European reputation in the work of Prof. Giard. It is but a small frame building, scarcely large enough to include the advanced students selected from the Sorbonne. The laboratory is, in a way, a rival of Roscoff, and it is noteworthy that its workers seem to make a point of studying the laboratory methods of the German universities.

"The marine laboratory of Arcachon, one of the oldest of France, was built in 1867 by the local scientific society, and was carried on independently until the time of the losses of the Franco-Prussian War. Its management was then fused with that of the faculty of medicine of Bordeaux, with whose assistance, aided by that of a small subsidy from the government, the work of the institution is carried on. Arcachon, in itself, is a most interesting locality near Bordeaux. It has become a summering-place, noted for its pine-lands and the broad, sandy *plage*, picturesque in summer with swarms of quaintly-dressed children, the local head-dress of the peasant mingling with the latest toilets from Paris. Here and there is to be seen that accompaniment of every French watering-place, the goat boy in smock and berret, fluting to his dozen charges who walk in a stately way before him. The Bay of Arcachon is a small, tranquil, inland sea, long known for its rich fauna. In large part it is laid out in oyster parks which constitute to no small degree the source of wealth of the entire region. Shallow and warm waters seem to give the marine life the best conditions for growth and development. The laboratory is placed just at the margin of the water. It includes a dozen or more work-places for investigators, well supplied with aquaria, a library on the second floor, a small museum containing collections of local fauna, including the numerous relics of Cetaceans that have found their way into this inland sea. A small aquarium-room, opened to the public, is well provided with local forms of fishes, and like that of Naples, is eagerly visited. Those who are entitled freely to the use of the work-places are instructors in French colleges, members of the Society, and all the advanced students from the colleges of the State. For other students work-place is given upon the payment of a fee whose amount is regulated each year by the trustees. As at Roscoff, material is plentifully supplied.

"The zoological station at Cette is a direct annex of the University of Montpelier. The present temporary building is to be replaced by one of stone, which will enable Prof. Sabatier to add in no little way to the working facilities of his students. The region, in every essential regard, is similar to that of Banyuls.

"The station at Marseilles is devoted in great part to questions relating to the Mediterranean fisheries, and owes, in a measure, its financial support to this practical work.

"The station at Ville-Franche is essentially Russian. An account of this with figures has recently been published (Russian text) in Cracow. The station itself is well known through the work of Dr. Bolles Lee, and it is here that Prof. Carl Vogt has been a constant visitor."

After a description of the Plymouth laboratory, Mr. Dean mentions those of Liverpool and St. Andrews, north-east of Edinburgh concerning which he remarks: "The work of these stations is only in part purely biological; the practical matters of fisheries must be considered to insure financial support. In addition to these there are several stations, notably one south-east of Edinburgh, and another, recently equipped, on the Isle of Man.

"At St. Andrews, Prof. MacIntosh has studied the questions relating to the hatching and development of the North Sea fishes. Its situation upon the promontory leading into the Firth of Forth seems to have been especially favourable for the study of the North Sea fauna—the locality, moreover, is far enough northward to include a number of boreal forms. The importance of St. Andrews is at length better recognised, and a substantial grant from the Government will enable a large and permanent marine station to be here constructed. The facilities for work have, up to the present time, been somewhat primitive—a simple wooden building, single-storied, has been partitioned off into small rooms, a general laboratory, with work-places for half a dozen investigators, a director's room, aquarium, and a

small outlying engine house with storage tanks. The laboratory owns a small sail-boat to assist in the work of collecting."

