THURSDAY, NOVEMBER 17, 1892.

THE GEOLOGY OF SCOTLAND.

Geological Map of Scotland. By Sir Archibald Geikie, D.Sc., LL.D., F.R.S., Director-General of the Geological Survey of Great Britain and Ireland. With descriptive text. (Edinburgh: J. Bartholomew and Co., 1892.)

THERE have been many attempts to frame a popular definition of man. To call him a "story-loving animal" would not be the worst of them. It may indeed turn out, when we understand monkey-talk a little better than now (and the hope that we may is, we are assured, not unreasonable), then it may be that this will prove to be not an exclusive definition. But this by the way; the description will hold for the present. Hence the delight with which we listen to all that the various branches of history, the history of the growth of knowledge included, have to tell us. It is the stories which first attract us, and they retain their charm long after we have learned that the study of history has other ends to fulfil besides the satisfaction of that craving for story-hearing which lies deep in our being, and the gratification of a natural curiosity to learn about things which we have not seen. But the conviction that history should be to us something more than a string of ancedotes soon forces itself upon us.

In tracing the growth of any branch of knowledge, in noting the steps by which, one by one, each advance has been made good, our interest lies first of all in the acquaintance, almost of a personal character we may say, which we make with the pioneers of a movement of which we see not perhaps the full development but the ripening fruit. We watch with absorbed attention their approach to the unexplored land; we follow them along the tracks by which they first traversed it; we stand by while they note and record all that is novel and characteristic in its features; we mark the birth and growth of the conceptions which their exploring work gives rise to; we live over again their fascinating life of discovery and deduction. But beside and beyond all this, their story, like the stories of all history, carries with it a lesson; and their caution or rashness, as the case may be, in generalizing and drawing conclusions, serves as example or warning to us. We look up to candour and a readiness to court criticism and give up explanations which are shown to be untenable; anything like partizanship and a weakly parental predilection for the children of one's own brain we look down upon with sorrowing pity.

The history of the steps by which a knowledge of the geology of a country has been arrived at is written in the successive versions of its geological maps. The appearance of a map which embodies the results of the latest researches into the geology of Scotland tempts us to look back upon the earlier efforts to unravel the complications of its geological structure. And this all the more because we are dealing with a country in which Geology, as we know it, may be said to have come to the birth; and because it is to Scotchmen that we owe the first showing forth of these principles, whether of observation, deduction, or inductive confirmation, which have been the guide of geologists ever since. To Hutton, the precursor of Lyell, to Hall, the scientific ancestor of Daubrée, and to the line of illustrious followers who have carried on with such brilliant success the work which they started.

Among the earliest attempts to deal with the geological mapping of Scotland are the maps of Macculloch's "Western Islands," which bear the date of 1819. It is hard for us to realize how much of Scotland was at that time without adequate topographical delineation. Our present Ordnance Maps are far from being a credit to the Department which issues them, and the language which attends an attempt to use them on the mountainous moorlands, though not a whit stronger than is justifiable under the circumstances, had better be left to melt into thin air around the spots where it was uttered. But our geological life is one of luxury compared with Macculloch's, whose atlas is one string of apologies for the inadequate maps on which he had to record his observations. The map of the Isle of Man "is obviously very inaccurate, but there was only a choice between it and two others equally unworthy of confidence." The map of Staffa "was drawn under every unfavourable circumstance, and cannot fail to be inaccurate, having been merely paced with the assistance of a pocket compass in a severe gale of wind and rain."

Macculloch seems to have projected, but never completed, a geological map of the whole of Scotland. The materials collected by him were however utilized by the Highland Society in the construction of a general map in 1832.

Passing by the maps of Boué, and a sketch of Murchison's and Sedgwick's, laid before the Geological Society in 1828, we come to the publication of Nicol's "Guide to the Geology of Scotland" in 1844.

In a country where the rocks are so largely unfossiliferous, it is natural, even necessary, that the earliest geological maps should be more of a lithological than a stratigraphical character, and this is the case with the maps so far noticed. In the map which accompanies Nicol's guide, and which he says is based on Macculloch's, some of the main varieties of the crystalline schists are distinguished, but the order in which they occur is not indicated. One colour comprises all the red sandstones, the Torridon, the Old Red, and even the red rocks of Dumfriesshire; under the head of "Porphyry and Trap" are lumped together all the volcanic rocks, including those of the western islands and of the central valley; only two of the groups which we now call formations are separated, the "Carboniferous" and the "Lias and Oolite." But the great leading features in the physical geography of Scotland are sharply marked out, the three regions into which it naturally falls are lucidly delineated, and the work is crowded with local details that betoken acquaintance with the work of others and patient investigation of his own.

At the meeting of the British Ass iation at Glasgow in 1855 Murchison gave an account of the result of the joint work of Nicol and himself in the north western Highlands. The existence of three great sub-divisions had been clearly established; what we now know as the Hebridean or Lewisian Gneiss at the base, the Torridon sandstone resting unconformably on it; while above that, and separated from it by another unconformity, came the limestones and quartzites of Durness and Loch Erriboll, in which Peach had recently discovered fossils. The last group appeared to be conformably overlaid by a great mass of crystalline schists, which came to be known afterwards as the "Upper or Eastern Gneiss." Though the fossil evidence was then incomplete, Murchison saw nothing in it to forbid the belief that the Durness beds were of Lower Silurian age, and his conjecture was confirmed by the discovery of better specimens. This conclusion was announced in a paper read before the Geological Society in 1858, in which it was also stated that the author looked upon the Upper Gneiss as metamorphosed Silurian.

In the meantime Nicol had read a paper before the Geological Society (1856), in which he describes the joint explorations of himself and Murchison, and some subsequent work of his own. He recognizes the same main sub-divisions as Murchison, but still leans to the old notion that the Torridon sandstone belongs to the Old Red; this involves the assigning a later date to the Durness Beds, and these he thinks may be Carboniferous. But he is content to hold this merely as a provisional hypothesis till further fossil evidence is forthcoming. With respect to the Upper Gneiss he is very cautious, suggesting that it may be a newer metamorphic group, or may be merely a portion of the lower, that is Hebridean, gneiss *forced up by some great convulsion.* This latter solution was evidently present very vividly to his mind, for it is repeated, as a possible explanation, no less than three times.

Here a very important difference of opinion between Murchison and Nicol makes its appearance.

It was probably about this time, but the map bears no date, that Nicol issued a new geological map of Scotland. In this all gneiss is denoted by one colour; but the explanation states that the author does not consider all the Scotch gneiss to be of the same age; that the tract of this rock, with associated quartzite and limestone, stretching from Aberdeenshire through Perthshire to the Breadalbane Highlands of Argyllshire, may be a newer formation; while he is disposed to look upon the great mass of gneiss, extending from the north coast of Sutherland southwards through Ross-shire and Inverness-shire, rather as belonging to an older period. The Torridon sandstone is distinguished by a separate colour, though the author is still inclined to class it with the Old Red.

Nicol expounded his views to the British Association at Aberdeen in 1859, and again in a paper read before the Geological Society in 1860. He adduces many reasons for doubting the existence of an "upward conformable succession" from the Durness Beds to the Upper Gneiss, and explains the sections on the supposition that this rock is the Hebridean Gneiss brought up by faults. Though the expressions, "forced up by convulsion" and "pushed up over," which he uses in his paper of 1856, seem to show that the notion of what we call "Thrust Planes" was present to his mind, the sections of this paper hardly bear out that inference. He neatly twits Murchison with failing to see that the principles which he had applied with such success to an explanation of the structure of the Alps were equally applicable to the North-west Highlands. In 1861 Murchison stoutly maintained his view regarding the Upper Gneiss; with an advocate's skill he hits Nicol hard on his weak point, justly urging "that local interferences of eruptive rock nowise set aside broad data." In the same year was issued the "First Sketch of a new geological map of Scotland by Sir R. I. Murchison and A. (now Sir A.) Geikie," in which Murchison's views vere adopted.

Here then was a promise of a fair stand-up fight between two champions, each well able to hold his own. But the promise was not fulfilled. The combat would have been far from equal. On the one side there were the pull which wealth and social position bring with them; the advantage which accrues from living in London and having thus the ear of a great centre of scientific life; and that pushing ambition, that eagerness to secure precedence in discovery, which so often go along with an active and energetic disposition. On the other side there were comparative social insignificance; residence in a hyperborean region far more difficult of access than now; a happy indifference to fame based on a confidence that the settlement might be safely left to time, and that the world would go on pretty much as heretofore, whichever of the two turned out to be nearer the truth: more than all a reluctance to embitter the closing years of life with anything that looked like an altercation with an old and esteemed friend and fellow-worker. So, because it takes two to make a quarrel, the fight never came off. Naturally, under these circumstances, (and can we blame it?) the world took the man who vigorously pushed his views, at his word; he had plenty to say in their favour and said it well; no one gainsaid him; his contention was accepted. There will be those who, without presuming to blame, do not covet success on such terms; and whose sympathies go out towards the peace-loving old man who was content to bide his time and possess his soul in silence.

And so the "Upper Gneiss" and "the upward conformable succession" held their own; and in the geological map of Scotland, issued in 1876 by the present Director-General of the Geological Survey, the crystalline schists of the Central Highlands are designated "Metamorphosed Lower Silurian." It would be tedious to enumerate all the points in which this map is an improvement on the "First Sketch" of 1861, but the student will find it an instructive exercise to compare the two maps, and ascertain by reference to memoirs on special districts how each correction and addition was arrived at.

The Highland problem remained in abeyance for nigh a quarter of a century, though during that interval the minds of many geologists were constantly recurring to it and evidence was being accumulated to help towards its solution. But it came to the front again, and like a giant refreshed with sleep, when Prof. Lapworth in his "Secret of the Highlands" (1883), and other workers in the same ground, began to throw doubt on the explanation which had so long held the field. When the Geological Survey were able to take up the question and work out the ground with precision and detail that no observer could attain to single handed, the anticipations of their immediate predecessors were substantially confirmed, and of the earlier observers it came out that Nicol was nearer the truth than his illustrious antagonist.

It calls for no small exercise of judgment, in an endeavour to depict the geology of so complex a district on a map of small scale, to decide what details must be retained because they are essential to a grasp of its broad general structure, and what may be safely eliminated without impairing the comprehensive view. In the map now before us this end has been compassed with consummate skill. It bristles with detail, but there is nowhere crowding; the colours are well contrasted, and so transparent that they do not hide the topography, which is full and clearly printed.

The richness in detail of the strip of country between Cape Wrath and Loch Torridon marks one scene of the recent work of the Geological Survey. Then follows a broad band of "gneissose and schistose rocks not yet differentiated." A portion of this ground is occupied by the crushed and mangled-out complex of the "Moine schists," but a large part is yet imperfectly explored. To the south-east of the Great Glen we enter again on ground which has been largely worked out by the Geological Survey. We have here a group of various sedimentary deposits in a more or less altered condition, containing sheets of basic igneous rocks. The geological age of this series is not known, and they are provisionally classed as Dalradian.

The presentation of the results of the work of the Geological Survey in the north-west and central Highlands are the two most conspicuous novelties in the map; but during its use other corrections and additions, too small to catch the eye on a general view, become noticeable. In the explanatory notes we have a concise summary of the geology of Scotland, and feel that our thanks are due to the author for having put so much into so small a space without in any way sacrificing descriptive clearness. When the time comes for a new version of the map, may the same hand be with us to draw it up.

A. H. GREEN.

MEDICAL MICROSCOPY.

Medical Microscopy. A Guide to the Use of the Microscope in Medical Practice. By Frank J. Wethered. M.D.(Lond.), &c. With Illustrations. Pp. 412. (London: H. K. Lewis, 1892.)

THIS volume, one of Lewis's practical series, bears an ambitious title, and must necessarily traverse a wide and intricate field of medical work. Its appearance is justified by the distinct need existing at the present time for a manual dealing with the various microscopical methods so essential to diagnostic accuracy and rational treatment.

The subject-matter is arranged in twenty-four chapters; and as an indication of the scope of the book, we instance some of the headings. The earlier ones treat of the microscope and its accessories, the methods of hardening, decalcifying, embedding, section cutting, staining, and injection of tissues. Then follow others on the examination of tissues, urinary deposits, blood, expectoration, and the detection of micro-organisms, and cutaneous parasites; while the latter chapters deal with the examination of food, water, and with bacteriological methods. In fact, the book is almost an epitome of the course pursued by a student earnestly working with the microscope from the commencement to the end of his curriculum. The tendency has been, by the specialized character of the primary examinations in late years, to sever in some degree the knowledge obtained in the earlier part of a student's career from the practical application of the same at the bedside. So much is this the case, that it has been deemed advisable in some quarters to introduce new courses of lectures, their aim being to indicate with precision to students those facts in anatomy and physiology which have a distinct clinical value. One of the chief merits of Dr. Wethered's book is that he has therein demonstrated the important relationship between histology and morbid anatomy, and has shown that any attempt at acquiring a knowledge of the latter is dependent upon a practical and searching training in the former.

Moreover, the book is worthy of more detailed criticism. Necessarily in a first edition there are some points omitted. In speaking of the microscope the author offers a cursory remark on the fine adjustment; no mention is made of the best pattern, and there are many of an inferior and useless description foisted on students; nor are there any directions for the precise use of this portion of the microscope. In the chapter on "Hardening and Decalcifying Tissues," on p. 35, are found some well-meant platitudes on the necessity of immediately labelling specimens; but at the same time the use of lactic acid as a decalcifying agent is omitted. We have succeeded in completely softening small pieces of bone in 4-7 days, and teeth may be cut with the freezing microtome in from two to three weeks.

With certain statements of the author we venture to disagree. In speaking of the celloidin method he advises that the specimen be placed in equal parts of ether and alcohol previously to being placed in celloidin. A mixture of four parts of ether and one part of absolute alcohol ensures more rapid and complete penetration of the embedding material. Also in using paraffin for this purpose we have found by extensive practice that sections containing a large amount of fibrous tissue are useless after being in the paraffin bath for three to five hours, even at a temperature of 48° C.; twenty to thirty minutes is ample, provided that the material is properly dehydrated. The chapter on staining is succinct and comprehensive, and we note the usual and indeed only rational classification of stains, as nuclear, general, and selective. Hæmatoxylin still holds the first place, and Delafield's, or as it is miscalled, Grenacher's, is undoubtedly the best formula. It is here stated that if the sections be overstained, and washing in acid-alcohol be necessary, the colour is not permanent. Our experience is that if after the acid they be washed thoroughly well with "tap water," a very clear nuclear stain results which remains unchanged for years. Gram's method of staining for micro-organisms, with Weigert's modification, is clearly detailed. But here we fail to observe any mention of the brilliant results obtained by the Ehrlich-Biondi method. The employment of rubin for actinomycosis may with confidence be recommended, and the same remark applies to the use of saffranin in bringing out clearly the nuclear figures in karyokinesis. The chapter on mounting is somewhat tedious and the use of origanum oil in clearing celloidin-specimens is not advocated, although it has found general acceptance in Continental laboratories.

Weigert's method of preparing and staining nerve-tissue is given, but with one important detail left out, viz., that on removing the specimen from Müller's fluid or chromic acid solution it should have a brown, and not a green colour. The preparation of individual tissues and organs is well dealt with in chapter xii., but in the succeeding one on the examination of tumours there are such evident signs of hasty composition as to render it of small intrinsic value. On the other hand, the important subjects of urinary and excrementitious matters receive ample treatment; and we have a clear *résumé* up to this date of all that is taught on these subjects. As an example we note with pleasure the account of Dr. Delepine's work on "sable intestinal." The bacillus of Asiatic cholera and the methods of its detection are described on p. 228; and the diagnostic points between it and that of cholera nostras are found on the next page. A large amount of space is necessarily devoted to the examination of sputa. Dr. Wethered's experience at the City of London Hospital for Diseases of the Chest enables him to speak with the voice of authority on the signification of the presence or absence of the tubercle bacillus. Physiologists will find their side of the question well considered in the observations on blood; on Dr. A. Garrod's authority we are told that the blood of the Londoner has not yet been found to contain its true proportion of hæmoglobin. Eosinophile cells are not omitted; but for more detailed information on this point we commend to the notice of pathologists the article by Dr. A. Kanthack in the *British Medical Journal* of June, 1892.

Medical microscopy as a subject is exceedingly elastic, and we believe Dr. Wethered has stretched it to its widest limits when he finds space for describing the examination of various kinds of cereals, also of water. Even the homely tea-leaf has not escaped his notice. A few instances of clerical errors are to be found, thus Hartnach for Hartnack, on p. 122, Richert for Reichert. At the term "collodionization" we venture to express our distaste. A growing practice exists of introducing ungainly expressions of doubtful expediency into scientific works.

We have read this book with considerable attention, and are convinced that it has a most distinct *raison d'être*, and justifies on the whole, by the merit of its execution, the ambition of its title. It treats of the matter in hand with much ability, and in a manner that evidences considerable experience on the part of the author as a pathologist, physician, and teacher.

A. H. TUBBY.

ODOROGRAPHIA.

Odorographia; a Natural History of Raw Materials and Drugs used in the Perfume Industry. By J. Ch. Sawer, F.L.S. (London: Gurney and Jackson, 1892.)

CONSIDERING the importance of the subject of perfumes both from a scientific and a commercial point of view, it is somewhat surprising that a really good and authoritative book dealing on the matters encompassed by "Odorographia" has not before been attempted. The delay in the appearance of such a work is probably due to the fact that but few persons possess the requisite knowledge to treat the subject in a thoroughly satisfactory manner in all its bearings, such as the origin and production of the numerous products, whether animal or vegetable, and the chemical aspect of every substance and its commercial value, which are points that could scarcely be expected to be mastered by one mind. In the "Pharmacographia" of Flückiger and Hanbury, two master minds on the subject of drugs were brought into co-operation, with the result that a most satisfactory and standard work on medicinal plants was produced. That this book was in the mind of the author when he compiled his "Odorographia," and selected its title, is quite apparent, and we are bound to say that on the whole he has done his work remarkably well, though we wish that he had adhered more strictly to the lines of his pattern. Mr. Sawer, however, at the very commencement of his preface, is so modest as to say that "an endeavour has here been made to collect together into one manual the information which has hitherto been only obtainable by reference to an immense number of works and journals, English and foreign, in many cases inaccessible to readers interested in the subject," and that he is thoroughly well acquainted with all that has been written is apparent not only from a glance through the pages, where numerous references occur, but also from the "List of Principal Works referred to." Besides this the author has, as he tells us, obtained information first hand from some of the largest perfume-plant growers and manufacturers of Grasse, Nice, and localities in the Straits Settlements and West Indies. The difficulties attending the compilation of a work of this nature have, no doubt, been very great, because scraps of information are so widely dispersed, and even when found oftentimes very confusing. The botany alone of the subject must have occupied a considerable amount of time in looking up, the plants yielding perfumes being natives of various parts of the globe, and consequently described in the several floras appertaining to those special countries, besides which the chemical and commercial aspects occupy a large portion of the book.

Though we are grateful to Mr. Sawer for giving us a book that was really wanted, we regret, as we said before, that he has not followed more closely the plan of the "Pharmacographia" and arranged his matter under distinct heads, such as History, Botany, Cultivation, Chemistry, Commerce, &c. Practically he has done so to a certain extent, but the paragraphs are not sufficiently distinguished to enable one to turn at once to that upon which information may be specially sought. The arrangement of chapters, in which the most important and marked odours, such as those of musk, rose, violet, the citrine odours, &c., are brought together, is good, but the principal plants in each of these groups might have been treated as we have described, the least important ones being given as they are at the end of the chapters.

