THURSDAY, OCTOBER 11, 1877

FLEISCHER'S "VOLUMETRIC ANALYSIS"

A System of Volumetric Analysis. By Dr. Emil Fleischer. Translated by M. M. Pattison Muir, F.R.S.E. (Macmillan and Co., 1877.)

THERE is no question that volumetric analysis does not yet play that important part in quantitative chemical analysis which it merits, and which on the appearance of Mohr's well-known "Titrirmethode" it was confidently anticipated that it would assume. The method of instruction commonly pursued in many of our large public laboratories is in a great measure to be blamed for this result. It is, of course, necessary that the student should be put through a thorough course of gravimetric analysis, in order that he may attain that manipulative dexterity without which he cannot hope to become a successful operator, and perhaps no branch of practical chemistry is better calculated to afford the requisite training and practice than the somewhat tedious process of weight analysis, with its innumerable separations, filtrations, washings, and weighings. But however excellent may be their educational value, and however accurate their results, there is no doubt that many of the gravimetric methods at present in common use when viewed as practical processes for every-day application, fall very far short of what is required of them. It not unfrequently happens that the busy chemist, uncertain whether a lengthy analysis will afford him, after all, the requisite information, hesitates to incur what he fears may turn out to be a useless sacrifice of valuable time, and hence, from the want of rapid and sufficiently accurate analytical methods, many weighty facts may have been, doubtless actually have been, overlooked. Indeed, it is a question whether some of these analytical processes have not done as much to retard the progress of chemical science as to advance it. The majority of chemical workers, especially those engaged in scientific research, have not made analysis a special study, and hence when they are under the necessity of making a particular determination, they are content with the time-honoured processes which they have learned in the course of their laboratory-training. It is only by the appearance of such works as the one before us that the greater number of chemists are made aware of the advances which quantitative chemistry has really made.

Mr. Muir has done a very considerable service to his chemical brethren by his translation of Dr. Fleischer's work, for if we are not mistaken, it is the first attempt at a rational system of volumetric analysis which has been offered to us in this country. The work is divided into three distinct parts. In Part I., which treats of the volumetric method, we have, in Section I., an account of the principles on which this branch of the art of analysis rests. The several forms of burettes, pipettes, and measuring flasks recommended by the author, are described, together with the methods for their calibration and verification. The modes of preparing and standardising the normal solutions are next described. Section II. treats of the ordinary alkalimetric and acidimetric processes. Section III. gives an account of the various methods depending upon oxidation and reduction; these are respectively designated as oxidimetric and iodometric methods. Lastly, in Section IV., we have a description of the more important precipitation methods, *e.g.*, Mohr's method of determining chlorine by standard silver solution, and Wildenstein's process for estimating sulphuric acid by a standardised solution of potassium chromate. There is little in this part which calls for special remark; we would, however, point out that in the discussion on experimental errors, the magnitude of which, as the student is vaguely informed, may in certain cases be calculated by the mathematical method of least squares, it is not very apparent from the description how certain of the errors are eliminated. Dr. Fleischer's language is either not very clear on the subject, or his translator has failed to catch its exact meaning. The account of a method of verifying a pipette given on p. 23 will be apt to puzzle a beginner, on account of the unfortunate confusion between burette and pipette. We fail to see the necessity for the retention of the Réaumur scale of temperature in a work intended for English readers; and we are constrained to protest, with all possible energy, against the introduction of a new standard of temperature. What particular significance has 14°·5 R. to us in this country? If we are not content to take the melting-point of ice or the point of maximum density of water as our standard, let us at least maintain our credit as a law-abiding people by conforming to the enactments of our Legislature. In these respects Mr. Muir has undoubtedly sacrificed his independence to his loyalty to his author.

Unquestionably the most distinctive feature of the work is seen in Part II.; indeed, this constitutes a most valuable addition to the art of chemical analysis. In this part the author describes a variety of volumetric processes by means of which a large number of acids and bases may be determined, either separately or when mixed. He has not attempted to describe all the methods which have been proposed for the determinations of the several constituents, but has given only those which he has himself found to be reliable and capable of general application. In Section II. of this part it is shown how each base may be determined by volumetric methods without previous group-separation. The substance to be analysed is obtained in solution by the appropriate methods (which are fully described), and is divided into as many portions as there are constituents to be determined. As the author tells us, "the process of analysis is thus much shortened, not only by the omission of group-separations, but also by the fact that but one or two filtrations at the most are necessary; in many instances no filtrations are required. The precipitates do not require the same long-continued washing which consumes so much time in the ordinary processes. Two circumstances more especially recommend the methods under consideration. Every estimation is readily controlled by repeating the process on the original liquid; the analyses of technical products in which one or more, but not all, of the constituents is to be determined, becomes a matter of ease, and can be carried out much more rapidly than when it is necessary to make a systematic separation of the metallic groups.' Lastly, in Part III. it is shown how these methods are applied to the analysis of a number of important techni-

cal products such as potashes, soap, gunpowder, bone-ash, superphosphates, metallic ores, alloys, &c.