Passing to Holland, we read—"Holland, in the summer of 1890, opened its zoological station in the Helder, a locality which, for this purpose, had long been looked upon with the greatest favour. There is here an old town at the mouth of the Zuyder Zee, the naval stronghold of Holland, a station favourable for biological work on account of the rapid running current which renews the waters of the Zee. The station was founded by the support of the Zoological Society of the Netherlands, whose valuable work by the contributions of Hubrecht, Hoek, and Horst has long been known in connection with the development of the oyster industry of Holland. The work of the society had formerly been carried on by means of a portable zoological station which the investigators caused to be transplanted to different points along the East Schelde, favourable on account of their nearness to the supplies of spawning oysters. The present station at the Helder is situated directly adjoining the great Dyke, a small stone building of two storeys, surrounded by a small park. In itself the laboratory is a model one—the rooms are carefully finished and every arrangement has been made to secure working conveniences. A large vestibule leads directly into two laboratory rooms, and by a hallway communicates with the large, well-lighted library, and the rooms of the director. The aquarium-room has, for convenience, been placed in a small adjacent building. The director of this station is Prof. Hoek, and the president of the society is Prof. Hubrecht."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Stanford University of California (the *Times* says) is rapidly becoming the wealthiest institution of the kind in the world. Yet there are several American Universities and colleges which enjoy enormous wealth. For example, Columbia University has an invested capital of £2,600,000; Harvard, £2,200,000; Yale, £2,000,000; the California, £1,400,000; and the Johns Hopkins, £600,000. The endowment fund of the Stanford University cannot at present be stated, partly because the benefaction exists in the shape of property which is rapidly increasing in value. But estimates which appear to be well founded have been made at San Francisco showing that at no distant date the University will be worth £40,000,000, yielding an annual income of £2,200,000.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 8 (1893).—Polarisation of undiffracted infra-red radiation by metal wire gratings, by H. E. J. G. du Bois and H. Rubens. Polarised light passing without diffraction through silver wire gratings experiences in general a rotation of its plane of polarisation. The transmitting power of the gratings for light polarised in a plane perpendicular to the length of the wires was found to be greater than that for light polarised in a plane parallel to them. The present experiments were conducted with finer gratings than before the smallest interval attained being 0·001 cm. and the measurements were taken in the infra-red region. The intensity of radiation transmitted was measured by the bolometer. It was found that as long as the wave length does not exceed a certain value, the grating transmits a larger fraction of the radiation when the electric vector is parallel to the wires; this value appears to be independent of the width of interval, but characteristic of the metal; for greater wave-lengths the transmittance is greater when the magnetic vector lies in the direction of the wires.—The superior limit of wave-lengths which may occur in the thermal radiation of solids; a conclusion from the second law of thermodynamics, by Willy Wien. Assuming the second law, and the existence of none but Maxwell's ponderomotor forces in the pressure exerted by a gas, the author shows that thermal radiation does not imply waves of all lengths, but that the curve of energy, when traced along the spectrum, falls continuously to infinitesimal values on the less refrangible side, and practically disappears in the region of Hertz's finite waves.—Electric oscillations of molecular structures, by H. Ebert. It is shown that the mechanism of luminescence may be fully explained by Maxwell's theory, regarding the luminous molecules as analogous to Hertz oscillators of very small dimensions.—A photometer, by E. W. Lehmann. This is constructed on the principle of Joly's photometer; it consists of two totally reflecting prisms placed side by side in a box. In each prism one of the adjoining faces is ground, and the two ground faces are turned in opposite directions so as to be illuminated by the two sources to be compared. The plain faces are turned towards the observer, with their edges touching. The observer looks at them through a tube containing a telescope; the box to which the tube is attached can be swung round through 180°, so as to exchange the ground faces. The sensitiveness is such that forty successive readings with amyl acetate burners at 120 cm. gave results not differing by more than 0·4 per cent.