Returning to the botany of the book, we cannot but think that the author might well have spared much space by the omission of numerous varietal names and synonyms, many of which are scarcely ever heard of now, and which often only tend to confusion. Under Violet, for instance (p. 104), half a page is given to a list of the names of nine varieties of the Sweet Violet (*Viola odorata*). Again, at p. 309, Vétiver, or Cus Cus, is rightly described as the root of *Andropogon muricatus*, after which follow the names of five synonyms. In reference to this Mr. Sawer says, referring to the "Asiatic Researches," that "there is a verse in the Sanskrit language composed of nine words, arranged in two lines, purporting to be the nine names under which the plant was known; doubtless they were poetical names, as they are not found in the extensive list of local names recently enumerated by Watt." This would show that Dr. Watt, who in his "Dictionary of the Economic Products of India" does not err on the score of brevity in the adoption of synonyms, considered that there was a line to be drawn somewhere. We may perhaps also be allowed to draw attention to a paragraph on page 19, where the musk tree of Jamaica and the muskwood of Australia have got confused. The paragraph in question runs thus: "The *Eurybia argophylla* or *Guarea Swartzei*, the silver-leaved musk tree of Jamaica, New South Wales, and Tasmania, is a meliaceous tree, attaining a height of twenty-five feet." Eurybia, or more properly *Olearia argophylla* is the muskwood of New South Wales and Tasmania, and belongs to the natural order Compositæ, while *Guarea Swartzii* is a meliaceous tree of Jamaica, where it is known as musk tree. Another muskwood, not mentioned by Mr. Sawer, is that of *Moschoxylum Swartzii*, a highly fragrant resinous tree, closely allied to *Guarea*, and a native also of Jamaica and Trinidad. We refer to these matters in no captious spirit, but simply with the hope that Mr. Sawer may see his way to overhaul and modify this part of his useful book in a future edition, so as to make it even more useful and trustworthy. We are glad to note that he "is still engaged upon studies in this department, and hopes to publish another volume in due course."

OUR BOOK SHELF.

Catalogue of Eastern and Australian Lepidoptera Heterocera in the Collection of the Oxford University Museum. By Colonel C. Swinhoe. Part I. Sphinges and Bombyces. (Clarendon Press, 1892.)

THIS volume is the first part of a Catalogue of the moths from the Oriental and Australian regions in the collection of the late Mr. W. W. Saunders, which was acquired by the Oxford Museum some fifteen years ago, and consists chiefly of specimens collected by Wallace during his famous voyage to the Malay Archipelago, and described by the late Francis Walker in his British Museum Catalogue. Since Walker's arrangement of the collection it has remained untouched and mostly neglected by lepidopterists, so that a rearrangement and comparison of the types had become highly necessary, which useful work has been undertaken and very ably carried out by Colonel Swinhoe. All the types have been brought to the British Museum, their synonomy carefully worked out and the species placed in their proper families and genera, many of them being figured in the eight coloured plates, and it is to be hoped the other parts will soon follow, and also that a list of the types which should be in the Museum and are missing will be added. There is one statement in the preface which requires correction; the only types of Walker's species described in his Catalogue which are in the Oxford Museum are those which are expressly stated to be in "Coll. Saunders," all the others are in the British Museum, including those for which a locality is given before the list of British Museum specimens.

Charles Darwin: His Life Told in an Autobiographical Chapter and in a Selected Series of his published Letters. Edited by his son, Francis Darwin. (London: John Murray, 1892.)

PROF. DARWIN describes this volume as practically an abbreviation of the well-known "Life and Letters." The task of compression has been accomplished admirably, and there can be little doubt that the work will be cordially appreciated by a large number of readers. Of course it has been necessary to omit many details which are of interest to men of science; but everything is included which is really essential to a proper comprehension of Darwin's fine personal character, and a sufficiently full and clear idea is given even of his scientific labours. No one will read this fascinating book without feeling anew how much reason England has to rank Darwin among the greatest and noblest of her sons. The volume is enriched with a reproduction of an exquisite photograph of Darwin by the late Mrs. Cameron.

Strange Survivals: Some Chapters in the History of Man. By S. Baring-Gould. (London: Methuen and Co., 1892.)

EVERY one who has given any attention to anthropology is aware that many remarkable customs and beliefs, which are still to be found among the uneducated classes even in highly civilized communities, are relics of ancient superstitions. In the present volume Mr. Baring-Gould examines various groups of these curious survivals, and traces them back to their origin in the ideas of past ages. He knows his subject well, and, being interested in it himself, is able to present it in a way which is likely to make it interesting to others. The value of the text is considerably increased by some well-selected illustrations.

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.*]

Botanical Nomenclature.

IN NATURE for October 6 (p. 549) there is a note "on the progress of the negotiations concerning the nomenclature of genera, started by a committee of botanists at Berlin to supplement the decisions of the International Botanical Congress held at Paris in 1867." It is stated that "the botanical authorities of the British Museum favour the suggestions; those at Kew are against them."

Now this requires a little correction. It may be remarked to begin with that many botanists are exercised at the present time not merely about the nomenclature of genera, but also about that of species. Kew has, however, never given its adhesion to the attempts that have been made to bring about an international agreement on these matters. It has always felt that so many considerations must determine the course taken by the systematist in any particular case, that there is no advantage, but positive inconvenience, in being subjected to a hard and fast rule. It is therefore with no disrespect to, or want of sympathy with, the able school of Berlin botanists, who have recently formulated some new proposals with regard to nomenclature, that Kew has officially refrained from expressing any opinion upon those proposals. It has neither expressed approval nor disapproval.

In America Harvard has long occupied the leading place in the botanical world, and the principles adopted there have been substantially in accord with those adopted at Kew. Hitherto, therefore, the leading English-speaking botanists who have occupied themselves with systematic botany have been in substantial agreement that the adoption of a strict law of priority in nomenclature must give way to considerations of convenience.

Well known and accepted names are not therefore to be lightly changed as the result of mere bibliographical research. As to specific names the often merely mechanical process of describing a new species is held to be of little value compared with the more difficult task of assigning to the plant described its true affinities and correct systematic position. The principle which guides Kew practice in this matter is laid down by Sir Joseph Hooker in the preface to "The Flora of British India" (p. vii). He remarks:—

"The number of species described by authors who cannot determine their affinities increases annually, and I regard the naturalist who puts a described plant into its proper position in regard to its allies as rendering a greater service to science than its describer when he either puts it into a wrong place or throws it into any of those chaotic heaps miscalled genera with which systematic works still abound."

The following paper on the subject deserves the wider circulation which its reprint in NATURE would give it. It represents the Harvard tradition and practice, and is the last scientific utterance of Dr. Sereno Watson, who so soon followed to the grave his illustrious predecessor, Asa Gray.

Kew, November 14. W. T. THISELTON DYER.

ON NOMENCLATURE.[1]

[It was the request of the late Dr. Sereno Watson that the following communication, dictated by him in his last illness, should appear at an early date in the *Botanical Gazette*.—EDS.]

FOR some time I have had a desire to give expression to my views upon botanical nomenclature. Under the circumstances, I must speak briefly and somewhat dogmatically. In my opinion botany is the science of plants and not the science of names. Nomenclature is only one of those tools which is necessary to botany, and this being the case, points of nomenclature should be subordinated to science.

A principle of botanical convenience has been established by those who prefer one name to another on account of expediency or convenience. This principle should have a great deal of influence. It has been so recognized by the greatest botanists, and from their authority receives great weight. I prefer the word *expediency* as a better term than convenience to designate the principle, that the demands of science over-ride any merely technical claims of priority, &c.

Priority of specific names appears to be based entirely upon one section of the code of 1867. That simply says that when a species is transferred from one genus to another, the specific name is maintained. This principle is usually understood and applied in the way that the oldest specific name has a right in all cases to be retained. It cannot fairly be so interpreted and applied, since it governs only to the extent that this should be the law, but it is not to be made an *ex post facto* law. Thus when a transfer has been made, that ends the matter so far as the choice of a specific name is concerned, and no one is authorized to take up a different name. This practice of retaining the oldest name *under the genus*, no matter what older specific names there may be, was adopted by Dr. Gray in his later years and by the Kew botanists, for the reason that once established and pretty generally recognized, it would avoid the great mass of synonymy, which is being heaped like an incubus upon the science. I must express surprise that Dr. Britton had not considered it his duty to publish the last written words of Dr. Gray which were addressed to him upon this subject and which expressed his positive opinions upon this point.

There is nothing whatever of an ethical character inherent in a name through any priority of publication or position which should render it morally obligatory upon any one to accept one name rather than another; otherwise it would be applicable or true as well in the case of ordinal names, morphological names, teratological, and every other form of name, to which now no one feels himself bound to apply the law of priority. The application of this law as at present practised by many botanists, which would make it the one great law of botanical nomenclature, before which every other must yield regardless even of common sense, is a mere form of fetichism exemplified in science. Many instances of the application of this law are not science but are rather superstition. SERENO WATSON.

February 22, 1892.

[1] From *Botanical Gazette*, vol. xvii.

The Reflector with the Projection Microscope.

THE lantern is now used for so many purposes—scientific, photographic, and recreative—that any improvement in its construction will be acceptable. When we look into this instrument whilst at work we must be disappointed at the large quantity of light lost by reflection and by dispersion—light which ought to go to the illumination of the screen. In the ordinary form of the lantern three lenses of dense glass are employed as condensers. Each of these six surfaces reflects and scatters the light, and the glass itself is absorbent of its rays.

The dioptric construction of the projection lantern has been well worked out by Messrs. Wright, Newton, Salomons, and others, but the catoptric principle, which would eliminate almost entirely these disadvantages, has been scarcely at all studied.

Although my experiments have been made solely with the limelight in various forms, the following remarks may equally apply to light given by the electric arc:—

If a reflector be used instead of the ordinary condensers it is obvious that the position of the lime cylinder must be reversed. This will present no difficulty, for the tube holding the jet can be bent into a helical form. The dark image of the lime-cylinder also will have no more practical disadvantage than is experienced by a like image formed by the small plane speculum of the Newtonian telescope.

As to the mirror itself, although a parabolic form is the most correct, a spherical surface will be sufficient for mere illuminating purposes, and thus expense may be spared in the grinding of the more difficult curve. A speculum of from 5 to 7 inches diameter, having a radial curvation of from 2½ to 3 inches, will grasp a large quantity of light, much more than that obtainable from the 5-inch condenser usually employed.

Silver deposited by one of the various reducing processes on the surface of a clear glass lens will have many advantages over a metal mirror. The front surface will give perhaps the finest definition, but by silvering the back part of a spherical glass film, or that of a ground lens, the brilliant surface will remain untarnished for an indefinite time, and the whitish bloom formed by slow volatilization of the incandescent lime is easily removed. This silver film adheres with remarkable tenacity, and it will bear a great deal of heat without blistering or becoming detached.

I have had considerable success in constructing such mirrors from the large ornamental glass spheres blown in Germany, and silvered within by Liebig's process, viz. with milk sugar and ammonio nitrate of silver. A glass sphere of 10 or 11 inches in diameter may be easily cut into eight or nine mirrors by a red-hot iron, and this without disturbing the silvering, which will require only gentle friction with a pad of cotton impregnated with a trifle of rouge to brighten it. Thus, at the cost of a few shillings, eight or more mirrors can be made, and also provision be made against possible accidents of cracking by heat.

The light-radiant is so placed that the secondary focus is intercepted by a plano-concave lens of dense glass, as has been happily proposed by Mr. L. Wright. The convergent rays from the speculum are thus made into a parallel beam, which must be deprived of its heat by an alum-trough, for the light and heat at the substage condenser is very great.

Convergence, I find, is usefully promoted by a plano-convex lens of about eight inches focus, placed two or three inches before the above-noted plano-concave lens. In all other respects the arrangements are like those of the usual modern projection microscope.

I have pretty constantly used the ether-oxygen saturator, and I consider it to be perfectly safe, if ordinary precautions be taken. The oxygen, compressed in cylinders, is much recommended, as there can be no mixture of vapour, except at the right place. The U-shaped horizontal saturator, plugged with flannel, must be well charged with ether, or with the best gasolene, and care should be taken, before beginning or ending an exhibition, to shut off the oxygen tap before closing the ether tap. This will prevent the harmless "snap" from the mixture in the small chamber at the joining of the gas tubes. If a disc more than eight feet be required for the microscope, it will be well to use hydrogen gas instead of ether, since the calibre of the jet cannot in the ether light very well exceed $\frac{1}{16}$ of an inch.

As an extra security, I pack the mixing chamber with asbestos-fibre, moistened with glycerine; but, as before urged, the oxygen must leave the saturator, saturated.

To insure the coincidence of the foci of the reflector with the optical axis of the microscope, it will be well to place three adjusting screws in a triangle behind the mirror, and this last may have both a small vertical and horizontal movement.

I claim for this catoptric arrangement a larger grasp of light than can be got from ordinary lenses, and this may be effected also at a small outlay. For the amateur constructor the plan will afford many advantages. G. B. BUCKTON.

Note on the Colours of the Alkali Metals.

WHEN these metals are heated in a vacuous tube in such a way as to cause an extremely thin sublimate of the metal to condense upon the glass, the film so obtained will be found to possess a beautiful and strongly-marked colour. That this colour is not in any way due to the combination of the metal with any lingering minute traces of oxygen, is evident from the fact that vacuous tubes which have contained the clean and bright metal for years, and in which the metal has been frequently melted and rolled about, and even vapourized in places, and in which, therefore, it is impossible to conceive of any oxygen remaining, will continue to show the phenomenon whenever a portion of the contained metal is heated. The experiment may readily be made by introducing a freshly-cut fragment of the metal into a glass tube sealed at one end and drawn down to a narrow and thickened constriction near the middle. The tube is then drawn out at the open end and connected to a Sprengel pump. As soon as a good vacuum is obtained the tube is warmed throughout its entire length, the pump being still in operation, and the metal heated sufficiently high to cause it to melt and run out of the crust of oxide. When the exhaustion is again as complete as possible the tube is sealed off. The metal is once more melted, the whole tube being at the same time gently heated, and the molten mass allowed to filter through the constriction into the other portion of the tube. The vacuous condition of the tube allows of the metal freely running through an extremely fine aperture, and in this way it becomes perfectly separated from all dross. The tube is then sealed off at the constriction. On gently heating a minute fragment of the bright metal so obtained, by means of a small pointed gas flame, the coloured film of sublimed metal will at once be seen. Viewed by transmitted light, the colour of the film of sodium thus obtained is greenish-blue, inclining to green. Potassium gives a sublimate which is of a magnificent rich purple colour, while rubidium, on the other hand, forms a film which is a pure indigo blue.

In the cases of sodium and potassium, the colour of the metallic sublimates is different from the colour of the vapour as seen when the metals are boiled in an atmosphere of hydrogen. Potassium, it will be remembered, yields under these circumstances a vapour possessing an emerald-green colour, while that of sodium, which appears colourless when seen in small layers, shows a violet or purple colour when viewed through a sufficient thickness.

When the liquid alloy of sodium and potassium is treated in the same way, the sublimate obtained is found to be greenish in colour nearest to the source of heat, quickly shading off to blue and purple as it is more remote from that point, indicating apparently that the two metals sublime separately.

As a means of observing these colour phenomena, this alloy is more advantageously employed than the solid metals themselves, for, by rolling the liquid about, the sublimate may be wiped away and the experiment repeated indefinitely in the same tube.

As to whether the colours of these sublimed films are properties intrinsic to the particular metals, or are merely a function of the physical condition of the substances, it is perhaps rash to dogmatize. A number of other elements have been treated in a similar manner, but without similar results; thus lithium, cadmium, mercury, arsenic, tellurium, and selenium, when heated in vacuous tubes are readily sublimed, but in no case does the film appear coloured. On the other hand, however, it is well known that some of the very malleable metals when beaten out into thin films are capable of transmitting light varying in colour from green to violet. G. S. NEWTH.

Women and Musical Instruments.

IN answer to Prof. O. T. Mason's letter which appeared in a recent number of NATURE (vol. xlvi. p. 561), I may draw attention to the following facts which bear upon a part of the subject which he broaches, namely, the part played by savage women in the use of musical instruments. In the South Pacific the "nose-flute" is very generally, though by no means exclusively, played upon by women. In the account of the voyage of Capts. Cook and King there is in one of the plates a figure of a woman of the Tonga Islands seated under a hut playing upon a "nose-flute." A similar figure of a woman playing upon a "nose-flute" may be seen in plate 28 of Labilladière's "Voyage de la *Perouse*," in the representation of a Tongan double-canoe. Melville ("Four Months' Residence in the Marquisas Islands," p. 251) mentions playing upon the "nose-flute" as being "a favourite recreation with the females." In Wilkes' "U. S. Exploring Expedition," iii. p. 190, there is a description of this instrument as used in the Fiji Islands, and it is stated that "no other instrument but the flute ['nose-flute'] is played by the women as an accompaniment to the voice."

Turning now to another genus of primitive instruments, viz., the "musical bow," we find a peculiar local form, the "Pangolo," occurring at Blanche Bay, New Britain. There are specimens of this at Berlin and Vienna. This instrument is stated by Dr. O. Finsch (*Ann. des K. K. Naturhist. Hofmuseums*, suppl. vol. iii. pt. 1, p. 111) to be only played upon by women of Blanche Bay. Guppy too ("Solomon Islands," p. 142), says that the women of Treasury Island produce a soft kind of music by playing, somewhat after the fashion of a jew's-harp, on a lightly-made fine-stringed bow about 15 inches long.

It cannot, I believe, be said that any of these instruments have been *invented* by women, and it is undoubted that women in savagery but seldom figure as performers upon musical instruments. It would certainly be interesting to collect all the instances recorded. I hope that the above few notes regarding instruments in the South Pacific may be of use to Prof. Mason, and I can only regret that lack of the necessary time prevents my going further into the matter.

University Museum, Oxford, HENRY BALFOUR.
November 7.

AN ANCIENT GLACIAL EPOCH IN AUSTRALIA.

A VERY interesting "special report" has just been issued by the Department of Mines of Victoria, giving an account of the remarkable evidences of glaciation observed at a locality about twenty miles south-east of Sandhurst, and about the same distance north of the great Dividing Range.[1] The report is illustrated by a map and sections on a large scale, and by eight excellent photographic prints, showing the character of the deposit on the surface and in railway cuttings, the striated bed rock, and the striated and grooved blocks and boulders, so that full materials are given for the conclusion that we have here an undoubted glacial deposit. A brief summary of this report will therefore be interesting to all students of the phenomena and problems of terrestrial glaciation.

The district now specially described is about fifteen miles in one direction by five in another, and over this area of about thirty-six square miles the conglomerate is continuous, overlying the Silurian rocks of the district. It has generally a rounded or undulating surface, but shows cliffs about 100 feet high in some of the gullies, and its maximum thickness is estimated at 300 or 400 feet, while its highest point is about 700 feet above sea-level. As well seen in the cliffs and several railway cuttings, the conglomerate consists of a matrix of sand and clayey matter containing huge boulders, great angular and sub-angular masses of rock, pebbles, and rock-fragments of endless variety of size, form, and material. Many of these masses are planed, scored, striated, or polished.