We cannot close this notice of a book which is really a solid contribution to chemical literature without referring to a circumstance which greatly detracts from its value; indeed, we fear that in many cases it may prevent the recognition of its great merit. Dr. Fleischer, like the great apostle whose worthy disciple he is, praises the times which are past; he is of opinion that our modern system of notation is founded on the most daring hypotheses, and he believes that the distressing complexity which the formulæ erroneously styled "modern" have produced, and the phraseology which has accompanied them, far outweigh any slight advantage which they have bestowed upon science; he thinks that such formulæ, "even supposing that there is a 'shadow of a reason' for their existence as Mohr trenchantly remarks, are peculiarly unfitted for analytical chemistry and for mineralogy." *O tempora, O mores!* With such convictions we are not surprised that Dr. Fleischer should have insisted on the retention of the old formulæ, although he has not actually prohibited the introduction of the newer notation in the translation. Mr. Muir has something to say for himself on this point; we entirely agree with him that the objections raised by the author have been answered times without number. *Il sabio muda conscio.* We hope therefore that, should a second edition be called for, Dr. Fleischer may be persuaded to put the work more in harmony with the time; we feel bound to say that had he done so in the outset the appearance of this second edition might have been considerably accelerated. T.

HARTLAUB'S BIRDS OF MADAGASCAR

Die Vögel Madagascars und der benachbarten Inselgruppen. Ein Beitrag zur Zoologie der äthiopischen Region. Von G. Hartlaub. Pp. 425, 8vo. (Halle: Druck und Verlag von H. W. Schmidt, 1877.)

NOTHING can be more conducive to the progress of zoological science in any country than the issue of handbooks of the different branches of its fauna in a cheap and convenient form. Such publications bring home to a multitude of observers a *résumé* of the facts previously known only to a few, and such as are too often scattered over the pages of periodicals and other works which can only be consulted in an extensive library. Those who are acquainted with the vast advance made towards our knowledge of the Birds of India since the issue of Dr. Jerdon's Handbook will readily admit the truth of what we say and many other examples might be adduced of the beneficial effects of similar publications.

Dr. Hartlaub's "Birds of Madagascar," although an excellent and original scientific work, is quite of the "Handbook" character—that is it gives us a *résumé* of all that is yet known concerning the Avifauna of Madagascar and the appendent islands in a cheap and portable volume—such as may be conveniently carried in the hand of any naturalist visiting those regions. Fifteen years ago Dr. Hartlaub issued a volume of similar character,[1] but much smaller in dimensions. To understand how great has been the advance lately made in our knowledge of the birds of these regions, we have only to compare the "Ornithologischer Beitrag" of 1861 with the "Vögel Madagascars" of 1877. Since the publication of the former work Holland has sent forth Pollen and Van Dam, France Grandidier, and England Crossley and Newton, into that rich and still imperfectly explored field, from which every one of them has reaped an abundant harvest.

The "Lemurian Avifauna,"[1] according to Dr. Hartlaub, is now known to contain 284 species of birds. Of these 220 are found in Madagascar itself, and 104 out of these 220 are absolutely restricted to that island. Moreover, of these 104 birds not less than ninety are so abnormal in structure that it has been found necessary to refer them to peculiar genera. Compared with Madagascar itself the appendent island groups are poor in species, although in every case there are many interesting forms amongst their winged inhabitants. The Comoro Islands muster only some forty-four species[2] of birds, Mauritius about sixty, of which fifteen or sixteen have been introduced by man's agency, and Bourbon about the same number, while Rodriguez appears to have only about twenty-five species now existing in it, of which four or five are certainly recent introductions. But we cannot speak of the recent ornithology of these islands without a passing allusion to the singular forms—now mostly known to us by their fossil remains—which have become but very recently extinct, and the gradual rediscovery of which must ever rank among the most interesting scientific achievements of the present epoch. Besides the Dodo of Mauritius and its brother, the *Pezophaps*, of Rodriguez, we now know that divers curious parrots (*Necropsittacus* and *Lophopsittacus*) and extraordinary rails (*Miserythrus* and *Aphanopteryx*) lived in those islands not long ago, and that other strange fowls were found in the same company. Two of the remarkable forms of the Mascarene Islands (*Coracopsis mascarina* and *Fregilupus varius*) have indeed become exterminated so recently that examples of their skins are still to be found in some of our older museums.