Bulletin de l'Académie de Belgique, No. 6 (1893).—We notice the following among the scientific papers: Megamicros, or the sensible effects of a proportional reduction of the dimensions of the universe, by J. Delbœuf. According to Laplace, if the dimensions of all the bodies in the universe, their mutual distances and velocities were to increase or diminish in a constant proportion, these bodies would describe the same curves as they do now. The appearances presented to observers would be the same, and independent of the dimensions assumed. Hence the only facts we are able to appreciate are ratios. In opposition to this theorem, M. Delbœuf shows that if a system consisting of the sun and the earth were to be diminished in linear dimensions to one-half, all densities remaining the same at homologous points, and the orbital velocity of the earth were reduced to one-half its value, there would be certain changes in the relations of an observer to his surroundings which could not escape notice. The velocity of sound propagation will be the same as before, but the distance traversed during a certain number of vibrations will appear larger. If a metric system were to be determined on the reduced planet in a manner analogous to ours, the hectare will be a quarter, the litre one-eighth, and the kilogramme—owing to the reduction of gravitation—one-sixteenth of the corresponding actual measures. Hence the work done in lifting a kilogramme through one metre will be $\frac{1}{32}$ of an actual kilogramme-metre. Muscular power, on the other hand, being proportional to the volume or mass of muscle, will be only reduced to one-eighth, and the observer will be able to lift four times the previous maximum weight. All work necessary for life will proceed at four times the usual rate, and hence life itself will be more rapid. These considerations pursued by the author into the regions of building, thermometry, animal heat, respiration and circulation, go to show that real space is different from geometric space, and that the dimensions of the universe are absolute.—Note on the variations of temperatures of transformation below and above the critical temperature, by P. de Heen. The superior limit of pressure of superheated steam before the passage into the liquid state is the simple prolongation of the curve expressing the variation of the tension of saturated vapour.—On the production of ammonia in the soil by microbes, by Émile Marchal. Nitrification takes place in three principal stages, which may be described as ammonisation, nitrosation, and nitratation, resulting in the production of ammonia, nitrites, and nitrates respectively from the organic nitrogen. Ammonisation takes place essentially under the influence of microbes living in the upper layers of the soil. In arable land, the action of bacteria is predominant. The *Bacillus mycoides*, the most energetic of these, exerts a double activity in the production of ammonia, being ammonising in the presence of nitrogenous organic matter, denitrifying when embedded in easily reducible substances such as nitrates.

SOCIETIES AND ACADEMIES.

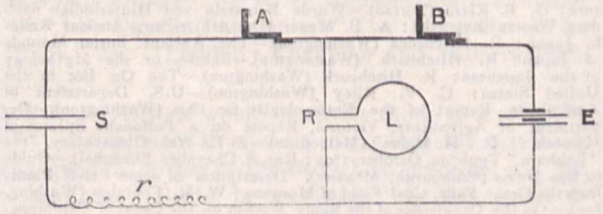
LONDON.

Royal Society, June 1.—"On the Flow in Electric Circuits of Measurable Inductance and Capacity; and on the Dissipation of Energy in such Circuits." By Alfred W. Porter, B.Sc., Demonstrator of Physics in University College, London. Communicated by Prof. G. Carey Foster, F.R.S.

The arrangement of the apparatus in the experiments described was as follows:—

L is a coil possessing self-inductance; S, a condenser; R, an

inductionless resistance; E, a battery; and A and B are two contact pieces of a pendulum interruptor. A and B are initially closed; B is first broken; A is then broken, and the charge remaining in the condenser is measured by discharging it through a galvanometer. The time interval between the two ruptures



can be varied one twenty-thousandth of a second at a time, and the manner of discharge of the condenser under the circumstances is thus determined. Curves were obtained showing (1) a merely leaking discharge; (2) the critical discharge that just fails to ever have negative values; (3) the critical discharge that just fails to be oscillatory; and (4) a thoroughly oscillatory discharge.

The differential equation to be satisfied by the discharge is—

$$\left(L\frac{d^2}{dt^2} + \rho\frac{d}{dt} + \frac{1}{S}\right)Q = 0,$$

where Q is the charge at any instant and ρ is the dissipation constant.