[1] "Notes on the Glacial Conglomerate, Wild Duck Creek." By E. J. Dunn, F.G.S. (R. S. Brain, Government Printer, Melbourne, 1892.)

Planing is very common, and is either flat or with a hollow or a convex surface. Some of the intensely hard hornfels blocks have been ground on one or more sides, several planes being sometimes ground on the same stone, while some very hard rocks are deeply grooved. In other cases the striations and scratches are so fine as only to be seen with a lens; while one surface block of very hard material has been ground down and polished, so that it glitters in the sun. In fact, every form of surface-grinding produced by recent glaciation appears to be here present.

The surface of the ground is everywhere strewn with pebbles and boulders, the result of the washing away of the finer materials of the conglomerate; but, besides these, there is a tract of about two and a half miles by one mile near the centre of the conglomerate-area, on the north side of Mount Ida Creek, which is rather thickly strewn with large blocks, termed by the writer "erratics," though they can hardly be erratics in the sense of having been deposited on the present surface by ice. There are forty-five of these blocks, which are either of granite, sandstone, or quartz, and vary in size from 6 feet by 4 feet, to 20 by 12 feet. One of the finest, termed "The Stranger," of coarse-grained granite, is 16½ feet by 10½ feet, and 5 feet thick, the estimated weight being 30 tons. It is planed and scored in a remarkable manner, as are most of the other blocks. It is curious that beyond this limited area only three or four large blocks are found on the surface, while no pebbles or boulders derived from the conglomerate are found more than a hundred yards beyond the present limits of that formation.

A striking feature of the conglomerate is the great variety of rocks present in it, seeming as if "the débris of a continent" had been here gathered together. There are an almost infinite variety of granites, syenites, gneisses, schists, quartzites, sandstones (hard and soft, coarse and fine), slates, shales, conglomerates, amygdaloids, porphyries, vein-quartz, red, yellow, and grey jaspers, and many others. Some of these can be identified with existing rocks, but others are not known in Victoria. In some cases there is what appears to be river shingle, in others the delicate scratches preserved even on soft shale show that the material has not been exposed to any denuding action. There are also sandstone beds of considerable extent and thickness intercalated with the conglomerate, indicating that there were alternating periods of river or current action while the conglomerate was being formed.

The whole of the phenomena here briefly sketched point unmistakably to glacial action; in fact, there seems to be hardly any part of Wales or Scotland where such action is more clearly indicated. There are, it is true, no moraines, because the period when the conglomerate was laid down is too remote, both newer and older pliocene rocks overlying it in some places. Indeed, from fossils found in shales overlying what appears to be a similar conglomerate at Bacchus Marsh, south of the Dividing Range, the writer of the report is inclined to consider the whole formation to be of Palæozoic age. In one part of the area the bed rock is exposed, and this is covered with abundant striations crossing the stratification lines, indicating either powerful glacier or iceberg action.

A list of localities where similar conglomerates have been found is given, showing that they occur to the northward for about 250 miles along the foot of the hills bordering the Murray valley, disappearing under the Tertiary deposits of the lowlands; they have also been met with forming the floor of the auriferous deposits in mines at Creswick and Carisbrook, on the northern slopes of the Dividing Range; and also, as already stated, at Bacchus Marsh, and a few other localities on the south side of the range. We are not told, however, whether similar indications of glacial action occur in these localities. If these deposits are really all glacial and contemporaneous, they indicate an extent of glaciated country that would imply either a very lofty mountain range or the occurrence of a real glacial epoch in the southern hemisphere.

The direct evidence of the superposition of Tertiary rocks of Pliocene age shows that the glacial conglomerate itself is of great antiquity, but no special attention appears to have been given to the question of the age of the so-called "erratics." The fact that they are found in so limited an area seems to show that they are not derived from the conglomerate itself by the process of sub-aerial denudation, and the same thing is indicated by the apparent fact that they all rest upon the present land surface. The photographs seem to indicate this, and nothing is said about their relations to the subjacent conglomerate, or whether any considerable proportion of them still form part of it, merely protruding above the surface, as would certainly be the case if they owe their present position to the mere washing away of the finer parts of the deposit. But, if so, why should they be called "erratics," as distinguished from the blocks and boulders which are still embedded in the formation? If, on the other hand, they are supposed to be true erratics—that is, to have been deposited on the present land-surface by ice agency—they must clearly be much less ancient than the conglomerate itself, or they would hardly retain such fresh-looking striations, grooving, and polishing as some of them exhibit. It is to be hoped that these most interesting deposits will be the subject of very careful study by Australian geologists, since they seem calculated to throw much light on the geological history of the old Australian continent.

ALFRED R. WALLACE.

ON THE WALKING OF ARTHROPODA.

IN a letter to NATURE, published January 8, 1891, I described the manner of walking of several insects. Recently I have been able to examine a greater number of Hexapoda, together with several Arachnida and Centipedes, and a few Crustacea. The results of most of these observations were communicated to the Royal Dublin Society a few weeks ago.

I stated in my former letter that most usually the insects examined moved three legs, *e.g.* the 1st and 3rd on one side, and the 2nd on the other, almost, but not quite, simultaneously. In some insects it is the most anterior leg of this tripod which is raised first; in others it is the most posterior. An example of the first case is the cockroach, and of the second the blow-fly. But again exceptions appear to occur in each case. This almost simultaneous raising of the "diagonals" is shown by observations, photographic and otherwise, to be the rule in all the adult Hexapoda which I have examined, except the Thysanura. Of this last group I have observed *Tomocerus longicornus*, and find that, while it often moves by the simultaneous use of the diagonals, it also often raises its opposite legs simultaneously in pairs, especially when the animal is walking on a smooth surface, and using the sucker which is placed on the anterior part of the abdomen.

This use of the opposite legs in pairs was also found very frequently, as well as the diagonal walk, in the larva of one of the Coleoptera, and is always to be observed in caterpillars. Thus it is interesting to find that in one species at least of the Thysanura, which are regarded as having preserved many of the characteristics of primitive insects the adult walks in the same manner as the larvæ of other insects.

It is to be observed that those insects which have long antennæ move them, and apparently the maxillary palps, in accordance with the diagonal rule; for when the front leg of one side is moved the antenna of that side is twitched.

A midge and some arachnids very frequently use the front pair of walking legs as antennæ. The midge which I observed probably belonged to the Cheironomidæ; it often, when at rest, stood on the two posterior pairs of legs with the anterior pair aloft in the air; when walking it moved them much as a beetle moves its antennæ, gently tapping the ground in front of it with them, their motions being always subject to the diagonal rule; in flight the midges often hold the anterior pair of legs straight out in front, while the last pair are held out in a similar manner behind, and probably have the effect of balancing the insect.

The spiders photographed (*Tegenaria Derhamii* and *Tarantula pulverulenta*) also exhibited the diagonal motion and sometimes the use of the anterior pair of legs as antennæ. When, in order to photograph them, these animals were put on a piece of paper floating in a shallow dish of water, so as to confine them without casting a shadow on the space in which they walked, they used frequently to stand on the three posterior pairs of legs at the edge of the paper, while they moved their anterior pair of legs through the air, or touched the water lightly with them. Several spiders—for instance, *Theridion Sisyphum*—have the anterior pair of legs longer than the others, and very frequently seem to use them as tactile organs. Specialization in this direction is carried very far in the Pedipalpi, in which group the anterior pair of legs are very long, thin, and flagelliform.

The wave of motion in one set of diagonals (*i.e.* the 1st and 3rd of one side, and the 2nd and 4th of the other) in the Tarantula sometimes travelled from before backwards and sometimes in the opposite direction; while in Tegenaria it passed on the whole forwards, but sometimes commenced by the raising of one of the middle legs, or by the raising of the two extreme legs of a set.

When confined on the floating island of paper, the Tarantula sometimes, after a good deal of hesitation, took to the water. When on the surface of the water, its legs, and sometimes the under surface of its abdomen, made conical capillary depressions in the surface, so that the water acted as a diffusing lens to the sunlight, and a dark circular shadow surrounded with a bright line appeared on the bottom of the dish corresponding to the depression at the tip of each leg. This suggested a method of determining the weight supported by each leg, for the diameter of the depressions, and consequently that of the shadows, bears some ratio to the weight on the point which causes the depressions. By fixing the leg of a spider on the end of a straw, hung delicately as a balance-beam, and by measuring the diameters of the shadows caused by the depressions in the surface of the water formed by this leg for various positions of a rider on the straw, I find that these diameters are approximately proportional to the weight on the point causing the depressions. Thus, by dividing the total weight of the spider proportionally to the diameters of the shadows, we get approximately the weight on each leg.

Fig. 1 is from a photograph of the Tarantula standing

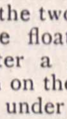


FIG. 1.

on water; above the spider in the picture is its shadow on the bottom of the vessel, and at the ends of the three posterior pairs of legs in the shadow appear circular shadows corresponding to the depressions made by the legs; and there is also a shadow thrown by the depression caused by the abdomen. The weight of this spider was 30 mgrs. Thus we find that approximately the weights on the legs are the following:—On the right side, 2nd supports 1·875 mgrs.; 3rd, 7·125 mgrs.; 4th, 3·375. On the left side, 2nd, 4·875 mgrs.; 3rd, 5·250; 4th, 3·000; and the abdomen supports 4·500 mgrs. When walking, the Tarantula usually supported all its weight on a tripod formed by the 2nd and 4th legs on one side, together with the 3rd leg on the other side. The weights on the tips of the legs when one photograph was taken were found to be:—On the 2nd right leg, 9·50 mgrs.; on the 4th right, 10·25; and on the 3rd left, 10·25.

Profile photographs also seem to show that the 1st pair of legs are not generally used to support much weight. Fig. 2 is a diagram of the positions of the 1st pair of legs

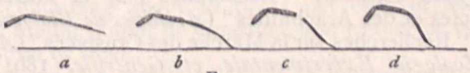


FIG. 2.

drawn from a number of profile photographs of Tegenaria. The first position, *a*, is that of the leg which has been thrown forward, and is just about to come to the ground; *d* shows the position of the 1st leg when the body has come forward, owing probably to the traction of this leg as well as to the pushing of some of the other legs, and so the leg is bent; *b* and *c* are intermediate positions. The next

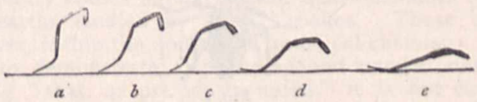


FIG. 3.

figure is a somewhat similar diagram of the 4th pair of legs made from profile photographs. At *a* the leg has just been moved forward, and is on the ground, and is in a good position both for bearing the weight of the body and shoving it forward. At *e* it is stretched to its full length, and so is not of any use in driving the spider forwards, while, owing to its almost horizontal position, it is almost useless in supporting the weight of the body. Accordingly the spider has commenced to raise the extremity of the leg prior to lifting the leg completely off the ground.

Last autumn I had the opportunity of observing two scorpions which Mr. R. J. Moss brought from North Africa and exhibited at the Royal Dublin Society. These also appear to proceed according to the diagonal rule; but I do not know what is the order of succession in one set of diagonals, as I have not yet photographed any of these animals.

The hermit crab uses three pairs of legs in walking—the chelæ, and two pairs of thoracic walking legs; these it uses according to the diagonal rule, whether it walks sideways or forwards. Sometimes it simply shoves the chelæ along the ground without lifting them, while it moves the two pairs of legs in a diagonal manner. One of the Asellidae I found often used the opposite legs in pairs simultaneously when walking.

The centipede does not either raise its opposite legs in pairs together, nor does it move its legs according to the diagonal rule. In a number of photographs taken with an exposure of about the $\frac{1}{70}$th of a second the legs appear to move in threes diagonally, for instance, the 3rd, 4th, and 5th, and the 9th, 10th, and 11th on one side move simultaneously with the 6th, 7th, and 8th of the other side, while on the first side mentioned the 6th, 7th, and 8th, with the 12th, 13th, and 14th are on the ground, and on the other side the 3rd, 4th, and 5th, and 9th, 10th, and 11th are also on the ground. At either end of the body this order is usually more or less disturbed; thus on the right side the 14th leg might be on the ground, while on the left the 13th, 14th, and 15th would be also in contact with the ground; but in none of the photographs was the symmetrical diagonal movement of the successive threes disturbed between the 2nd and 12th pairs of legs inclusive. This apparently simultaneous motion of three adjoining legs may probably be explained by supposing a series of waves, whose crests traverse three legs in the $\frac{1}{70}$th of a second, to be passing along the body, since the different photographs show different legs moving in threes; thus in one photograph the 6th, 7th, and 8th on the left side are seen to be moving forward, while in another the 5th, 6th, and 7th, are moving.

Since reading the paper at the Royal Dublin Society, Mr. G. H. Carpenter brought to my notice two papers by M. Jean Demoor, "Recherches sur la Marche des Insectes et des Arachnides" (*Archives de Biologie*, 1890) and "Recherches sur la Marche des Crustacés" (*Archives de Zoologie Expérimentale et Générale*, 1891). M. Demoor points out the simultaneous use of the tripod in the insects which he examined, but as he did not use photography he does not seem to have observed the minute want of synchronism of the legs of a tripod. Figs. 4 and 5 illustrate this.[1] These are two photographs taken of the same specimen of *Blaps mucronata*. Fig. 4 is from a photo-

FIG. 4.

graph taken with a long exposure, and shows the 1st and 3rd of the left side, and the 2nd of the right moving at the same time, just as it appears to the eye. Fig. 5 is from

FIG. 5.

a photograph taken with less than half the exposure of 4, and shows that while the 1st leg on the right side is raised off the ground, the 3rd on the same side and the 2nd on the left have not yet been raised. That they have not been raised and are now come to rest is shown by their backward position with regard to the body and other legs. These two photographs also show that the antenna is often twitched almost simultaneously with the motion of the 1st leg of its side. M. Demoor also observed a scorpion (*Buthus australis*), but its method of progression does not seem to have agreed with that of the scorpions (*Buthus europœus*) which I observed. He has not, so far as I know, recorded any observations on spiders. HENRY H. DIXON.

Trinity College, Dublin, June.

[1] Figs. 4 and 5 show the legs, which are raised from the ground, quite sharp. In the negative they are more or less blurred owing to their motion during the exposure.

ON IRON ALLOYS.

THE merely mechanical expert in the working of metals would naturally consider it probable that a given metal when fused with another would communicate its physical properties, roughly, in proportion to the quantity added. A soft, tough metal added to iron would, from his point of view, render the latter softer; a brittle or hard metal would have the contrary effect, and so on throughout the whole series of metallic alloys.

Actual experiment would soon, however, show the fallacy of this, and that in the majority of cases no reliance could be placed on this assumption solely based on the physical properties of the elements severally considered. A further study of the laws which govern chemical combination would quickly show that alloys formed by fusion were not merely intermixtures, but that something else took place, bodies being often produced, or rather formed, differing considerably from the metals severally used. It would therefore be fair to assume that the metals entered into combination with each other, and yet it would be found that the problem even at this stage was not completely solved.

Further inquiry and experiment would indicate that it was not always possible to prove that chemical combinations "were in all instances" formed by fusion alone. Instead of this something closely akin to only an intermixture of the metals occurred; second, one of the metals had apparently dissolved in the other; third, it was difficult to differentiate betwixt intermixture and solution. Here we are on all fours with modern ideas which seem to have met with general acceptance, although it is not denied that elements or metals are capable of chemically combining with each other. We are not, however, quite prepared to draw a hard and fast line betwixt chemical combination of the metals with each other, solutions, and intermixtures of metals. One appears to merge into the other, and no good reason "so far as is known" can be given why solution, as ordinarily understood, or as defined by Van 't Hoff and others, may not be as applicable to fused metals as to the solution of certain salts in water.

Water at 60° is nothing more nor less than fused ice; fused iron, therefore, may obey the same laws, and, "like water," may be capable of dissolving certain substances, and rejecting others, temperature constituting the sole difference—or plainly, solid ice is fusible at 60°, iron at about 2500°.

Now what happens in the case of water? Certain bodies are soluble in it, others not; on lowering the temperature, these bodies are to a certain extent rejected, and nearly, but not quite, pure ice is formed; and so far as we know this equally applies to fused iron. As an instance, on cooling, the carbon is rejected, and appears in the graphitic[1] form, merely diffused throughout the solid cold metal. It is impossible here to treat this matter in detail; but enough, we think, has been said to indicate that the analogy is fairly complete throughout.

But there is another matter—apart from the solution of foreign bodies in fused ice or iron—which requires to be discussed. Ice dissolves in warm water, and so does cold iron or steel in superheated fused iron; the hot fluid metal from the Bessemer converter fuses or dissolves large lumps of solid steel placed in it as easily as ice is thawed in warm water. Temperature here, in both instances, determines the quantity which can be added; the higher the heat, the greater the quantity which can thus be dissolved or fused, ere the bath becomes thick, pasty, and incapable of being poured out into another vessel.

In so-called solutions the same rule appears to hold good; but, as all chemists know, there are many exceptions; in some cases heat is evolved, in others absorbed; and some bodies are more soluble in the cold fluid solvent.

It is, however, believed that no instance can be quoted of a body being more soluble in iron at a low degree of heat than at a high one. Confining ourselves to hot fluid iron or steel, it apparently readily dissolves cold metal. Similarly, other bodies, such as copper, &c., are dissolved in the same way when added to it.

The cold metal is fused by absorption of the enormous

[1] The relations existing betwixt carbon and iron are peculiar, and require to be separately discussed.

extra heat of the bath, but this may not be strictly true, for something like solution may also take place. In melting iron in the reverberatory furnace it often happens, when the heat is insufficient, that the iron sets in a pasty semi-fluid mass on the bottom of the furnace; the operator then adds some molten iron, and the whole soon becomes fluid.

This process is closely akin to solution. It cannot be explained as simple fusion of iron in iron; the molten iron, in fact, seems to exert a solvent action on the pasty metal, and heat alone plays only a secondary part. This may seem absurd to those not practically engaged in the manufacture of iron, but the fact remains as the result of the experience of iron-workers.

It follows that other metals can be similarly taken up, and the theory of certain iron alloys simplified. There are certain metals intimately related to iron on the periodical scale of the elements, also by atomic volume and atomic weight, and their combination with iron may be achieved by fusion, and possibly something like solution as well, as described, resulting in the production of a similar homogeneous product, which compound metal cannot well be termed either a solidified solution of one metal into another, a chemical combination, or intermixture of metals. The physical properties of this alloy, of course, are different from those of iron. This seems an extreme view to take, but it may be mentioned that the absolutely pure elements prepared by special experts are known in some instances to differ somewhat from those accepted as such in an ordinary laboratory. It has been also noted that the so-called impurity extracted does not differ very greatly from the pure product, and yet is not precisely the same—(quoting from memory, "this applies especially to alumina," why not iron?)

As the result of an extensive experience in the chemical examination of crude iron, steel, and the purest wrought iron, one finds that some metals cling persistently to iron—manganese is always present, nearly all contain copper, nickel also may often be detected if sought for, chromium is not so rare a constituent as might be supposed—all, however, in minute quantities in the case of wrought iron or Bessemer decarbonized metal.