Let us now see what Dr. Hartlaub's conclusions as to the general facies of the avifauna of Madagascar and its appendent islands point to.

"Many years ago," he tells us, "the late distinguished naturalist, Isidore Geoffroy St. Hilaire, remarked that, if one had to classify the island of Madagascar exclusively on zoological considerations, and without reference to its geographical situation, it could be shown to be neither Asiatic nor African, but quite different from either, and almost a fourth continent. And this fourth continent could be further proved to be, as regards its fauna, much more different from Africa, which lies so near to it, than from India, which is so far away. With these words, the correctness and pregnancy of which later investigations tend to bring into their full light, the French naturalist first stated the interesting problem for the solution of which an hypothesis based on scientific knowledge has recently been propounded.

"For this fourth continent of Isidore Geoffroy is Sclater's 'LEMURIA'—that sunken land which, containing parts of Africa, must have extended far eastwards over

[1] "Ornithologischer Beitrag zur Fauna Madagascars. Mit Berücksichtigung der Inseln Mayotte, Nossi-Bé und St. Marie, sowie der Mascarenen und Seychellen." 8vo. Bremen: 1861.

[1] Madagascar and its islands were proposed to be called Lemuria, in 1864, by Sclater, as being supposed remnants of the old "Terra Lemurum," wherein this peculiar form of mammalian life had its origin. The name has been adopted by Haeckel and other writers on Distribution.

[2] Since Dr. Hartlaub's work was published, an important addition has been made to the Avifauna of the Comoros by Mr. Edward Newton, in his memoir of the birds of the Island of Anjuian. (P.Z.S. 1877, p. 295 *et seqq.*)

Southern India and Ceylon, and the highest points of which we recognise in the volcanic peaks of Bourbon and Mauritius, and in the central range of Madagascar itself—the last resorts of the mostly extinct Lemurine race which formerly peopled it. When Wallace, whose utterances on this subject everyone must read with the greatest interest, puts forward a former junction of Madagascar with Africa as beyond doubt—a junction which, however, must have terminated before the inroad into Africa of the more highly organised mammals—everyone will allow this opinion to be at all events well founded. But when he proceeds to state that the fauna of Madagascar is manifestly of African origin, his assurances are based upon very slender grounds. In truth the individuality of the fauna of Madagascar is so unique that even that of New Zealand can hardly be compared with it. Wallace's attempted parallel between Madagascar and Africa, and the Antilles and South America is, in our eyes, sufficiently disproved by the occurrence in the Antilles of Trochilidæ, one of the most characteristic forms of South America. But in Madagascar not one single one of the genera most characteristic of Africa occurs. This originality of the fauna is much too pronounced to allow Madagascar to be treated of only as a 'sub-region' or as an 'aberrant part' of the Æthiopian region."

To prove this position, Dr. Hartlaub in his interesting introduction to the present work, recapitulates the points in which the avifauna of "Lemuria" approximates to that of India and diverges from that of Africa."

"But the negative evidence," he adds, "is still stronger in the same direction. The groups of Musophagidæ, Coliidæ, Lamprotornithinæ, Buphagidæ, Capitonidæ, Indicatoridæ, Bucerotidæ, and Otidinæ, so eminently characteristic of Africa, are entirely absent in Madagascar, besides the genera *Gypogeranus*, *Helotarsus*, *Coracias*, *Craterops*, *Irrisor*, *Bradyornis*, *Dryoscopus*, *Laniarius*, *Telephonus*, *Prionops*, *Platystira*, *Saxicola*, *Picathartes*, *Balæniceps*, and others, which are remarkably rich in individuals and species in Africa. Besides this, Larks and Chats, which in the African fauna are specially prominent on account of their numerous forms as well as regards their individual and specific abundance, are only represented by a single species in Madagascar itself, and in the rest of the sub-region not at all.

"In conclusion," Dr. Hartlaub adds, "if we take a glance at the families of the Madagascar sub-region as compared with those of Africa, four of these (Mesitidæ, Paictidæ, Eurycerotidæ, and Leptosomidæ) are peculiar, whilst the Diurnal Accipitres, Pigeons, Honeyeaters, and Cuckoos, are richest in species. In a considerable degree this is also the case with the orders Grallæ and Anseres. As contrasted with Africa the Fringillidæ, Meropidæ, and Sturnidæ (represented by only one genus), are extraordinarily poor. On the other hand, the Coraciidæ, Laniidæ, Artamidæ, Turdidæ, Muscicapidæ, Pycnonotidæ, and Lusciniidæ, are remarkable for their peculiarly modified types, and the Sittidæ, which are quite unrepresented in Africa, for the anomalous form *Hypherpes*."