The solution of this for the case of oscillations is of the form—

$$Q = Q_0\epsilon^{-mt}\sec\phi\cos.(pt + \phi).$$

Experiment shows that the rate of damping is much greater than that calculated from the above, assuming that the wire circuit is the only seat of dissipation of energy. The explanation offered is that dissipation also takes place in the dielectric of the condenser. In accordance with this it is possible to reproduce the experimental curve by increasing the value of ρ from 28 ohms (the wire resistance in a particular case) to 59·4 ohms. The observed time period in this case is ·009147 seconds; the time period calculated on the above assumption is ·009154 seconds.

Experimental curves have also been obtained when iron rods are inserted in the coil. Their chief characteristics are—

(α) A decrease in time-period as the discharge progresses.

(β) Much more rapid decrement.

That (β) is only very partially due to eddy currents in the iron, was shown by repeating with a brass rod inserted in the place of iron.

Experiments are also in progress in connection with circuits of negligible capacity; a Wheatstone's bridge method being employed.

SYDNEY.

Linnean Society of New South Wales, June 28.—The following papers were read:—Notes on Australian Coleoptera, with descriptions of new species, part xiii., by the Rev. T. Blackburn.—Notes on the family Brachyscelidæ, with descriptions of new species, part ii., by W. W. Froggatt. This paper deals with Schrader's two genera Opisthoscelis and Ascelis; the two original species of Schrader are re-described, and two new species of Ascelis are added.—On the habit and use of nardoo (*Marsilea Drummondii*, R. Br.), together with observations on the influence of water-plants in retarding evaporation, by T. L. Bancroft. The author has visited the south-western corner of Queensland, journeying there *viâ* South Australia and eastward across Queensland. He first encountered nardoo in quantity near Lake Copperamana on Cooper's Creek, where, as over all the drainage-areas of the Cooper, Diamantina, and Georgina Rivers, the Blacks still make use of it as in the days of Burke and Wills. As originally stated, the plant thus utilised under the name of nardoo is a Marsilea; though doubt has been cast upon the statement under the idea that it would be impossible to obtain the involucres (sporocarps) in sufficient quantity to serve as food; and by those who took this view the seeds of *Sesbania aculeata*, Pers., were supposed to furnish the nardoo of Burke and Wills. In a day one could gather about a hundredweight of the dried rhizomes of the Marsilea with involucres attached, yielding perhaps about forty pounds weight of the latter. It was found also that the nardoo did not grow in permanent water nor in swamps, but in country subject to inundation; and from specimens brought home vigorous pot plants were reared without difficulty. As regards floating water-plants retarding evaporation, the author has made experiments with a series of gallon glass cells, some furnished with *Lemna*, *Azolla*, and *Nymphæa gigantea*, others without, and with some of each placed out of doors in the sun, and others in the shade and under cover, he found that evaporation was neither retarded nor hastened by the presence of the aquatic plants.

PARIS.