It is curious that these particular metals should cling to iron, but the previous exposition of their relation to iron possibly affords a clue accounting for their persistent presence.

Again, one gathers from a study of Crookes's theory of the genesis of the elements, together with his spectroscopic researches on the composition of the rare earths, yttria, &c., that one so-called element apparently merges into another by almost insensible gradations; it is probable that iron is one of these. Probably it is, for recently it has been all but demonstrated by Prof. Roberts-Austen and others that iron is a compound body, but the relations betwixt these bodies are so close that they have not been isolated, and both are still termed iron.

We have evidence of the possibility of one element merging into another and that iron is not an element, and any one who has studied the periodic law cannot fail to see at least the probability that minute variations in the composition of the elementary bodies may occur, which, however, cannot well be differentiated by our present comparatively coarse analytical methods. Modern methods, however, have been sufficiently accurate to enable us to show that certain relations can be traced throughout the whole series of the elements, and it is in this way that the periodic law has been formulated; and fairly trustworthy atomic weights have been obtained.

Admitting the possibility of minute variations in the composition of elementary bodies, or more correctly that, as urged by Crookes, an element may have more than one atomic weight—the atomic weight accepted being the mean of these: with the periodic law for our guidance, and also attaching due weight to the relations existing betwixt the weights and volume of the atoms, it would seem that the theory advanced of the homogeneous formation of bodies by fusion is in accord with the periodic law, &c., governing the genesis of the elements.

This is equivalent to saying that a fourth state of combination may be imagined, which is—

(1) Neither solution of one metal in another.
(2) Chemical combination of bodies.
(3) Intermixture of bodies.

Hadfield's alloys of iron and manganese may be members of this class.

The first series of these alloys are hard, but when the manganese exceeds 7 per cent. the metal softens; and alloys containing about 12 to 15 per cent. of Mn are strong, tough, cannot be annealed, and cannot be termed either iron or steel.

The same to a certain extent, it is believed, applies to the nickel alloys of iron.

There are other properties, which show that the FeMn alloys are unique.

The alloys of chromium and iron recently made by Mr. Hadfield appear to be of the same class, as also those of nickel and copper with iron.

More plainly, the homogeneous compound bodies previously commented upon may be practically termed elementary bodies similar to the quasi-elements of the rare earths studied by Prof. Crookes. These being, however, within the domain of practical chemistry, it is easy to demonstrate their compound nature, not forgetting "that, as previously noted," it is not easy to entirely eliminate these bodies allied to iron.

We may even go further and assume that the fourth state indicates a species of combination even more intimate than the chemical combination of the chemists.

In fact, reactions "occur quite unlike chemical combination in which atoms only combine with atoms, or bodies are built up atomically." The fourth state may go beyond this; at present this is pure assumption; yet an eminent man of science has suggested that even the atoms may be *smashed*, and this is equivalent to saying that under certain conditions the atom may be non-existent; or in an alloy of, say, iron and nickel or iron and manganese, the separate atoms of iron and manganese do not exist; or in an alloy of iron and Mn or nickel, the severally separate atoms of Fe and Mn, &c., may have no tangible existence apart from each other, as in the case of true chemical combination. Further, this seems more probable if we remember that chemical combinations are, according to modern views, nothing more nor less than structural formations governed by physical laws which regulate their molecular arrangement and the relative positions of the atoms to each other, just as in any structural work built by the hand of man, certain laws or rules must be adhered to. In Nature's laboratory something beyond this may be going on—something, indeed, altogether outside our limited knowledge and experience.

Iron is only one member of a very complicated group, which are closely in accord both as regards their atomic volumes and weights and position on the periodic scale of the elements; and, if we are to accept the work of Prof. Crookes, the well-known investigations of Prof. Roberts-Austen, Osmond, and some data derived from the spectroscopic work of Lockyer, one may be really justified in assuming that quasi-elements may be formed by fusion in the workshop—*i.e.*, elements which can afterwards be dissociated by ordinary chemical processes. The accepted elements, it is true, have not been so dissociated; but it is clear something has been done to indicate the compound nature of at least some of these.

The theory of the possible existence of iron as a quasi element when fused with other elements of like nature clashes with the generally received ideas of chemical combinations or solution; because undoubtedly these are formed.

Granting that chemical combinations likewise take place, does it not seem probable that when these latter are present they may be strictly termed impurities?

If so, iron alloys may be divided into two classes—(1) those in the homogeneous or fourth state, "the true alloys," (2) those in which chemical combinations or solution only takes place; and this latter class may be termed impure metal, in contradistinction to the first or quasi elementary body.

In conclusion it is urged that many of our most eminent metallurgists and men of science have "by very different modes of investigation" come to the conclusion that iron itself is a compound very complex body. It is true that we have only indirect proof of this, but it only remains to find methods of isolating these bodies from each other.

NOTES.

THE medals of the Royal Society are this year awarded as follows:—The Copley Medal to Prof. Rudolph Virchow, For. Mem.R.S., for his investigations in Pathology, Pathological Anatomy, and Prehistoric Archæology; the Rumford Medal to Mr. Nils C. Dunér, for his Spectroscopic Researches on Stars; a Royal Medal to Mr. John Newport Langley, F.R.S., for his work on Secreting Glands, and on the Nervous System; a Royal Medal to Prof. Charles Pritchard, F.R.S., for his work on Photometry and Stellar Parallax; the Davy Medal to Prof. François Marie Raoult, for his researches on the Freezing Points of Solutions, and on the Vapour Pressures of Solutions; the Darwin Medal to Sir Joseph Dalton Hooker, F.R.S., on account of his important contributions to the progress of Systematic Botany, as evidenced by the "Genera Plantarum" and the "Flora Indica," but more especially on account of his intimate association with Mr. Darwin in the studies preliminary to the "Origin of Species." The award of the Royal Medals has been graciously approved by the Queen.

THE American Ornithologists' Union has been holding its tenth congress at Washington. The meetings began on Tuesday, and were held in the U.S. National Museum.

JAMES PLANT, F.G.S., of Leicester, who has just died in his seventy-fifth year, was well known as a local geologist in the midland counties, and as a member for some years of the Committee of the British Association on Erratic Blocks. Such blocks are numerous in Leicestershire, those on the southern side of the county being chiefly derived from the Charnwood range, and Mr. Plant was diligent in searching out and recording the more important of them. Several large boulders striated and partially polished stand in the grounds of the Leicester Museum, rescued by him from various railway cuttings. In 1868 he collected a very fine series of massive specimens representing all the hard rock formations of his native county, for exhibition at the meeting of the Royal Agricultural Society. These were afterwards built up into a great cone about 8 feet in diameter and 15 feet high in the museum grounds, and when the enlargement of the building necessitated its removal they were formed into a diagrammatic geological section on another site. Having to be again removed two years ago some of them were used to form a rough geological model of Charnwood Forest in the Abbey Park. In his latter years Mr. Plant acted as consulting geologist in several important borings for water and coal. The curious concentric rings on the face of a rock in Charnwood Forest interested him greatly, and with much trouble and labour he succeeded in obtaining plaster casts of them. He was active also in procuring photographs of many of the most remarkable geological features of the district.

DR. R. V. WETTSTEIN, of Vienna, editor of the *Oesterreichische Botanische Zeitschrift*, has been appointed ordinary Professor of Botany at the University of Prague.

THE Prussian Government has decided to introduce the use of the Centigrade thermometer instead of that by Reaumur, which is still in use in some parts, and no further Reaumur thermometers are to be supplied to any public officials. The Centigrade thermometer has long been in use in Germany for scientific purposes.

A VALUABLE collection of fossils, minerals, and shells, comprising several thousand specimens, and particularly rich in specimens from the carboniferous formation, has just been presented to the University College of North Wales by Mr. Evan Roberts, of Manchester. It is hoped that this gift will become the nucleus of an important geological collection suited to the educational requirements of a University College, and that similar gifts will from time to time be made to the College by those interested in the progress of geological study.

THE Oxford Medical Society held its first meeting on Saturday last, at the University Museum. Sir Henry Acland presided. The inaugural address was delivered by Sir James Paget. He said they all knew that the practice and science of medicine, or, as it was sometimes called, the science and art of medicine, were by some regarded as things quite distinct, wide apart, and in study almost incompatible. A few there were who had the capacity of pursuing both. The great mass of those engaged in the pursuit of medicine were either practitioners or men devoting themselves to science. Each method of work was essential to the practice of the other. It might be asked how could practitioners work as men of science even where they had the time for it? He believed that would come about by the increase in the teaching of science in all medical schools and Universities. He pointed out the work which might be undertaken by the society, and spoke at length on various subjects which might be studied with advantage. Prof. Burdon-Sanderson said the society had been established for the furtherance and promotion of science, and they wished to make an advance, so to speak, towards the University. There was a yearning in the minds of the medical profession in Oxford to unite itself more closely than it had hitherto with the scientific studies of the University which depended immediately on medicine.

THE weather has continued very unsettled during the past week, the most notable features being the prevalence of fog and abnormally high temperature. During the latter part of last week fog extended over nearly the whole of England, as well as a large part of the Continent. In London and the suburbs intense darkness occurred on several days, interspersed with very short intervals of sunshine, but in the north-western parts of the kingdom the weather was generally fair. These conditions were due to the distribution of pressure, which was cyclonic over the western portion of these islands, but anti-cyclonic over western Europe. Temperature was uniformly high for the season, the daily maxima ranging from about 50° to 60°, and reached 62° in several places in the southern counties on Monday. This maximum is the highest that has been recorded in the neighbourhood of London during the last ten years. In the early part of the present week a deep depression passed to the westward of Ireland from the Atlantic, causing southerly gales in the north and west, with rain in all parts of the country, the amount measured at Valencia Observatory on Monday exceeding an inch. On Tuesday afternoon a fresh depression reached our south-west coasts from the south-eastwards, while a trough of low pressure lay over the Bay of Biscay and France, causing further heavy rains and local fogs. For the week ending the 12th instant the reports show that bright sunshine was, as might have been expected, very deficient generally, especially over northern and eastern England, where the percentage of possible duration was only 9; the lowest amount was at Stonyhurst, where it was only 2 per cent. The south-west of England enjoyed the brightest weather, as there the sunshine amounted to 33 per cent. of the possible amount.

THE current number of the *Annalen der Hydrographie* contains a short note of a hurricane at Marseilles on October 1, which is said to have been more severe than any experienced during the last thirty years. From 8 a.m. until 1 p.m. the wind, rain, hail and lightning were incessant, all the lower parts of the town being under water, while several houses and bridges in the neighbourhood were destroyed. The weather charts for the day show that the storm was caused by a small whirl which occurred on the south-eastern side of a large depression, whose centre lay in the south of Scotland. While the centre of the depression scarcely altered its position, the whirl increased in extent, but diminished in intensity, and on October 3 it had crossed Northern Italy and lay over Hungary.

MR. CHARLES CARPMAEL, director of the meteorological service of the Dominion of Canada, urges in his latest report the need for more thorough inspection of the various stations under his control. He points out that the stations in Great Britain and Ireland, connected with the Meteorological Office, London, are constantly inspected, and that in every country where meteorology is worked out on a large scale inspection is admitted as the only system whereby trustworthy and satisfactory results can be obtained. He recommends therefore that a sufficient appropriation should be placed at his disposal to enable him to have the meteorological stations in the Dominion inspected and the observers thereof thoroughly instructed in the duties required of them. If this is not done the data furnished to the Central Office cannot, he says, be accurate.

TWO numbers have now been issued of the new series of the quarterly cryptogamic journal, *Grevillea*, under the editorship of Mr. G. Massee. It is conducted very much on the old lines, and contains many articles of interest to cryptogamists. It is strange that one peculiarity of the journal should still be retained which detracts very much from its usefulness as a work of reference, the absence of any table of contents or index to each separate number.

THE Cambridge University Press has issued the Sedgwick prize essay for 1886, by the late Thomas Roberts, on the Jurassic rocks of the neighbourhood of Cambridge. The essay has been edited by Mr. Henry Woods, Scholar of St. John's College, and Lecturer on Palæontology in the Woodwardian Museum. In an interesting preface, Prof. T. McKenny Hughes explains the nature of the problem which the author endeavoured to solve, and expresses his belief that the work is indispensable for the student of Cambridge geology, and most valuable for all specialists in the Jurassic rocks.

SIR HENRY H. HOWORTH has completed and will shortly publish a considerable work on which he has been long engaged entitled, "The Glacial Nightmare and the Flood." It begins with an account of the various theories which have been forthcoming to explain the drift phenomena, in which the very large literature on the subject has been for the first time condensed and tabulated. It then proceeds to criticize the extreme glacial views which have recently prevailed among geologists, and to call in question the theory of uniformity as developed by the followers of Lyell and Ramsay, and especially to attack the notion that ice is capable of distributing materials over hundreds of miles of level country, and of producing many of the effects attributed to it by the glacial school of geologists. The author argues that the evidence points to the former existence of much larger glaciers than exist now, but not to an ice period when the temperate regions were covered with ice. On the contrary, these great glaciers existed side by side of fertile plains. Lastly he argues that the phenomena of the drift can only be explained by reverting in a large measure to the diluvial theories of Sedgwick and Murchison, Von Buch and others, and that the purely geological evidence is completely at one with that collected in the author's previous work on "The Mammoth and the Flood," and establishes that a great diluvial catastrophe forms in the temperate zones the dividing line between the mammoth age and our own.

THE Libraries Committee of the Glasgow Town Council, in the eleventh general report on the Mitchell Library, Glasgow, make a suggestion which deserves to be kept in mind. It is to the effect that an admirable way of perpetuating the memory of a relative or friend would be to present a public library with a separate collection of books, to be kept together and called by such name as may seem proper to the donors. "Such a memorial collection," say the Committee, "would, with propriety, be composed of books devoted to any department of literature or learning in which the person to be commemorated was interested or which the donors desired to see more fully represented."

A VALUABLE paper on the present state of Morocco is contributed to the current number of the *Revue Scientifique*, by M. A. Le Châtelier. He brings out very strikingly the mixed character of the population of Morocco. First he notes the fair-haired, blue-eyed type, which is represented in the sculptures of some tombs of the twelfth Egyptian dynasty. Then come the various Berber types, the Arabs, several elements (including the Draoua) which have come down from remote antiquity, Spanish Moors and Jews, and the descendants of Christian captives. M. Le Châtelier thinks we must also take into account descendants of Phenicians, Carthaginians, Romans, Byzantines, and Vandals.

MR. C. H. EIGENMANN has contributed to the Proceedings of the U.S. National Museum (vol. xv.) a paper in which he presents a valuable account of the observations made by him on the fishes of San Diego and vicinity from December 11, 1888, to March 4, 1890. Especial attention was paid to the spawning habits and seasons, the embryology, and migration of the fishes of Southern California. A diary was kept of the occurrence of each species throughout the year 1889 and part of 1890. Mr. Eigenmann's knowledge of the occurrence of each species is largely based on observations of the fish brought into the markets, which he visited twice or thrice daily, and of those caught with hook and line by the numerous habitual fishermen found on each of the wharves, and of those caught by the seiners, whom he accompanied on several occasions. During the early part of 1888 each individual fisherman sold his catch as best he could and the data for this part of the year are not as full as for the latter part of 1888, when practically the whole catch was brought to two markets, where Mr. Eigenmann could see the fish as they were unloaded. The knowledge of the ocean fishes is largely derived from frequent visits to ocean tide-pools, from the fish brought to the markets, and from a two-weeks' stay on the Cortes Banks. As a matter of course, hundreds of specimens of most species have been observed to every one preserved, and the present paper is to be looked upon as a contribution to the economic history of the fishes, rather than to the anatomy of the various species. With two exceptions, the types of the new species discovered, and otherwise interesting specimens, have been deposited in the U.S. National Museum. A nearly complete series of types has been placed in the British Museum, and minor series in the Museum of Comparative Zoology and the California Academy of Sciences.

THE Committee of the Field Naturalists' Club of Victoria have hit upon an excellent plan for interesting the more active members in definite lines of investigation. They have arranged that special meetings shall be held once a month for the carrying on of practical work which cannot conveniently be undertaken at the ordinary monthly meetings. The first of these special meetings assembled on August 22 in the Royal Society's Hall, Melbourne. We learn from the Club's journal that there was a good attendance of members, those interested in microscopic work being principally represented. No fewer than twenty-four microscopes were set up. Mr. J. Shephard undertook to give a slight sketch of some interesting forms amongst the rotifera. A typical form was first described, the chief points in its structure being made clear by good diagrams, and then variations in the various orders from this type were briefly referred to—special allusion being made to the modifications in the ciliary wreath and the foot. Mr. Shephard had fortunately met with a large number of the Australian member of the rhizotic group (*Lacinularia pedunculata*), and at the conclusion of his remarks a slide of mounted individuals was handed to each member for careful examination under the microscope. Half an hour was profitably spent in the endeavour to make out all the points of detail in the specimens, during which time Mr. Shephard also supplied full information as to the best methods of mounting and examining these interesting organisms. Some four or five entomologists had a quiet corner to themselves, where they compared specimens and talked over some plans for future operations.

AT the ordinary monthly meeting of the Field Naturalists' Club of Victoria, on September 12, the feather boots of a native rain-maker from M'Donnell Ranges were exhibited. It is believed among the natives of certain tribes in Central Australia that droughts are caused by the swallowing up of all moisture by a rain-devil. If this personage can be captured and made to disgorge, rain follows at once. The feather boots are worn by the native rain-maker in order that he may steal noiselessly and unawares on the author of the drought and consequent misery. Mr. A. W. Howitt is having drawings made of these boots, which he considers to be one of the most valuable and interesting additions to aboriginal ethnology yet brought to light.

AN interesting paper on the anthropology of Spain, contributed to the "Anales" of the "Soc. española de Historia Natural" by Luis de Hoyos Sáinz and Telesforo de Aranzadi, has now been published separately at Madrid. The paper is accompanied by three excellent maps, in which, by means of various degrees of shading, the authors bring together a number of most interesting conclusions. One of these maps shows the cranial types which prevail in different parts of Spain.

IN the November number of the *Mediterranean Naturalist*, Mr. John H. Cooke gives an interesting account of his recent discovery of Ursus arctos in the Malta Pleistocene. The late Admiral Spratt and the late Prof. Leith Adams found among the cavern deposits of the Maltese Islands a remarkable land fauna, including elephants, hippopotami, land tortoises, gigantic dormice, and aquatic birds. From the fact that many of the remains of elephants presented the appearance of having been fiercely gnawed, it was concluded that carnivoræ had lived in the district; but, notwithstanding the most diligent search extending over a period of twenty years, the only tangible evidences in support of the inference were these gnawed bones. Mr. Cooke has now solved the problem. His discovery was made in the spring of the present year, when, with the aid of a money grant from the Royal Society, he carried out some excavations in the Har Dalam cavern, a subterraneous gallery situated in a gorge of the same name in the eastern extremity of Malta. After having excavated six large trenches and obtained some hundreds of bones of *Hippotamus pentlandi*, *Elephas mnadraensis*, *Cervus barbaricus*, and numerous other animals, he had the satisfaction of discovering an entire ramus of the lower jaw of a bear, Ursus arctos with its canine and molars *in situ*, as well as five other canines belonging to other individuals of the same species. Afterwards four other canines were discovered, each of which was in a fairly perfect state of preservation. One of these Mr. A. S. Woodward has determined as belonging to the left side of the mandible of a species of *Canis* equalling a wolf in size. Associated with these remains were found several vertebræ and fragments of limb-bones of hippo, and vertebræ and portions of horns of stags; but none of them presented any evidences of having been gnawed.

THERE is some difference of opinion as to whether the process of digestion is promoted or hindered by bodily exertion. Herr Rosenberg recently made some experiments on a small dog with reference to this point (*Pflüger's Archiv.*). The animal was fed once daily with a certain quantity of lean horseflesh, lard, and rice, and the amount of nitrogen and fat daily absorbed was determined by an examination of the excreta. There were five series of experiments, each consisting of a rest period of several days, followed by a working period of several days, the dog being made to work in a kind of treadmill. In some cases these efforts were made during stomachic digestion, in others during intestinal. In both series of experiments the differences observed lay within the limits of physiological variations, the inference being, accordingly, that in a healthy dog the utilization of food is quite independent of whether the animal rests during digestion or is energetically at work. Whether this applies to man could only be determined by direct experiment. Herr Rosenberg thinks it probable, however, as observations on people with heart disease appear to show that the absorption of food is to a certain extent independent of the circulation and distribution of the blood.

THE characteristic mantle of ascidians, consisting of a ground mass with cellulose and embedded cells, has been much studied, especially with regard to the origin of the cells. The most favoured view is that it is produced by the ectoderm, that it is a thickening of the outer epithelium. Recent researches by Kowalevsky, however (described to the St. Petersburg Academy) give reason for believing that the mantle-cells are from the mesoderm. Studying the metamorphosis of *Phallusia mamillata*, he observed certain mesoderm-cells applying themselves to the ectodermal epithelium, penetrating it and entering the mantle, which (secreted from the ectoderm) was before quite transparent. These cells also move freely about in the mantle, and this amœboid movement is further in favour of their mesodermal nature. A similar process occurs in vertebrates, viz., the passage of lymph-cells (leucocytes) through epithelium to the surface of a mucous membrane, or the surface of the body (in fishes); the mucous layer is comparable to the ground mass of the mantle. But in vertebrates the cells at length disappear; whereas in ascidians they persist. Besides their share in the growth of the mantle, they have an important function as phagocytes. In compound ascidians certain individuals are every now and again perishing, and these dying parts are known to be absorbed by the mantle-cells. Also, incoming foreign bodies, such as bacteria, the cells attack and seek to destroy. Numerous bacteria are always present in the mantle of tunicata. Moreover, experiments were made by introducing bacteria through fine glass tubes inserted in the mantle; the mesoderm-cells collected round these tubes, entered them, and fought with the bacteria. Kowalevsky attaches great importance to this function, and supposes the above-mentioned passage of wandering cells to the surface of epithelia to be explained as a means of protection against the intrusion of agents of disease.

MR. L. STEJNEGER gives in the fifteenth volume of the Proceedings of the U.S. National Museum an interesting preliminary description of a new genus and species of blind cave salamander from North America. The discovery of a blind cave salamander in America is regarded by Mr. Stejneger as "one of the most important and interesting herpetological events of recent years." The discovery is primarily due to Mr. F. A. Sampson, who, in July last year, found the adult animal as well as a larva in the Rock House Cave, Missouri, and forwarded both to the U.S. National Museum. Mr. George E. Harris afterwards went to great trouble in order to procure additional specimens. Unfortunately, he has only succeeded so far in obtaining larvæ, but Mr. Stejneger hopes to be able to secure more adults. A more detailed anatomical description of this interesting animal is postponed until then, as he has not felt justified in mutilating the type specimen beyond what was necessary in order to ascertain the character of the vertebræ. The present preliminary description is, therefore, only prepared in order to call attention to the discovery and to supply the diagnosis by which the animal may be identified.

DR. MORRIS GIBBS contributes to *Science* an interesting paper on the food of humming-birds. He has carefully dissected many humming-birds, both old and young, but has never found anything to convince him that the birds live on insects. It may be that at times when flowers are scarce some species of insects are captured, but Dr. Gibbs is satisfied that in season, when flowers are abundant, the ruby-throat of Michigan lives on honey.

IN a recent investigation of the action of accumulators, Herren Neumann and Streintz have shown (*Wied. Ann.*) that lead has the power of absorbing hydrogen. In one case the metal was used as an electrode, and charged with electrolytic hydrogen; in another it was melted, and a current of hydrogen passed through it. Care must be taken that the charged metal is not in contact with air, as the oxygen of the latter then unites with the hydrogen; and this, the authors think, is why previous observers have not been able to prove an occlusion of hydrogen by the lead plates of accumulators. The authors examined other metals, and they give the following numbers for the gas absorbed per unit volume of metal:—Lead, 0·15; palladium, 502·35; spongy platinum, 29·95; platinum black, 49·30; gold, 46·32; silver, 0·00; copper, 4·81; aluminium, 2·72; iron, 19·17; nickel, 16·85; cobalt, 153·00. When the same pieces of metal were repeatedly used, the occluding power generally fell off; in the case of the noble metals this is thought to be due to increased density; but why the occluding power of iron and cobalt should be reduced to one-half or more was not explained. Nickel and copper retained their power. With regard to the high power of cobalt, the authors tried that metal in a voltameter, but curiously it showed no hydrogen polarization when the charging circuit was opened.

MESSRS. WILLIAMS AND NORGATE'S Natural Science Catalogue (No. 9) includes classified lists of books and periodicals on mathematics, astronomy, meteorology, physics, electricity, chemistry, microscopy, optics, mechanics, engineering, technology, &c., in French, German, and other foreign languages.

THE opening meeting of the one hundred and thirty-ninth session of the Society of Arts was held yesterday (Wednesday) evening. The following arrangements have been made for the ordinary meetings:—November 23, "The Disposal of the Dead," by F. Seymour Haden; November 30, "The Copper Resources of the United States," by James Douglas; December 7, "The Chicago Exhibition, 1893," by James Dredge; December 14, "The Utilization of Niagara," by Prof. George Forbes, F.R.S. The following papers, for which dates have not yet been fixed, will be read:—"Transatlantic Steamships," by Prof. Francis Elgar; "The Detection and Estimation of Small Proportions of Inflammable Gas or Vapour in the Air," by Prof. Frank Clowes; "The Purification of the Air Supply to Public Buildings and Dwellings," by William Key; "Pottery Glazes: their Classification and Decorative Value in Ceramic Design," by Wilton P. Rix; "The Chemical Technology of Oil Boiling, with a Description of a New Process for the Preparation of Drying Oils, and an Oil Varnish," by Prof. W. Noel Hartley, F.R.S.; "The Mining Industries of South Africa," by Bennett H. Brough; "Ten Years of Progress in India," by Sir William Wilson Hunter; "Australasia as a Field for Anglo-Indian Colonization," by Sir Edward N. C. Braddon, Agent-General for Tasmania; "Indian Manufactures," by Sir Juland Danvers, late Public Works Secretary, India Office; "Caste and Occupation at the last Census of India," by Jervoise Athelstane Baines, Imperial Census Commissioner for India; "Mexico, Past and Present," by Edward J. Howell; "Newfoundland," by Cecil Fane: "New Zealand," by W. B. Percival, Agent-General for New Zealand. The following courses of Cantor lectures will be delivered on Monday evenings, at eight o'clock: Prof. Vivian Lewes, "The Generation of Light from Coal Gas" (four lectures, November 21, 28, December 5, 12); Dr. J. A. Fleming, "The Practical Measurement of Alternating Electric Currents" (four lectures, January 30, February 6, 13, 20); Prof. W. Chandler Roberts-Austen, F.R.S., "Alloys" (three lectures, March 6, 13, 20); Lewis Foreman Day, "Some Masters of Ornament" (four lectures, April 10, 17, 24; May 1); C. Harrison Townsend, "The History and Practice of Mosaics" (two lectures, May 8, 15). A special course of six lectures, under the Howard bequest, will be delivered on the following Friday evenings at eight o'clock: Prof. W. C. Unwin, F.R.S., "The Development and Transmission of Power from Central Stations" (January 13, 20, 27; February 3, 10, 17).

THE additions to the Zoological Society's Gardens during the past week include a Squirrel Monkey (*Chrysothrix sciurea*) from Guiana, presented by Mrs. K. Betts; a Brown Capuchin (*Cebus fatuellus* ♀) from Brazil, presented by Miss L. Blackburn; a Himalayan Bear (*Ursus tibetanus* ♀) from Burmah, presented by Major W. H. Cunliffe; a Herring Gull (*Larus argentatus*) British, presented by the Rev. Sidney Vatcher; a Goshawk (*Astur palumbarius*) captured at sea, presented by Capt. F. Manley; an Egyptian Vulture (*Neophron percnopterus*) from Africa, presented by Mr. J. L. Teage; two —— Buntings (——) from North Africa, presented by Lord Lilford, F.Z.S.; eighteen Filfola Lizards (*Lacerta muralis* var. *filfolensis*) from the Island of Filfola, eighteen Wall Lizards (*Lacerta muralis* var. *tiliguerta*), an Ocellated Sand Skink (*Sepsocellatus*), a Moorish Gecko (*Tarentola mauritanica*), a Turkish Gecko (*Hemidactylus turcicus*) from Malta, presented by Capt. Robert A. Threshie; a Common Kite (*Milvus ictimus*) from Spain, received in exchange; five Dingos (*Canis dingo*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE NEW COMET.—The weather has prevented observations of the new Comet. Its brightness is about that of the nebula in Andromeda, and it has been suggested that it is a return of Biela's Comet.

COMET BROOKS (AUGUST 28).—The following is a continuation of the ephemeris of Comet Brooks for the present week, extracted from *Astronomische Nachrichten*, No. 312:—

12*h*. *Berlin M.T.*

1892.	R.A. app. h. m. s.	Decl. app. ° ′	Log *r*.	Log Δ.	Br.
Nov. 17	10 25 3	−2 35·2			
18	29 40	3 34·7			
19	34 20	4 34·8			
20	39 3	5 35·3	0·0674	9·9568	20·51
21	43 48	6 36·2			
22	48 36	7 37·5			
23	53 27	8 39·0			
24	10 58 20	9 40·8	0·0540	9·9483	22·70

The unit of brightness occurred on August 31.

The motion of this comet will be noticed from the above ephemeris to be very rapid in a southerly direction, amounting to about 1° per day.

THE LIGHT OF PLANETS.—The question as to whether the light of planets is capable of casting shadows must have, especially during the last few months, been in the minds of many, and perhaps many observations have already been made, but unfortunately not published. With regard to this question, *L'Astronomie* for November contains two notes, the first of which, communicated by M. Marcel Moye on August 30, relates to the planet Mars. His observations were made just before the meridian passage and in a room where the light of the planet could enter the open window. In this way white paper invisible in the corners of the room was easily distinguished when placed on the wall opposite the window, while one could see well the shadows between the fingers of the hand; placing a newspaper in the light of Mars only the place of the table and the number of the words could be recognized, but not read, as was the case with Jupiter. M. Moye concludes then that Mars certainly casts shadows, less strong than those of Jupiter but still appreciable.

In the note on the light of Venus M. Léon Guiot tells us that on August 29, when about to get up to observe Jupiter, he was astonished at the brilliancy of the light that entered his window. Observing his watch, which was hanging on the wall, he was actually able to trace its shadow on the wall, for he says that all was visible as in the light of the moon; one could even read the newspaper. It was about this time that Venus was constantly seen with the naked eye in full daylight.

STELLAR MAGNITUDES IN RELATION TO THE MILKY WAY.—Prof. Kapteyn is the author of an important memoir, which is published in the *Bulletin du Comité International Permanent* pour l'execution photographique de la carte du ciel, relative to an observed systematic difference between the photographic and visual magnitudes of stars depending on their distance from the Milky Way. Prof. Kapteyn first noticed that a difference existed in 1890, but in the present paper he presents a preliminary account of the results he has obtained. The clichés which have been under examination were exclusively those made at the Cape Observatory for the chart mentioned above. In this discussion he has adopted the two following laws: (1) that increasing the time of exposure in the proportion of 1 to 2·5, the fraction of a magnitude gained is 0·7, and (2) the atmospheric extinction of actinic rays rises to 2½ above the visual rays. Since there is an undoubted difference between the photographic and visual magnitudes, denoting this difference by the symbol Δm, the author commences to investigate whether this quantity is ever equal to zero, that is when the photographic and visual magnitudes are equal, and if so to find the locus of these points. Charting the points down on a map and connecting them up by means of curves, the latter are found to follow in a striking manner the path of the Milky Way. Table II. gives the values of Δm obtained from several clichés, and the positive values lie without exception between these two curves, while the negative ones are situated without. Taking into consideration both bright and faint stars, that is stars from the 4th to the 10th magnitude, the author finds that there a strong relation depending on their galalactic latitude exists between them, whether they be even very near or distant from the Milky Way, and the same systematic variation of Δm apparently holds good, being represented by the formula

$$\Delta m = a + \kappa\beta$$

β representing the galalactic latitude and $\kappa = -0^{m}\cdot0099 \pm 0^{m}\cdot0010$.

In seeking for an explanation of the difference, Prof. Kapteyn investigates each possible cause singly. His conclusion, to state briefly, amounts to this, that, if one considers the stellar magnitudes given in the "Uranometrique" and in Gould's "Catalogue of Zones" (it is from these two sources that he has obtained the visual magnitudes) to be correct and not subject to systematic errors amounting sometimes to as much as half a magnitude, then it must be concluded that the light of the stars situated in the Milky Way or in its vicinity is much richer in actinic rays than those at considerable galalactic latitudes. We may remark that the publication of this paper has been purposely hurried owing to the importance of the matter therein, but although sufficient observations have not been taken in account for a very rigid investigation, Prof. Kapteyn hopes to eliminate many of the difficulties and accidental errors by the discussion of clichés of different regions of the sky, differing in galalactic latitudes, made at equal altitudes, on similar plates, with equal lengths of exposure.

THE CANALS OF MARS.—The late opposition of Mars, and the re-observation of the doubling of the canals has brought forward many theories relative to this very curious phenomenon. There seems to be no doubt now that this doubling is not due to instrumental deficiencies, or even to an optical delusion caused by the fatigue of the eyes; but that it is a real observed fact and therefore requires a rigid explanation. Omitting the now well-known hypotheses suggested up till quite lately, the most recent is that put forward by M. Norman Lockyer and which is recorded in NATURE, vol. xlvi. p. 448. Mr. Lebour also (NATURE, vol. xlvi. p. 611) points out the likeness of these markings to the cracks produced in glass broken by torsion, adding that the chief characteristic features in the Mars' lines are there produced. In *Comptes rendus* (No. 18) for October 31 M. Stanislas Meunier relates another possible cause, and illustrates the phenomenon experimentally. The experiment is as follows:—He takes a polished metallic surface and on it traces a series of lines and spots, representing as nearly as possible the Martial surface as seen by us, and illuminates it all by sunlight. He then stretches at some distance (a few millimetres) from it a fine transparent piece of muslin. Looking at the surface through this medium he finds that all the lines and spots are doubled, and, "se germiner par suite de l'apparition, à côté de chacune d'elles, de son ombre, dessinée sur la mousseline par la lumière que le métal a réfléchie." A fact observed by M. Schiaparelli is that the canals when doubled are not always exactly parallel, and that sometimes there is an "aspect de nébulosité." These and other peculiarities are, according to M. Meunier, reproduced by simply undulating the muslin. His explanation is that the solar light is reflected from the planet's surface very unequally, that from the continents exceeding that emitted by the deeper parts, seas and canals. Although the atmosphere is a limpid one, we are unable to see its motions; but if, as he says, the ærial envelope includes a transparent veil of fog at a suitable height, a contrast would be produced, as was the case with the muslin, by the production of shadows "qui pour une œil placé ailleurs que sur le prolongement des rayons réfléchis, à côté de chacune des surfaces peu réfléchissantes, une image pareille à elle." This explanation of the phenomena of shades by reflection if valid should of course hold good for the planet Venus when properly situated, and that it is not observed on the Moon is only another proof that our satellite has no atmosphere.

GEOGRAPHICAL NOTES.

THE *Revue Française* states that a subterranean town, laid out with regular streets in a series of great caverns, near Karki, on the right bank of the Amu-daria, has recently been explored. Pottery and metal work were found amongst the ruins, and from the coins and inscriptions seen the town must have been occupied at least as early as the second century B.C.

BY the new constitution of the United States of Brazil the seat of government is to be transferred from Rio de Janeiro to a site upon the central plateau where an area is to be marked off as a federal district. A scientific mission under Senor Cruls has been appointed to examine the region where the three rivers, Sao Francisco, Tocantins, and Parana, take their rise at an elevation of over 3,000 feet, with the view of finding a suitable site for the new capital.

MR. D. J. RANKIN communicates to the *Scottish Geographical Magazine* an account of his journey up the Zambesi in 1890-91, with a map of the country between the Zambesi and Shire. He found the Zambesi freely navigable for light-draught steamers as far as the Acababassa Falls, more than 300 miles from the sea, the Lupata narrows presenting no difficulty. Between Lupata and Acababassa extensive coal deposits occur, and these are sure to become valuable. Beyond the falls after a portage of about thirty miles, the Zambesi is again navigable to Zumbo, and thence for a distance of 300 miles up the Loangwe river.

A NOMINATION to the geographical studentship of £100 in the University of Oxford will be made at the end of Hilary term, 1893. Particulars of the appointment may be obtained from Mr. Mackinder, the Reader in Geography.

TWO sudden deaths of men known in connection with minor exploration and geographical writing are announced. Mr. Theodore Child, author of "South American Republics" and other works, died of cholera at Ispahan, and Lieutenant Frederick Schwatka, who has travelled extensively in Alaska, committed suicide in Portland, Oregon.

MR. PRATT, whose departure for the head-waters of the Amazon was announced in this column at the time, has been compelled to relinquish the expedition on account of ill-health, and is now in this country.

AT the first meeting of the Royal Geographical Society the certificates of 106 new members, including 15 ladies, were read. This is the largest number seeking admission into the society which has yet been proposed at one time.

DR. NANSEN'S ARCTIC EXPEDITION.

DR. FRIDTJOF NANSEN opened the session of the Royal Geographical Society on Monday night by a description of his plans for crossing the north polar region, and received a most enthusiastic reception from a crowded audience. His scheme involves two separate considerations: (1) the direction of the prevailing polar currents, and (2) the means by which these currents can be utilized for transporting an expedition. All attempts to reach the pole by Smith Sound, by the east coast of Greenland, and by the north of Spitzbergen have been complicated by contrary currents; the few expeditions by way of Bering Sea, although equally unsuccessful, have had the currents in their favour.

Taking into account all the available data, it appears that the polar current between Greenland and Spitzbergen carries southward between 80 and 120 cubic miles of water every twenty-four hours. The Gulf Stream drift may carry 60 or 70 cubic miles of water a day into the polar basin north of Nova Zembla, about 10 or 14 cubic miles daily probably flow in through Bering Strait, and possibly about one cubic mile a day of fresh water pours in on the average from the great Siberian rivers. This comparatively small addition of fresh water must account for the salinity of the Greenland outflowing current being somewhat less than the average salinity of the North Atlantic. Theoretically there would thus appear to be a current running from near the New Siberian Islands towards the north of Greenland.