Academy of Sciences, August 14.—M. Lœwy in the chair.—On the Tubulane, a truffle of the Caucasus, by M. A. Chatin. This is a new variety of the *Tirfezia Boudieri*, which is so widely distributed in North Africa and Arabia. The roundness of the spores resembles that of the African variety, whilst the surface markings are those of *Tirfezia Boudieri Arabica*. The new variety, found about Tiflis and Baku, and sent from there by the French Consul, M. Auzepi, has been named *Tirfezia Boudieri Auzepii*. The natives call it Tubulane. It is the size of a large walnut, and its good quality and low price renders it fit for European export.—Study of the microbian origin of purulent surgical infection, by MM. S. Arloing and Ed. Chantre. Purulent surgical infection has for its essential agent the ordinary microbes of suppuration (streptococci in the cases examined). If microbes other than the preceding ones exist in the wounds, they complicate the purulent infection, but are not necessary to its development. To produce purulent infection, the streptococcus must assume the virulence which it possesses in the acute and grave forms of puerperal septicemia, and not that shown in erysipelas. There is a suspicion of etiological relations between surgical purulent infection, puerperal septicemia, and erysipelas, but it is not known as yet where and how the transformation of the pathogenic properties of the streptococcus take place which enables it to produce alternately these different clinical states.—On a product of incomplete oxidation of aluminium, by M. Pionchon. Submitted to the action of an oxy-hydrogen blow-pipe flame containing an excess of hydrogen, aluminium oxidises with vivid incandescence and is changed into a substance of a greyish-black colour, in which the ratio of the weight of oxygen to that of the aluminium has a value approaching 0·6, and therefore very different from 0·888, the value characteristic of alumina. A treatment of the substance with hydrochloric acid gave rise to a disengagement of hydrogen and the formation of aluminium chloride in solution, besides leaving an insoluble residue. A quantitative estimation of these various constituents leads to the conclusion that the grey substance contains small quantities of freer aluminium and alumina, and consists of a new oxide of aluminium, probably represented by the formula $Al_6O_7 = Al_2O, 2Al_2O_3$, which may be either a mixture or a compound.—On a new reaction of eserine, and a green colouring matter derived from the same alkaloid, by M. S. J. Ferreira da Silva.—Synthetic preparation of citric acid by the fermentation of glucose, by M. Charles Wehmer.—On the changes which have taken place in the glacier of the Tête Rousse since the catastrophe of Saint-Gervais, of 12th July, 1892, by MM. A. Delebecque and L. Duparc. Nearly all the water from the glacier escapes at present at the bottom, so that there is no immediate danger of its accumulation. But this state of things is only temporary. The valley of Montjoie appears to be exposed to a catastrophe similar to that of 1892, which must happen sooner or later. No preventive measures seem possible. A diligent watch, and an evacuation of the valley at the proper times seem to be the sole remedies.

BERLIN.

Physical Society, June 16.—Prof. von Helmholtz, President, in the chair.—Prof. Kœnig gave an account of the construction of the newest forms of artificial larynx, more especially the one described by Prof. Julius Wolff. The capabilities of the latter were demonstrated on a patient operated upon by Prof. Wolff, who could not only speak continuously so as to be audible throughout the whole lecture-room, but could also sing. The president pointed out that this case fully substantiated his theory as to the production of vowel-sounds, inasmuch as the tones being initially produced by a vibrating elastic membrane acquired their vowel quality solely by means of the varying shapes of the resonating buccal cavity. Prof. Fraenkel exhibited a man who without either a natural or artificial larynx could both speak and repeat the whole alphabet. It appeared that the patient while speaking swallowed at frequent intervals

and ejected forcibly a considerable mass of air from the open end of the trachea. Careful investigation showed that there was no communication between the trachea and œsophagus; Prof. Fraenkel referred the power of speech to the existence of a fold of mucous membrane at the end of the widened pharyngeal cavity, at about the level of the former larynx, which was thrown into vibration during speech. It had not been possible to ascertain whence the patient obtained the air requisite to keep the fold in vibration; possibly the air which had been swallowed sufficed for this purpose. Dr. Krigar Menzel had, in conjunction with Dr. Raps, studied the motion of plucked strings by the method previously employed for stroked strings. The string is stretched across the long axis of a narrow brightly illuminated slit, and thereby casts a small punctiform shadow on a screen. When the string swings, a curve is traced on the moving screen, which admits of being fixed by photography. The speaker developed the theory of strings vibrating as above, and deduced formulæ which corresponded to the curves obtained. Dr. Wien spoke on the upper limits of wave length for radiant heat as based upon certain properties of Hertz's waves and the second law of thermodynamics.

Physiological Society, June 23.—Prof. du Bois Reymond, President, in the chair.—Prof. Koenig exhibited the two patients with extirpated larynx as described in the preceding report of the Physical Society.—Dr. Benda gave an account of his microscopical investigations on the development and function of the mammary gland. He had studied the development on five- and eight-month-old calves, and the functions on cows and bitches during lactation, and arrived at the conclusions that the mammary gland must be regarded as a tubular gland, and that there is no evidence of a new formation of cells during its activity. The idea that the secretion of milk depends on a breaking-down of the gland cells cannot apparently be supported by the results of microscopic investigation.