The existence of such a current is strongly indicated by the drift of the *Jeannette* from 71° 30′ to 77° 15′ N. after being caught in the ice, this drift being northwestward from Bering Strait. Again, articles lost on the sinking of the *Jeannette* in the latter position off the New Siberian Islands were found on an ice-floe near Julianehaab, in the south of Greenland. A throwing-stick, of a kind made only by the Eskimo of Alaska, was found a few years ago near Godthaab, on the west of Greenland. Siberian driftwood is stranded regularly on the coasts of Greenland, and even on the north coast of Spitzbergen. These facts can only be accounted for by the theory of an ocean current across the polar basin. The evidence of the relative thickness of ice in different parts of the Arctic Sea, and of the occurrence of Siberian diatoms in the mud of ice-floes between Greenland and Iceland is strongly confirmatory.

Dr. Nansen intends to make the northwesterly current transport him across the middle of the polar basin, and so give him an opportunity for making scientific observations nearer the pole than has ever previously been done. He will sail next June *via* the Kara Sea for the New Siberian Islands, thence work a way as far north as possible; when stopped, he will run into the ice, and await the time when he will be drifted into the open sea again between Greenland and Spitzbergen. He has had a ship built in Norway expressly for the voyage. Her form is such as to cause the ice, on closing round, to lift her out of the water, and she will rest upright on its surface. This vessel, named the *Fram* (*i.e.* Forward), is built of very long-seasoned timber, and is more strongly put together than any other vessel of her size. The frame timbers are of great thickness, and set close together, so that if all the planking were stripped off the vessel would remain water-tight. The planking is first a ceiling of pitch pine, alternately 4 and 8 inches thick, then outside two layers of oak, 3 and 4 inches thick respectively, and over all is an "ice-sheathing" of from 3 to 6 inches of the hard and slippery greenheart. The sides are thus from 28 to 32 inches thick of solid wood. The decks are equally strong, and the cabins are planned so as to be isolated by store rooms and coal-bunkers from the sides, while non-conducting materials such as cork, felt, and reindeer hair are introduced between the walls or decks and the rooms to guard the crew from cold.

The vessel is sharp fore and aft, and both propeller and rudder may be lifted in wells so as to avoid risk of fouling the ice. The rudder is deeply immersed when in action, so that floating ice will not touch it. Both stem and stern overhang greatly, and are heavily plated with iron to crush and cut through thin ice. The length of keel is 101 feet, and the length of deck over all is 128, while the greatest beam (exclusive of ice sheathing) is 36 feet, and the depth 17 feet. These proportions are very unusual, but were adopted as the result of experience in other ships. With light cargo she will draw 12 feet, and fully loaded 15½, the displacement being about 800 tons. She is rigged as a three-masted schooner, with square sails on the foremast, and has an engine of 160 indicated horse-power. The crow's nest on the maintopmast is 105 feet above the water-line, so as to give a wide horizon for the look-out. Two large decked boats are carried, in either of which the whole crew of twelve men could live if the ship were lost. Dogs, sledges, ski, several small boats, canvas for building extra boats on an emergency, and provisions for five or six years are taken. A pendulum apparatus is included in the scientific outfit, which is otherwise very complete. The ship is fitted with electric light; the dynamo may be worked by a windmill when coal can no longer be spared, or as a last resort it can be driven by a capstan arrangement adapted for four men, thus supplying healthy exercise and useful work to one-third of the crew, and abundant light to the remaining two-thirds.

The duration of the voyage cannot be estimated, as it will entirely depend on the rate of drifting, which must vary considerably from year to year, but judging from the movement of the *Jeannette* relics, two years ought to suffice.

A REMARKABLE CASE OF GEOMETRICAL ISOMERISM.

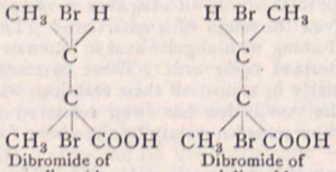
AN exceptionally interesting memoir is contributed to the current number of *Liebig's Annalen* by Prof. Wislicenus of Leipzig, who has latterly identified himself so earnestly with the subject of molecular configuration. It has been suspected for some years that there are two isomeric unsaturated acids of the composition $C_4H_7.COOH$. One of these substances exists in the free state in the roots of *Angelica archangelica* and has therefore received the name of *angelic acid*. The other compound is found along with angelic acid in Roman oil of cumin and has been termed *tiglic acid*. These two acids, moreover, behave so similarly in almost all their reactions with other substances that the conclusion has been rendered inevitable that they must be represented not only by the above formula, but by the same constitutional formula, $CH_3.CH:C\left\langle\begin{matrix}CH_3\\ COOH\end{matrix}\right.$. That the two acids are not identical, however, was indicated by certain slight differences of behaviour, and Prof. Wislicenus felt convinced that the two were in fact geometrical- or stereo-isomers, the difference consisting in a different arrangement of their various radicle groups in space. He considers it probable that the nature of the difference may be represented in one plane by the following formulæ:

$$\begin{array}{c} CH_3-C-H \\ \| \\ CH_3-C-COOH \\ \text{Angelic acid.} \end{array} \quad \text{and} \quad \begin{array}{c} H-C-CH_3 \\ \| \\ CH_3-C-COOH. \\ \text{Tiglic acid.} \end{array}$$

Judging from previous experience of the behaviour of other geometrical isomers of a similar nature, it appeared probable that the halogen addition products of the two acids would exhibit differences so marked as to determine definitively the separate nature of the two acids. Under the direction of Prof. Wislicenus, therefore, one of his pupils, Herr Pückert, undertook the investigation of the bromine addition products of angelic and tiglic acids, and was successful in showing that the two products were essentially different, exhibiting properties indeed so dissimilar that their identity was entirely out of the question. Although their similar constitution was indicated by melting-points differing by only one or two degrees, yet it was found that the crystals of the dibromide of angelic acid immediately reacted with water with production of a colourless oil, whilst the dibromide of tiglic acid remained unchanged in contact with water; moreover, the two compounds upon decomposition of their sodium salts, yielded two mono-brom-pseudo-butylenes, which differed essentially in their capability of reacting with alcoholic potash.

In the year 1890, however, Prof. Fittig, of Strassburg, who had previously investigated the subject in conjunction with Herr Pagenstecher, and had obtained *identical* bromine addition products from the two acids, published a paper in the *Annalen* in which he sought to show that the results of Herr Pückert were incorrect, and that the two substances were identical. Prof. Fittig has since requested Prof. Wislicenus to withdraw the work or substantiate it, and further charges Prof. Wislicenus with seeing facts through the veil of his theory. Unfortunately Prof. Wislicenus has been unable hitherto to meet the attack owing to domestic loss and serious illness, but at last he is able to publish the results of a really classical piece of work which he has carried through himself, and which not only demonstrates the truth of Herr Pückert's conclusions, but places the results beyond all criticism, and shows the singular cause of Prof. Fittig's inability to repeat them. It is indeed remarkable, but nevertheless true, that the fate of the theory of geometrical isomerism has actually been trembling in the balance owing to the different situation of the draught cupboards in the Leipzig and Strassburg laboratories. In the former laboratory they are placed *between* the windows, and in deep shadow; in the Strassburg laboratory they are *against* the windows, and are consequently brightly illuminated in daylight. Now Prof. Wislicenus shows that the dibromide of angelic acid is only formed in the absence of bright light, *rays of daylight intensity being absolutely fatal to its formation*. Hence Prof. Fittig only obtained the relatively more stable dibromide of tiglic acid, which in a good light is yielded by both angelic and tiglic acids. As the case is so remarkable, it may perhaps not be uninteresting to give a brief summary of the work of Prof. Wislicenus.

During the course of other researches concerning geometrical isomers, it was found that in order to obtain addition-products in which no internal re-arrangement of atoms had occurred, it was necessary to observe three conditions. One must operate at the lowest possible temperature, exclude light as much as possible, and take care that the halogen to be added is always present in tolerably large excess. When these three conditions are observed, the two respective and distinct bromine addition-products of angelic and tiglic acids are always obtained. They are probably represented by the formulæ—



Dibromide of angelic acid.   Dibromide of tiglic acid.

The operation of preparation is best conducted as follows:—A quantity of bromine, at least half as much again as is required by theory, and dissolved in three times its weight of carbon bisulphide, is placed in a flask surrounded by iced water. The flask is fitted with a triply bored caoutchouc stopper, through one hole of which is inserted a thermometer, through a second an exit tube furnished with a calcium chloride drying tube, and through the third the end of a burette containing a solution of pure angelic or tiglic acid in five times its weight of carbon bisulphide. The draught cupboard is darkened as much as possible and then the acid solution is slowly allowed to run into the flask. After the expiration of a few hours the formation of the brominated compound is complete, and the carbon bisulphide may be evaporated away in a rapid stream of dry air.

The difference between the two compounds is apparent even at this early stage, for the tiglic compound commences to crystallize long before the removal of all the carbon bisulphide, and soon forms a snow-white mass of crystals. On the contrary, the angelic dibromide shows no sign of crystallization, remaining as an oil for some time after the removal of all the carbon bisulphide. Eventually it crystallizes to a hard yellowish mass. The only solvent from which it was found practicable to recrystallize the angelic dibromide was the pentane fraction of petroleum ether boiling at 33°–39°.

The melting-point of pure angelic dibromide is 86·5–87. That of tiglic dibromide is 87·5–88. The two substances behave quite differently upon resolidification. The former congeals to a transparent resinous mass, whilst the latter forms an opaque solid.

The most striking difference is apparent in their respective behaviour towards water. The dibromide of tiglic acid is only slightly soluble in water, and dissolves unchanged, crystallizing out again upon evaporation. The dibromide of angelic acid, however, instantly combines with the equivalent of one molecule of water, to form a curious unstable liquid, an oil of high refractive power, which is somewhat soluble in excess of water, and is again deposited upon evaporation. This liquid compound is also formed when the dibromide is exposed to moist air, while the dibromide of tiglic acid is not changed in a moist atmosphere. In dry air the angelic liquid compound again dissociates into the dibromide and water vapour. In fact the dibromide of angelic acid would appear to act as an excellent indicator of the hygroscopic state of the atmosphere.

The two dibromides show a further difference in solubility, the angelic compound being far more readily soluble in all the solvents experimented with.

Finally the crystals of the two compounds, although both belonging to the triclinic system, are absolutely unlike. From measurements made by Dr. Fock, they are shown to exhibit different forms, entirely different angles, and different disposition of optic axes.

From the above description it will be quite evident that the two compounds are certainly not identical.

In conclusion, Prof. Wislicenus gives the results of attempts to obtain the dibromide of angelic acid in bright sunshine in the open air, then when working in front of a window, and again when the experiment was performed upon a table in the centre of the laboratory. In the first case, instead of the angelic compound, 92·8 per cent. of the dibromide of tiglic acid was obtained, in the second case 89·6, and in the third case 88·7 per cent. These results render it perfectly clear why Prof. Fittig could not obtain the angelic compound in his experiments, and they also show how it is possible for two chemists, both working with a desire to ascertain the truth, occasionally to obtain results apparently at complete variance with each other.

A. E. TUTTON.

MARINE LABORATORIES IN THE UNITED STATES.[1]

ONLY in comparatively recent times has the tremendous importance of the bearing of the invertebrates upon the general questions of biology been appreciated. We have seen that some work was done upon these animals at an early date, when the minds of workers were not much troubled by theoretical considerations, but the study of the adult forms is so small a part of a real understanding of these animals that it was unsatisfactory work, and never became popular among investigators until embryological methods had been introduced.

Dr. Brooks has remarked that "nearly every one of the great generalizations of morphology is based upon the study of marine animals, and most of the problems which are now awaiting a solution must be answered in the same way."[2] We find the reason for this in the fact that the biology of the present day is a study of vital phenomena and of natural laws governing living things. The importance of the invertebrates depends, therefore, upon the fact that in them life exists under simplified conditions, affording opportunities for the study of questions for which higher forms are, with our present knowledge, too complex.

As the study of invertebrates has extended, it has become more and more desirable to have more favourable conditions for this work, more abundant facilities for collecting and oppor-

[1] Reprinted from "Biological Teaching in the Colleges of the United States," by John P. Campbell, Professor of Biology in the University of Georgia; issued by the U.S. Bureau of Education.
[2] Johns Hopkins University Circulars, vol. vi., p. 37.

tunities for studying animals alive. Much of the early work was done upon specimens collected and stored in museums, but workers, both in this country and Europe, had frequently made excursions to the seacoast for the purpose of studying the invertebrate forms constituting so large a part of the marine fauna.

The unsatisfactory nature of this work was of course evident. Suitable accommodations and working appliances could not be provided under these circumstances, and desirableness of establishing permanent seaside laboratories was early felt. Nothing was done, however, in this country until 1871, when John Anderson, a wealthy citizen of New York, presented to Prof. Agassiz the island of Penikese in Buzzard's Bay, together with the sum of $50,000 with which to found a seaside station for the study of marine life. Another friend gave him a yacht of 80 tons burden for use in collecting. Agassiz had long wished for such a laboratory, and no one but himself could have aroused the necessary enthusiasm for carrying out the project. He soon set to work and built large aboratories, with suitable accommodations for a large number of workers. In 1873 they were opened for work. This constituted the first opportunity enjoyed by American students of studying marine animals in their native waters, with proper appliances for work. It inaugurated a new era in scientific research, being the first outward expression of an idea which has since taken a firm hold upon the investigators of the country. The death of Agassiz in December, 1873, put an end to the project. The buildings were used but two seasons and then abandoned.

Of this laboratory Prof. Whitman says :—

"At the close of the second and last season at Penikese, in 1874, Alexander Agassiz appealed to the colleges and all interested boards of education for support; but all in vain, for not a single favourable reply was received, and so his intention to remove the laboratory to Wood's Holl was never carried out. Thus that great and memorable undertaking, after absorbing money enough to build and equip a most magnificent laboratory, was abandoned from lack of interest on the part of educational institutions rather than of means. Such a failure, it must be frankly confessed, is not one to inspire confidence, but its explanation removes the apparent grounds for discouragement. It was the marvellous personality of Prof. Agassiz that made Penikese a possibility. It was his magic influence that created that school, his commanding individuality that organized and vitalized it. All interests centred in him so completely that with his sudden removal the enterprise was left without a soul. The school had no coherency except in his magnetic power and intellectual strength, and the moment these elements of stability were withdrawn, collapse followed as a natural and inevitable consequence. Then, too, it should be remembered that Prof. Agassiz lived just long enough to demonstrate the impracticability of maintaining such a school in such a locality, but unfortunately not long enough to convince the scientific world of its utility. The school was an experiment; its master was stricken down before it could be fairly tested, and the times were not ripe for it."

The establishment of this laboratory was an event of the greatest significance because of its bearings upon the history of education. Not only was Penikese the first biological station established in this country, and, indeed, in the world, but it was the beginning of the summer-school movement which has spread so generally over the country, and which, it should be noted, began with original research and finally extended to include the work of elementary instruction.

The movement met with the cordial support of naturalists everywhere, and was almost immediately followed by the establishment of Dohrn's magnificent station at Naples. Soon after, in 1875, a seaside station was established at Helder by the Netherlands Zoological Society, and other smaller ventures followed in Europe.

The need of opportunities for seaside study in the United States was too generally felt by those who had come under Agassiz's influence for the project to be allowed to stop. The advantages of this method of work over museum study had impressed themselves at least upon a few workers, and accordingly we find several attempts made to found new laboratories. They differed in character and aims, but all agreed in being founded upon the one idea of studying marine animals in their native waters.

The most direct successor of the Penikese laboratory is the private laboratory of Prof. Alexander Agassiz at Newport. While this building is constructed on a much smaller scale than that at Penikese and is open only to a limited number of workers, yet it is prominent for the elegance of its appointments and its conveniences for work.

The first laboratory for seaside study established in this country after the abandonment of Penikese was maintained by the Peabody Academy of Sciences, under the guidance of Prof. Packard, with the co-operation of Prof. Kingsley and others. This laboratory was for elementary instruction rather than research, and remained in existence only from 1876 to 1881.

In 1878 the trustees of the Johns Hopkins University made an appropriation to allow a party of workers to spend some time in seaside study. The party was under the guidance of Dr. W. K. Brooks, who had himself been a pupil of Agassiz and a member of the Penikese laboratory. The location selected was at the lower part of the Chesapeake Bay, from which the name of Chesapeake Zoological Laboratory was chosen. No permanent buildings were erected, as it was intended, if possible, to change the location from year to year; but an outfit of boats and collecting apparatus was provided. The summers of 1878 and 1879 were spent about the lower part of Chesapeake Bay at Crisfield, Md., and Fort Wool, Va., at which places special attention was given to the development of the oyster.

At the opening of the third season, in 1880, the need was felt of a locality that would offer a greater variety of objects for study, and accordingly the summers of 1880–82 were spent at Beaufort, N.C. This locality proved especially favourable, since sand bars, mud flats, salt marshes, and land-locked salt water, within easy reach, gave a large variety of different rare forms, and there was also abundant ocean dredging. A sufficient appropriation was made in 1880 to purchase a steam launch and a sloop, which put the workers in a position to take every advantage of their opportunities.

In 1883 a special study of oyster beds made a return to the mouth of the Chesapeake Bay necessary, and that season was spent at Hampton, Va., but the following two seasons were again spent at Beaufort.

In 1886 the need of a more southern location was felt, and the Bahama Islands seemed to offer an inviting field. The summer of 1886 was therefore spent at Green Turtle Cay, and the following summer at Nassau, New Providence.

Financial difficulties temporarily stopped the work of the laboratory, but it is announced that it will be reopened in the summer of 1891.[1]

It is difficult to summarize the work of this laboratory, and none the less so to over-estimate its importance. It enjoys the distinction of being the first marine laboratory ever carried successfully into operation in the United States, and its work was entirely original research. The character of work done differed from year to year, according to the facilities which the different localities offered; but in general it may be said that embryology received most attention, while considerably less was devoted to the discovery and description of new species. The methods employed, as well as the new facilities enjoyed, made it possible to apply effective means of solution to many problems previously obscure, as well as opening many questions in regard to which nothing had been done.

Of the lasting value of the work it is perhaps too early to speak, but the fact that over one hundred papers, based upon work there performed, have readily found publication in the best journals of this country and Europe, as well as the fact that much of the work has already found its way into standard textbooks, gives strong testimony to its value.

The Chesapeake Zoological Laboratory may be regarded as the successor of the Penikese laboratory to the extent that its aims are the same, but it differed in not being generally open to the workers of the country. Arrangements were not made for large numbers, and those who were present were mainly students of the Johns Hopkins University. During the nine years that this laboratory remained in existence, there were in all fifty investigators present, and the average length of each session was nearly two months.

The need was felt, especially in that portion of the country where Agassiz's influence was more directly exerted, of establishing a laboratory on a larger scale, and open to a larger

[1] Shortly after the above was written, Kingston, Jamaica, was chosen as a suitable locality, and a party of advanced workers, numbering about fourteen in all, were present from May until September.—September 21, 1891.

number of workers, and the first step taken in this direction was the founding of a laboratory by the Boston Society of Natural History. In their report for 1881 these words occur:

"It has been considered desirable to found a summer laboratory sufficient to supply the needs of a class of persons who have begun to work practically under our direction, but have hitherto had no convenient means for pursuing their studies on the seashore. . . . . We are sure that such a laboratory is needed for a limited number of persons, such as our own pupils in natural history, and some of the teachers of the Boston public schools, about a dozen in all, but we are not sure of any real demand outside of these."

Arrangements for laboratory work were speedily made at Annisquam, Mass. Boats and appliances for collecting were at once provided, and in the spring of 1881 a circular was issued announcing the opening of the new laboratory. From this the following extracts are taken:—

"The liberality and co operation of the Woman's Educational Association enable the Boston Society of Natural History to announce that a seaside laboratory, under the direction of the curator (Prof. Alpheus Hyatt), and capable of accommodating a limited number of students, will be open at Annisquam, Mass., from June 5 to September 15.

"The purpose of this laboratory is to afford opportunities for the study and observation of the development, anatomy, and habits of common types of marine animals, under suitable direction and advice. There will, therefore, be no attempt during the coming summer to give any stated course of instruction or lectures.

"It is believed that such a laboratory will meet the wants of a number of students, teachers, and others who have already made a beginning in the study of natural history."

Twenty-two persons were attracted to the Annisquam laboratory during its first season. Prof. Hyatt, in his report for 1882, remarks as follows:—

"The great need of an institution for teaching field work cannot be properly estimated by the number of those who are attracted by the opening of such opportunities for study. The mental condition of those who attend, and what it has done for them, and the sphere of influence which it reaches through them, are the only true standards by which its present and future usefulness can be properly measured. Nearly all the pupils were persons who could be termed 'well educated;' nevertheless they were, with the exception of some who had already worked in the laboratory or field, entirely unable to obtain knowledge with their own eyes and hands, and had even acquired a notion that this was not possible for anybody except the trained man of science. Several of these teachers, after their work was finished, expressed their gratefulness for the new powers the course had developed in themselves, and the fascinating pleasure they had experienced in learning to use their own eyes and hands in the study of things hitherto unapproachable for their uncultivated senses except through the deceptive mediation of books. When it is remembered that these teachers influence and mould the minds of thousands of young persons it is at the same time proved that what this laboratory has done and can do is not to be estimated by the nnmber of its own pupils."

The success of the undertaking seemed assured, and arrangements were made for its continuance during the five years following. The number of students fluctuated greatly, falling to ten in the third year, and running up in the sixth year to twenty-six.

During these six years the laboratory was carried on jointly by the Boston Society of Natural History and the Woman's Educational Association of Boston. It has been the policy of both of these associations to originate new enterprises, but to turn them over when well started into other hands. It seemed in 1887 that the time had come when the maintenance of the laboratory should be put on a firmer basis. It had been supported long enough to demonstrate its practicability and usefulness. The demands upon it had increased. It was no longer an experiment. The associations believed that a permanent organization should be effected, the working facilities increased, and the whole established on a larger scale. Moreover, it seemed that something more might be done to give the laboratory a wider sphere of usefulness in advancing knowledge of marine like. Great as was its work in teaching, it seemed to depend for its support upon a circle of people too small for the extent of its benefits. It seemed desirable that a change should come which would lead to a more widespread interest in the laboratory, and bring together more investigators. The Marine Biological Laboratory was the result of this movement.

While space will permit but a brief account of this laboratory, its history, development, aims, &c., it may be said that the one point which distinguished it from the Annisquam laboratory was the prominence given to research. Students are received, but from the outset there has been a settled determination to so adjust the claims of each as to secure the greatest amount of efficiency and do most to advance science. The organization was therefore effected so as to secure a permanent staff of investigators, who would always be present, increasing knowledge by their own work, and by their example stimulating others to follow. Moreover, the principle was thoroughly recognized that the best investigation is prompted by the work of teaching. The best investigator is often the best teacher, but the work of teaching reacts upon the work of investigation, influencing it for the better.

The experience of the laboratory shows that these points, which had previously been carefully considered, were well taken. Various means were resorted to for providing funds, and in March, 1888, the laboratory was incorporated.

Wood's Holl was chosen as a locality because of its convenience, accessibility, and the variety of its land and marine flora and fauna. The building was at once begun, and finished in time for work during the summer. Circulars could not be issued until after most of the colleges had disbanded for the summer, and yet during the first season seven investigators and eight students were attracted to the laboratory.

In subsequent years the growth has been a steady one. The number of workers has greatly increased, and even now, when only its third season has been passed, it is stated that the space is insufficient to meet the demands upon it; the facilities for collecting are too small, and the staff of instructors is not large enough for their classes. Its usefulness is now established, and the time is ripe for it. To it in great measure the United States must look for the advancement of biology. Let us hope that its trustees, all of whom are working biologists, may be successful in placing the laboratory upon such a financial basis that its full possibilities for usefulness may be realized.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Hill, Master of Downing College, has been appointed Chairman of the Natural Science Tripos Examiners for 1893. An election to an Isaac Newton Studentship in Astronomy, Astronomical Physics, and Physical Optics, will be held in the Lent term 1893. Candidates must be B.A.'s, and under twenty-five years of age on January 1. The emoluments are £200 per annum for three years. Applications are to be addressed to the Vice-Chancellor between January 17 and 27, with testimonials or other evidence of competency.

Dr. Lorrain-Smith, M.D. Edin., Demonstrator of Physiology at Oxford, and Dr. F F. Wesbrook, M.D., Manitoba, Professor of Pathology at Winnipeg, have been elected John Lucas Walker Students in Pathology. The Managers express their high approval of the valuable researches conducted by the late student, Dr. A. A. Kanthack, of St. John's College. The State Medicine Syndicate state that, at the two examinations held in April and October, 1892, there were in all sixty-four candidates, of whom thirty-five received Diplomas in Public Health. The fee in future will be five guineas for each of the two parts of the examination in State Medicine.

Examinations for open scholarships and exhibitions in Natural Science will be held in twelve of the Colleges in December and January next. A list giving the conditions and value of the scholarships is published in the *University Reporter* of November 12, pp. 198, 199.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 10.—Refraction and dispersion of light in metal prisms, by D. Shea. Thin prisms of gold, silver, nickel, and cobalt were prepared by the electrolysis of cyanide solutions by Kundt's method. Prisms of platinum were also prepared by the disintegration of platinum foil. A piece of foil 4 mm. broad and 0·02 mm. thick placed perpendicularly to a piece of plate glass at a distance of 0·5 mm. produced under the action of a current of 20 amperes a double wedge-shaped layer of oxide in half an hour.

This was easily reduced by a Bunsen flame, so as to represent a metallic prism with an angle of some 20 seconds. Only one in twenty of the prisms could be used, and only one in 200 silver or gold prisms. The source of light was a zirconium burner with a red shade transmitting light of the mean wave-length $64 \times 10^{-}$ cm. The index of refraction was found to vary with the incidence. For perpendicular incidence the following values were found: Au 0·26, Ag 0·35, Cu 0·48, Pt 1·99, Ni 2·01, Iron 3·02, Co 3·16. For silver the index was 0·39 at an incidence of 10°, 0·60 at 30°, 0·80 at 50°, 1·01 at 80°, and 1·03 at 90°. The following refractive indices for various wave-lengths illustrate the dispersion:

	Li, a	D	F	G
Au	0·29	0·66	0·82	0·93
Ag	0·25	0·27	0·20	0·27
Cu	0·35	0·60	1·12	1·13
Pt	2·02	1·76	1·63	1·41

—On a law of refraction for the entrance of light into absorptive media, by H. E. J. G. du Bois and H. Rubens.—On the infra-red emission spectra of the alkalies, by Benjamin W. Snow.—Absolute change of phase in light by reflection, by Paul Glan.—Inducti e representation of the theory of double refraction, by Franz Kolácek.—Studies in the electric theory of light, by D. A. Goldhammer.—On the passage of feeble currents through electrolyte cells, by Rud. Lohnstein.—On the m tion of the lines of force in the electro-magnetic field, by Willy Wien.—On the electric theory of magneto-optic phenomena, by D. A. Goldhammer.—An automatic interruptor for accumulators, by H. Ebert. This is to prevent the current from the accumulator exceeding the supply for which it is constructed. Two mercury cups are inserted in the circuit, connected by a piece of stout copper wire. The current next passes through an electro-magnet. As soon as the current reaches a certain strength the electro magnet overpowers an adjustable spring, and lifts the copper connecting-piece out of the cups.—Contribution to the history of the spheroidal phenomena, by G. Berthold.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 28.—Dr. J. H. Gladstone, F.R.S., past president, in the chair.—The discussion on Mr. Williams's paper, "On the relation of the Dimensions of Physical Quantities to Directions in Space," was opened by Prof. Perry reading a communication from Prof. Fitzgerald, president. The writer said Mr. Williams disagreed with the suggestion that electric and magnetic inductive capacity are quantities of the same kind principally because he had not got over the curious prejudice that potential and kinetic energy are different. No theory of the ether could be complete unless it reduced its energy to the kinetic form. Electric and magnetic inductive capacity would probably be found to be similar in the ether, and ultimately have the same dimensions. The analogies were not yet complete, but only in respect of *matter* was it probable that any difference existed between them. Diamagnetism corresponded to electrostatic induction, but paramagnetism had no definite electrical analogue. He was inclined to regard the phenomena of paramagnetism as connected with the arrangement of the material molecules, whilst diamagnetism depended on the electric charges on those molecules. So far no matter had been found which conducts magnetism, and such may not exist in our universe, but it may be gravitationally repelled by matter as we know it.—Mr. Madan remarked that in the first part of his paper Mr. Williams recognized that dimensional formulæ were originally change-ratios, but puts this aside for the higher conception which regards the e formulæ as expressing the nature of the quantity. Fourier showed how to find the dimensions of units by making the size of the fundamental units vary. But k (specific inductive capacity) did not vary with the fundamental units, for it was merely the ratio of the capacities of two condensers, and therefore, by Mr. Williams's definition, a pure number. It was difficult, he said, to see how k could have dimensions, but Mr. Williams regarded it as a physical quantity, and therefore possessing dimensions. The object in giving dimensions to k and μ seemed to be to get over the double system of units. Mr. Madan did not think that dimensions could express the nature of physical quantities, and said differences of opinion existed amongst authorities on this point. For example, Dr. J. Hopkinson, at the last B.A. meeting, said that because a co-efficient of self-induction had the dimensions of length it must be a length, whilst other learned professors objected to this view. Even if one admitted that dimensions are a test of the nature of physical quantities it was not necessary that the two systems of units should be identical. The connecting link between the two systems was $Q = C\,t$, and the validity of this equation had been questioned. If this objection be confirmed, then there would be no current in electrostatics and no Q in the electromagnetic system, and the units would not clash. Referring to dynamical units, Mr. Madan pointed out that two units of mass were used in astronomy, but astronomers got over the difficulty by using a co-efficient. Dimensional formulæ, he said, are the result of a convention that certain definitions should hold true generally, but they contain no further information respecting the nature of the quantities beyond that involved in those definitions. As an example of the inability of such formulæ to express the nature of quantities, he pointed out that whilst physical differences were known to exist between + and − electricity the dimensional formulæ showed so signs of such differences.—Prof. Rücker said every correct physical equation consisted of a numerical relation between physical quantities of the same kind, and might be written either as a mere numerical equation or as a relation between the physical quantities themselves. The equation $2 + 1 = 3$ may correspond to 2 feet + 1 foot = 3 feet, and the latter may be written $2[L] + 1[L] = 3[L]$, where $[L]$ represents the unit of length. So far as he was aware, nobody but a recent writer in the *Electrician* had denied that in such an equation $[L]$ represented a concrete quantity. Maxwell explicitly stated that it does in his article on "Dimensions" ("Encyl. Britt.") and elsewhere, and Prof. J. Thomson, in his paper on the same subject, makes no statement contrary to this. The above equation might also be written 2[feet] + 1[foot] = 1[yard]. Another equation involving time is 60[sec.] = 1[minute], and dividing one by the other one gets

$$\tfrac{2}{60}\left[\frac{\text{foot}}{\text{sec.}}\right] + \tfrac{1}{60}\left[\frac{\text{foot}}{\text{sec.}}\right] = 1\left[\frac{\text{yard}}{\text{min.}}\right].$$

A difficulty was felt here in understanding what dividing a foot by a second meant; but this difficulty Prof. Rücker considered was not greater than that involved in dividing an impossible by a real quantity, a very familiar analytical device. Reasons for regarding the symbols $\left[\frac{\text{foot}}{\text{sec}}\right]$ as legitimate were then given. Prof. Henrici said the communication under discussion was one of the most important contributions to physical science which he had come across for a long time. Such difficulties as presented themselves in the paper arose from its fundamental character. The author had attempted to express all physical quantities in terms of three, but quantities may exist which cannot be completely represented in terms of L, M and T. The tendency of modern mathematics was to express everything dynamically. Mathematicians had long been in the habit of using quantities which were neither numbers nor concretes in the ordinary sense, and different kinds of algebra with units not understandable had been developed. If a quantity, a times a unit u, be multiplied by b times another unit v, the result is expressed by $ab\ uv$, where ab is a number and uv a new unit which may or may not be physically interpretable. The interpretation of a product depended on the meaning attached to "multiplication," and if this be restricted to "repeated addition" the range is very limited. The narrow conceptions concerning multiplication acquired at school could only be removed by a careful study of vectors. Mr. Williams had treated his subject by vector methods, but a few traces of quaternions remained which might be omitted. To truly understand the subject, vectors must be treated vectorially. Dimensions might then show the nature of the quantities involved. The system adopted in Mr. Williams's paper was probably the best attainable at present, but he (Prof. Henrici) looked forward to the use of a more fundamental quantity than the vector—viz. "the point"—as the ultimate basis. Grassmann had worked out a "point calculus" in 1844, which was republished in 1880. Quantities more complex than vectors, viz. rotors, screws, motors, &c., had been used with advantage by Clifford, Ball, and others. Dr. Sumpner thought the first ideas of students on the subject of dimensions were that they represented the nature of the quantities, but could not see why every quantity should be expressed in terms of L, M and T. Prof. Rücker's paper on "Suppressed Dimensions" had cleared up several important points, and he (Dr. Sumpner) now considered that every quantity must be expressed in terms of a unit of the same kind as itself. He viewed Mr. Williams's attempt to express everything in terms of L, M and T, as rather a retrograde step. The discussion on Mr. Williams's paper was adjourned, and Dr. Young made some remarks on Mr. Sutherland's communication "On the Laws of Molecular Force." Mr. Sutherland, he said, thought that Ramsay and Young's law $\partial p/\partial T = f(v)$ is not correct for compounds in the liquid state. Barus, however, had proved that several liquids, including ether, only showed variations from the law at extremely high pressures. After writing the equation of the virial in the form $pv = RTvf(v) + v\phi(v)$, where $v\phi(v)$ stands for the internal virial term; the author of the paper had shown that $v^2\phi(v)$ ought to be constant, but, finding it not constant in the case of ether, &c., he attempted to explain the discrepancies by the formation of pairs of molecules at small volumes. Other substances, such as nitrogen and methane, were supposed to follow the law. This, Dr. Young said, could not be accepted as proved, for the range of volumes over which the experiments had been made was only small, and methane was difficult to prepare pure. After criticizing the use of two and sometimes three "characteristic equations" for the same substance, he went on to show that the formulæ given in the paper by which the critical temperatures, pressures and volumes might be calculated, lead to results differing from experimental numbers by quantities greatly in excess of experimental errors. Experiment also showed that capillarity had little or no effect on the determination of critical constants. Speaking of critical volumes he pointed out that MM. Cailletet and Mathias had published a method of finding critical densities which gave very accurate results. Mr. Sutherland's conclusions respecting Van der Waals's generalizations were practically identical with those expressed by Dr. Young in his paper on the subject, read before the Society last year. The views as to the nature of the various kinds of "pairing" mentioned in Mr. Sutherland's paper were open to serious objections, for his "physical pairing" is supposed to produce more effect on the "characteristic equation" than true chemical pairing. In his (Dr. Young's) opinion the idea of physical pairing appears somewhat speculative and requires further elucidation.—A paper on the determination of the critical density, by Dr. Young and Mr. A. L. Thomas, and two papers, on the determination of the critical volume, and on the boiling points of different liquids at equal pressures, by Dr. Young, were taken as read. The first paper gives an account of results obtained by Cailletet and Mathias's method, based on the fact that the means of the densities of a substance in the states of liquid and saturated vapour when plotted with temperature, lie on a straight line which passes through the critical point. In the paper on critical volumes the above-mentioned method is again referred to and results obtained thereby accepted in preference to those given by the author in his paper on Generalizations of Van der Waals, &c., read before the Society about a year ago. The alcohols do not strictly follow the straight-line law. Revised tables of critical volumes, densities, pressures, and temperatures are given, and it is pointed out that for many substances the ratio of the actual critical density to the theoretical density (for a perfect gas) is about 3·8. The paper on boiling-points of different liquids at equal pressures contains a comparison of the accuracies with which a formula for the relation between the boiling-points given by M. Colst (*Compt. Rend.*, cxiv. p. 653), and one by Ramsay and Young (*Phil. Mag.*, January 1886), accord with experimental results. The author concludes that the latter formula shows the best agreement, but that of M. Colst is satisfactory under certain conditions. The further discussions of Mr. Williams's and Mr. Sutherland's papers were adjourned till the next meeting.

Mineralogical Society, October 25.—At the Anniversary Meeting the following were elected Officers and Members of Council:—President, Prof. N. S. Maskelyne, F.R.S.; Vice-Presidents, Rev. Prof. S. Haughton and Dr. Hugo Müller, F.R.S.; Treasurer, Mr. F. W. Rudler, F.G.S.; General Secretary, L. Fletcher, F.R.S.; Foreign Secretary, Mr. T. Davies; Ordinary Members of Council, Prof. A. H. Church, F.R.S., Prof. Grenville A. J. Cole, Mr. T. W. Danby, Dr. C. Le Neve Foster, F.R.S., the Rev. H. P. Gurney, Mr. J. Horne, Prof. J. W. Judd, F.R.S., Prof. G. D. Liveing, F.R.S., Lieut.-General C. A. McMahon, Mr. H. A. Miers, Mr. F. Rutley, and Mr. J. J. H. Teall, F.R.S.—Dr. C. O. Trechmann detailed the results of the goniometrical measurement of two very perfect crystals of Binnite collected by himself in the Binnenthal. The measurements, besides adding a large number of forms to those previously recorded for this species, serve to establish the tetrahedral hemisymmetry of the mineral which has been left as a very doubtful feature by previous observers, and was denied by Hessenberg.—Mr. H. A. Miers and Mr. G. T. Prior announced the results of further researches on the rare silver minerals known as Xanthoconite and Rittingerite. According to their physical measurements and chemical analyses these two substances are identical, both having the same composition as Proustite, and crystallizing in rhombic-shaped tables belonging to the mono-symmetric system. The name Xanthoconite, given by Breithaupt, has the priority; the red-silver ores are now to be regarded as an isodimorphous (?) group consisting of the two sulph-arsenites Proustite and Xanthoconite, and the two sulph-antimonites Pyrargyrite and Fireblende. Previous determinations of the composition of Rittingerite and the crystalline form of Xanthoconite have been erroneous.—Mr. Fletcher gave a description of a new habit of Descloizite from the Argentine, and also an account of the new mineral Baddeleyite (native zirconia): the only fragment as yet found is part of a twinned crystal showing forms which belong to the mono-symmetric system: pleochroic: optically negative and biaxal with inclined dispersion: specific gravity 6·025: hardness 6·5.—Mr. Allan Dick contributed further remarks on Geikielite, supplementing his paper read at the previous meeting.—Prof. Judd exhibited photographs in illustration of his previous paper on the lamellar structure of quartz crystals and the method by which it is developed.—Mr. Rutley exhibited a large series of beautiful cardboard models illustrative of the symmetry and optical characters of the crystalline systems.—Mr. Miers exhibited specimens, including the rare mineral Turnerite from the Tintagel Slate quarries which he had visited in search of that mineral.