July 7.—Prof. Holowinsky, of Warsaw, spoke on a microphone he had constructed, by means of which it is possible to render audible rhythmic movements of long period, such as the cardiac impulse, the radial and carotid pulse, &c. The action of the instrument was demonstrated on several persons.—Dr. Baginsky had studied the relation of the nerves to the sensory end-organs in the case of the glossopharyngeal and olfactory nerves, by section of the nerves and subsequent investigation of the behaviour of the terminal sensory cells in each case. In the case of the tongue he found these cells unaltered after degeneration of their nerve; whereas in the case of the olfactory cells, both they and the whole mucous membrane degenerated after removal of the olfactory bulb. He, however, attributed the result in the latter case to injury of the ethmoid artery.

July 21.—Dr. Lilienfeld made a further communication on the clotting of blood arrived at by an examination of fibrine and of fibrinogen which he regarded as a nucleo-albumin. He came to the conclusion that some substance is present in normal blood which leads to clotting in presence of minimal amounts of calcium chloride. Dr. Paul Strassmann had studied the mechanism of the closing of the ductus Botalli in man, dogs, and cats, and found it dependent upon the anatomical arrangements of the entrance into the aortic arch, supporting his views by a series of preparations. Dr. Jacobs had investigated the action of extracts of a series of animal tissues on the number of the white corpuscles. He found that extracts of liver, kidney, pancreas, and thyroid had no effect on their number, while, on the other hand, extracts of spleen, thymus, and the marrow of bones, after producing a short fall, led to an increased production of leucocytes which continued for many hours, and was marked both in the peripheral as well as in the central blood-vessels and in the heart.

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PAMPHLETS.—The Yucca Moth and Yucca Pollination: C. V. Riley (Washington).—Parisitism in Insects: C. V. Riley (Washington).—Intorno all' Assorbimento della Luce nel Platino Diverse Temperature: G. B. Rizzo (Torino).—Wurde Bernstein von Hinterindien nach dem Westen Exportirt: A. B. Meyer (Dresden).—Some Ancient Relics in Japan: R. Hitchcock (Washington).—The Ancient Burial Mounds of Japan: R. Hitchcock (Washington).—Shinto, or the Mythology of the Japanese: R. Hitchcock (Washington).—The Ox Bot in the United States: C. V. Riley (Washington).—U.S. Department of Agriculture, Report of the Entomologist for 1892 (Washington).—Department of Agriculture, Victoria, Report on a Poisonous Species of Homeria: D. McAlpine (Melbourne).—Zi-Ka-Wei Observatory, the "Bokhara" Typhoon, October, 1892: Rev. S. Chevalier (Shanghai).—Guide to Ben Nevis (Edinburgh, Menzies). Description of some Fossil Plants from the Great Falls, Coal Field of Montana: W. M. Fontaine (Washington).—On the Occurrence of the Spiny Boxfish on the Coast of California: C. H Eigenmann (Washington).—Report on the Actiniæ Collected by the U.S. Fish-Commission Steamer *Albatross*, during the winter 1887-88: J. P. McMurrich (Washington).—Massachusetts Institute of Technology. Boston, a brief Account of its Foundation, Character, and Equipment (Boston).—National Association for the Promotion of Technical Education, Sixth Annual Report, 1892-93.—Cholera Prospects and Prevention: R. Thorne Thorne (Allman).—L'Anthropologie aux Etats-Unis: Dr. P. Topinard (Paris, Masson).—Revised Report on the Copepoda of Liverpool Bay: I. C. Thompson (Liverpool).—On the Evolution of the Art of Working in Stone, J. D. McGuire (Washington).—Guide to Sowerby's Models of British Fungi in the Department of Botany, British Museum (Natural History), W. G. Smith (London).—Maupertuis, E. du Bois-Reymond (Leipzig, Veit.).

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