Zoological Society, November 1.—Sir W. H. Flower, F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the months of June, July, August, and September, 1892, and called special attention to a young Gibbon from Hainan, South China, of a uniform black colour, belonging to the species recently described by Mr. Oldfield Thomas as *Hylobates hainanus*, presented by Mr. Julius Neumann, and to a young male Malayan Tapir (*Tapirus indicus*) from Tavoy, Burmah, presented by Col. F. M. Jenkins.—Mr. E. Hartert exhibited (on behalf of the Hon. Walter Rothschild) examples of two new Mammals from New Guinea (*Proechidna nigro-aculeata* and *Acrobates pulchellus*), and a stuffed specimen of *Apteryx maxima* from Stewart Island.—A communication was read from Lord Lilford, giving an account of the breeding of a pair of Demidoff's Galagos in his possession.—Prof. Bell read a note on the occurrence of *Bipalium kewense* in Ireland.—Mr. Finn gave an account of his recent zoological excursion to Zanzibar.—Prof. Newton, F.R.S., exhibited and made remarks on a specimen of *Sylvia nisoria* lately killed in England.—Prof. F. Jeffrey Bell read a description of a remarkable new species of Echinoderm of the genus *Cidaris* from Mauritius, proposed to be called *C. curvatispinis*.—A communication was read from Sir Edward Newton, and Dr. Gadow, F.R.S., describing a collection of bones of the Dodo, and other extinct birds of Mauritius, which, having been recovered from the Mare aux Songes in that island by the exertions of Mr. Theodore Sauzier, had been by him entrusted to them for determination. The collection contained examples of the atlas, metacarpals, pre-pelvic vertebra, and complete pubic bones of the Dodo, which had before been wanting, as well as additional remains of *Lophopsittacus*, *Aphanapteryx*, and other forms already known to have inhabited Mauritius. Besides these there were bones of other birds, the existence of which had not been suspected, and among them of the following, now described as new:—*Strix* (?) *sauzieri*, *Astur alphonsi*, *Butorides mauritianus*, *Plotus nanus*, *Sarcidiornis mauritianus* and *Anas theodori*, the whole adding materially to the knowledge of the original fauna of Mauritius.—Mr. Oldfield Thomas gave an account of a collection of Mammals from Nyassa-land, transmitted by Mr. H. H. Johnston, under whose directions they had been obtained by Mr. Alexander Whyte.—Dr. Günther, F.R.S., read a paper descriptive of a collection of reptiles and Batrachians from Nyassa-land, likewise transmitted by Mr. Johnston, and containing examples of several remarkable new species, amongst which were three new Chameleons, proposed to be called

Chamæleon isabellinus, *Rhampholeon platyceps*, and *R. brachyurus*.—Mr. R. Lydekker read a memoir on some Zeuglodont, and other Cetacean remains from the Tertiaries of the Caucasus.—Mr. Martin Jacoby read the descriptions of some new genera and new species of Phytophagous Coleoptera from Madagascar.

Linnean Society, November 3.—Prof. Stewart, President, in the chair.—The Rev. Prof. Henslow exhibited an instrument used in Egypt for removing the end of the sycamore fig, and gave some account of the mode of cultivation.—Mr. A. Smith Woodward exhibited and made remarks on some supposed fossil lampreys (*Paleospondylus gunni*) from the old red sandstone of Caithness.—The Rev. E. S. Marshall exhibited some hybrid willows from Central Scotland, believed to be rare or new to Britain.—Mr. G. N. Douglass exhibited the train of a peahen which had assumed the male plumage. The bird, which was reared at the Castle Farm, Tilquhillie, near Banchory, N.B., was believed to be about thirty years old at the time of its death, and for some years previously had not laid any eggs. In the opinion of the exhibitor and others present the phenomenon was correlated with disease of the ovaries. Similar cases had occurred with fowls, pheasants, and black game, but not, so far as was known, with peafowl.—Mr. C. T. Druery exhibited some new examples of apospory in ferns, namely a specimen of *Athyrium filix fœmina var clarissima* with pinnæ showing development of prothalli by soral apospory, and a seedling *Lastrea pseudomas cristata*, showing prothalli developed aposporously over general surface of frond (pan-apospory).—Mr. J. E. Harting exhibited some live specimens of the short-tailed fieldvole (*Arvicola agrestis*), and gave an account, from personal inspection of the serious damage done by this little rodent upon the sheep-pastures in the lowlands of Scotland.—Mr. A. B. Rendle exhibited some seedling plants of the sugar-cane which had been raised in this country by Mr. Veitch.—The discussion on several of these exhibitions having continued until a late hour, a paper by Prof. Henslow, on a theoretical origin of endogens through an aquatic habit, was by consent adjourned to the next meeting of the Society, which will be held to-day.

Mathematical Society, November 10.—Prof. Greenhill, F.R.S., President, in the chair.—This was the annual general meeting and after the election of the gentlemen whose names are given on p. 616 (NATURE, vol. xlvi.) to serve on the council for the session 1892–93, the new President, Mr. A. B. Kempe, F.R.S., took the chair and at once called upon the retiring president to read his valedictory address. Prof. Greenhill took as his subject collaboration in mathematics.—The following further communications were made. Some properties of homogeneous isobaric functions, by E. B. Elliott, F.R.S. This paper is a sequel to one which the writer communicated at the June meeting entitled a proof of the exactness of Cayley's number of seminvariants of a given type. The earlier part of the present paper supplies omissions in the preceding one and in the remainder the theorem on which Mr. Elliott's argument was based is transformed, and the result examined for its own sake without reference to the particular application.—On certain general limitations affecting hyper-magic squares, by S. Roberts, F.R.S. The paper does not aim at making any addition to the known ways of constructing magic squares. Hyper-magic squares, as the writer regards them, include those called by M. E. Lucas "carrées diaboliques," and also treated by Mr. A. H. Frost under the designation of "Nasik squares." The special form is of ancient origin. The second method given by Moschopulus (thirteenth century) is a general one for forming such squares and they have been discussed by various modern authors. The writer's object is to show some limitations to which they are subject when the elements are positive or negative integers. Incidentally it appears that hyper-magic squares of oddly even orders cannot be formed of series of consecutive natural numbers. There is some reason for believing that much ingenuity has been fruitlessly employed in trying to form such squares. We may here mention that a very interesting historical essay on the subject of magic squares has been published by Dr. Siegemund Günther, in his work entitled "Vermischte Untersuchungen sur Geschichte der Mathematischen Wissenschaften" (Leipsic 1876). The subject has also been brought into connection with the "Geometry of Tissues," by M. Lucas and others (see the "Principii Fundamentali della Geometria dei Tessuti," par Edoardo Lucas, Torino, 1880).—Note on the equation $y^2 = x(x^4 - 1)$ by Prof. W. Burnside.—Note on secondary Tucker circles by Mr. J. Griffiths. The idea of this note sprang from the fact that if G, g, are two inverse points with respect to the circumcircle (ABC) whose centre is O *i.e.* such that $OG \times Og = R^2$, then the pedal triangles DEF, *def* of G, g, with regard to ABC are similar. Taking G to be one of the Brocard points, then (DEF) is a Tucker circle and (*def*) a secondary circle.—On a group of triangles inscribed in a given triangle ABC whose sides are parallel to connectors of any point P with A, B, C, by Mr. Tucker. If DEF, D′E′F′, are a pair of such triangles they are readily seen to be in perspective. Their properties are considered with reference to the principal points and lines of the modern geometry of the triangle.—A note on triangular numbers by Mr. R. W. D. Christie.

PARIS.

Academy of Sciences, November 7.—M. de Lacaze-Duthiers in the chair.—Letter addressed to the President by the committee formed to celebrate the seventieth birthday of M. Pasteur.—Influence of the distribution of manures in the soil upon their utilization, by M. H. Schlœsing.—Note on the reply of M. Berthelot to my note of October 24, by M. Th. Schlœsing.—Comparison of the magnetic observations of General Pevzoff in Central Asia with the data of the English magnetic charts, by M. Alexis de Tillo. General Michael Pevzoff, in his last exploring tour in Eastern Turkestan, made some careful determinations of magnetic declinations and inclinations. If these are compared with those published by M. Creack in the report of the *Challenger* expedition, it appears that in declination an average correction of $+ 1°.7$ has to be applied to the latter, while the inclinations are practically identical.—On the new triangulation of France, by M. L. Bassot. This work was commenced in 1870. It comprised the establishment of a continuous chain between the Spanish frontier and Dunkerque, supporting the net on three base lines, and attaching it as far as possible to each of the parallel chains of the old triangulation. Also a new determination of the co-ordinates of the Panthéon, the fundamental point of the triangulation, the measurements of base-lines in terms of the international metrical standard, and the calculation of the new arc of meridian. It was found that, starting from the Paris base-line, the network was verified at Perpignan, at a distance of 6°, to within 1 in 250,000. Where the French system meets the English, Belgian, and Italian systems, the correspondence is found practically perfect, but on the Spanish frontier there exists a difference of 1 in 65,000 at present unexplained. The arc between Dunkerque and Carcassonne, as now calculated, exceeds that of Delambre by 44·7m., or 1 in 20,000.—Essay on a general method of chemical synthesis, by M. Raoul Pictet.—On the fifth satellite of Jupiter, by M. E. Roger. From the empirical formula for the distances of Jupiter's satellites

$$\log \text{hyp}\, a = 8 - \frac{3m}{2\pi} - 0{\cdot}03 \cos \frac{m\pi}{5} + \epsilon$$

the probable distances of any satellites yet undiscovered can be calculated. It appears that there may be one at distance 1·97, two others at 1·61 and 1·27, or a single one at 1·425, and others beyond the outermost satellite. The distances of those already known are 2·50, 6·05, 9·62, 15·35, and 27·00.—On the transformations of dynamical equations, by M. Paul Painlevé.—Lenticular liquid microglobules and their conditions of equilibrium, by M. C. Maltézos. The smallest drops of a liquid jet falling upon another liquid often assume a lenticular shape, one surface of which is more curved than the other. These are called microglobules. Their diameters were measured, and their volumes and masses calculated. The production of microglobules in all the liquids in Quincke's table was experimented upon.—Effects of weight on fluids at the critical point, by M. Gouy.—Dilatation of iron in a magnetic field, by M. Berget. An elegant experiment to exhibit the lengthening of an iron bar on magnetization, on the principle of Newton's rings. The bar in question, provided with a cap of black glass, presses against the flat side of a plano-convex lens screwed to the same stand. The bar is surrounded by a coil, which can be excited by a battery of accumulators. Magnetization is at once indicated by the expansion of the rings. On the dissipation of the electric energy of the Hertz resonator, by M. V. Bjerknes (see *Wiedemann's Annalen*, No. 9).—On the equality of potential at the contact of two electrolytic deposits of the same metal, by M. G. Gouré de Villemontée.—On the rotating power of the diamine salts, by M. Albert Colson.—Volumetric determination of the alkaloids, by M. E. Léger.—On the fixation of free nitrogen by plants, by MM. Th. Schlœsing, jun., and Em. Laurent.—Observations on the preceding note, by M. Duclaux.—Observations on the preceding communications, by M. Berthelot.—On γ-achroglobine, a new respiratory globuline, by M. A. B. Griffiths.—On the axinite of the Pyrenees, its forms and its conditions of occurrence, by M. A. Lacroix.—On the subterranean river of the Tindoul de la Vayssière and the springs of Salles-la-Source (Aveyron), by MM. E. A. Martel and G. Gaupillat.—On the comparative anatomy of the stomach in Ruminants, by M. J. A. Cordier.—Remarks on some means of defence in the æolidians, by M. E. Hecht.—On the evolution of the brachial apparatus of some brachiopods, by MM. P. Fischer and D. P. Œhlert.—On the mechanism of solution of starch in plants, by M. A. Prunet.—On the diuretic and ureopoietic action of the alkaloids of cod-liver oil on man, by M. J. Bouillot.—Results obtained at the crystal works of Baccarat by the introduction of metastannic acid into putty powder, by M. L. Guéroult.

BERLIN.

Physiological Society, October 14.—Prof. Munk, president, in the chair.—Prof. Kossel gave an account of further researches on nucleinic acid, a compound which, in union with albumin, composes the proteids of the cell-substance. In earlier researches he had studied the acid as derived from yeast-cells and salmon-milt, and found that while the substances obtained from these two sources differed in many respects, they resembled each other in that the ratio of phosphorus to nitrogen was in both as 1 to 3, and that they both yielded nuclein-bases during their decomposition. More recent researches on the nuclein derived from the leucocytes of the thymus gland have shown that the nucleinic acid it yields is more like that from milt, and resembles the product obtained from yeast even less than does the product from milt. The relationships of nucleinic acid to the chromatin bodies of the histologists were minutely considered.—Prof. Gad brought forward a theory of the excitatory process in muscles, based upon the theory of Fick, but further developed and supported by experiments on tetanized muscles.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, NOVEMBER 17.

ROYAL SOCIETY, at 4.30.—On the Characters and Behaviour of the Wandering (Migrating) Cells of the Frog, especially in Relation to Micro-organisms: Dr. Kanthack and W. B. Hardy.—On the Colour of the Leaves of Plants and their Autumnal Changes: Dr. Hassall.—Stability and Instability of Viscous Liquids: A. B. Basset, F.R.S.—Observations on the Earthquake Shocks which occurred in the British Isles and France during the Month of August, 1892: Prof. Hull, F.R.S.

LINNEAN SOCIETY, at 8.—A Theoretical Origin of Endogens through an Aquatic Habit: Rev. Prof. Henslow.—On the Buprestidæ of Japan and their Coloration: G. Lewis.

CHEMICAL SOCIETY, at 8.—Fluo-sulphonic Acid: T. E. Thorpe, F.R.S., and William Kirman.—The Interaction of Iodine and Potassium Chlorate: T. E. Thorpe, F.R.S., and George H. Perry.—The Magnetic Rotation of Sulphuric and Nitric Acids and their Solutions: also of Solutions of Sodium Sulphate and Lithium Nitrate: W. H. Perkin, F.R.S.—Note on the Refractive Indices and Magnetic Rotation of Sulphuric Acid Solutions: S. U. Pickering, F.R.S.—Hydrates of Alkylamines: S. U. Pickering, F.R.S.—On the Atomic Weight of Boron: W. Ramsay, F.R.S., and Miss Emily Aston.—And other papers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Problems of Commercial Electrolysis: James Swinburne (Discussion.)

LONDON INSTITUTION, at 6.—Lincoln Cathedral (Illustrated): Rev. Canon Edmund Venables.

SUNDAY, NOVEMBER 20.

SUNDAY LECTURE SOCIETY, at 4.—How Weather Forecasts are arrived at, and how we should use them (with Oxy-hydrogen Lantern Illustrations): Arthur W. Clayden.

MONDAY, NOVEMBER 21.

SOCIETY OF ARTS, at 8.—The Generation of Light from Coal Gas: Prof. Vivian B. Lewes.

ARISTOTELIAN SOCIETY, at 8.—The Nature of Physical Force and Matter: R. J. Ryle.

LONDON INSTITUTION, at 5.—Respiration in Man and Animals (Illustrated): Hy. Power.

TUESDAY, NOVEMBER 22.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Halifax Graving-Dock, Nova Scotia: Hon. R. C. Parsons.—Cockatoo Island Graving-Dock, New South Wales: E. W. Young.—The Alexandra Graving-Dock, Belfast: W. Redfern Kelly.—Construction of a Concrete Graving-Dock at Newport, Monmouthshire: Robert Pickwell. (Discussion.)

WEDNESDAY, NOVEMBER 23.

GEOLOGICAL SOCIETY, at 8.—Outline of the Geological Features of Arabia Petræa and Palestine: Prof. Edward Hull, F.R.S.—The Marls and Clays of the Maltese Islands: J. H. Cooke.—The Base of the Keuper Formation in Devon: Rev. A. Irving.

SOCIETY OF ARTS, at 8.—Cremation as an Incentive to Crime: F. Seymour Haden.

THURSDAY, NOVEMBER 24.

INSTITUTION OF CIVIL ENGINEERS, at 2.30.—Students' Visits to the Gas Light and Coke Company's Chief Office, Horseferry Road, Westminster.

LONDON INSTITUTION, at 6.—The Ruined Cities of Mashonaland (Illustrated): J. Theodore Bent.

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY, at 5. Experiments in Electric and Magnetic Fields, Constant and Varying: E. C. Rimington and E. Wythe Smith.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Value of Hypnotism in Chronic Alcoholism: Dr. C. L. Tuckey (Churchill).—Guide to the Science of Photo Micrography, 2nd edition: E. C. Bousfield (Churchill).—Das Centralnervensystem von Protopterus Annectens: Dr. R. Burckhart (Berlin, Friedländer).—Aids to Experimental Science: A. Gray (Auckland, Upton).—The Outlines of Organic Chemistry: C. J. Leaper (Iliffe).—Théorie Mathématique de la Lumière: H. Poincaré (Paris, G. Carré).—A Sequel to the First Six Books of the Elements of Euclid, 6th edition: Dr. J. Casey, edited by P. A. E. Dowling (Longmans).—The Jurassic Rocks of the Neighbourhood of Cambridge: T. Roberts (C. J. Clay).—Fossil Plants as Tests of Climate: A. C. Seward (C. J. Clay).—The Collected Papers of Sir Wm. Bowman, Bart., F.R.S.: vol. 1, Researches in Physiological Anatomy, edited by Prof. J. Burdon-Sanderson; vol. 2, Surgical and Ophthalmological Papers, edited by J. W. Hulke (Harrison).—The Fayûm and Lake Mœris: Major R. H. Brown (Stanford).—Text-book of the Embryology of Man and Mammals: Dr. O. Hertwig, translated by Dr. E. L. Mark (Sonnenschein).

PAMPHLETS.—A Sanitary Crusade through the East and Australia (Glasgow, Boyle).—Geologische und Geographische Experimente; ii. Heft, Vulkanische und Massen-Eruptionen: E. Reyer (Leipzig, Engelmann).—The Gods of Greece, and other Translations: Dr. J. F. Whitty (Grocock).—First Series of Field-path Rambles round Bromley, &c.: W. Miles (Taylor).—Un Avance á la Antropologia de España: L. de Hoyos Sáinz and T. de Aranzadi (Madrid).—Appunti in Conferma delle Osservazioni Tromometriche: P. T. Bertelli (Torino, Giuseppe).

SERIALS.—Journal of the Royal Horticultural Society, vol. xiv.; Report of the Conifer Conference (London).—Himmel und Erde, November (Berlin, Paetel).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1892, No. 2 (Moscou).—Quarterly Journal of Microscopical Science, November (Churchill).—The Kansas University Quarterly, October (Lawrence, Kansas).

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