Such are Dr. Hartlaub's matured views on a subject which he has long had before him, and is, above all persons, qualified to speak.

In concluding our notice we have only to thank him on the part of ornithologists for his convenient and useful volume, and to wish that the Avifauna of many other countries were treated of in a similar manner.

OUR BOOK SHELF

Pollen. By M. P. Edgeworth, F.L.S. Illustrated with 446 figures. (London: Hardwicke and Bogue, 1877.)

MR. EDGEWORTH informs us in the preface that this work is a considerably altered edition of a paper laid before the Linnean Society last year, but withdrawn by the author, on account of his omitting to notice the work of other botanists, British and foreign, on the same subject. The work chiefly consists of plates with the explanations and a list of forms of pollen figured by other authors, as well as some general remarks on the forms of pollen in different families. The figures are all drawn to scale, are fairly done, and there can be little doubt that the microscopist who loves pretty objects will promptly avail himself of Mr. Edgeworth's assistance in following up the subject. Very much valuable information is given in this book and it cannot fail to be useful to the scientific botanist. We feel, however, that Mr. Edgeworth does not wholly command our confidence on account of certain blunders he makes. Most of the German botanists have their names misspelt. Thus he always calls Purkinje "Purjinke," Naegeli "Nagili," Rosanoff "Romanoff," Pollender "Pollenden," Luerssen "Leursen." Surely if Mr. Edgeworth had been familiar with the writings of these men, he from merely seeing their names on their papers, would not have blundered so strangely. Then we feel rather doubtful about his references as we have failed to find any paper by "Nagili" in Pringsheim's "Jahrbücher," vol. iii. Naegeli's name does not occur at all in the index to the first ten volumes of Pringsheim's "Jahrbücher." The third volume of the "Jahrbücher" was published in 1863, while Naegeli's paper on the development of the pollen was published at Zurich in 1842. We think the student would hardly find the papers of "Purjinke in Latin," "Fritsche in German," "Pollenden Bonn." Why not refer to the proper title of the book or paper? Pollender has published two papers on pollen, at Bonn, one in 1867, in quarto; another in 1868, in folio. To which does Mr. Edgeworth refer? Then surely it is too late in the day to describe the pollen of the pine as consisting of "2 grains of pollen connected as it were by a broad band" (p. 8); or the pollen of some Acanthaceæ as existing "in a peculiar coil, which can be unwound," in both cases the peculiar development of the extine being overlooked. Altogether, then, the work has slightly disappointed us, but perhaps we should not judge so much by the blemishes we notice in it, as by the undoubted worth both to the amateur and scientific botanist of the figures and references.

Die Auster und die Austernwirthschaft. Von Karl Moebius. (Berlin: Wiegandt, Hempel, and Parey, 1877.)

MUCH has been said and more has been written about oysters and their culture. Astonished by large figures many writers wished to astonish their readers in a similar way, and to induce the coast population of all civilised countries to undertake the culture of enormous masses of this most costly of all molluscs. Thus a belief has been widely spread that wherever there was a coast and seawater, oyster-beds could be established and quantities of oysters could annually be obtained without much trouble. The little book we have under notice is therefore well timed. It reduces to their proper and reasonable measure all ideas on this subject in speculative heads, and, as the author owns himself, it will for that reason be hardly welcome to these would-be oyster cultivators. But it will be all the more so to biologists, proprietors of oyster-beds, and the educated public generally, since it contains valuable details of the biology, the peculiarities, and the life-conditions of oysters. It will, we have no doubt, also find a favourable reception amongst those government departments of the various states of Europe and America, whose duty it is to superintend the oyster-fisheries and the natural oyster-beds, since it will offer them a reliable basis for their judgment in adopting or rejecting measures relating thereto. Prof. Moebius gives a very able account of the artificial oyster culture in France, and of the attempts made in this country to introduce the French

system of artificial culture, which unfortunately all ended in failure. He then asks the question whether artificial culture after the French method would be possible on the German coasts of the German Ocean, and in a well-written chapter arrives at the conclusion that this question must be answered in the negative. An important query is whether natural oyster-beds can be artificially enlarged, and whether new oyster-beds can be established. Prof. Moebius thoroughly ventilates this question, and an attentive perusal of the little work will not leave anybody in doubt as to whether any intended experiments will or will not be crowned with success. The author quotes several examples of natural beds which were ruined by over-fishing; he also gives an account of the repeated experiments made in the Baltic with a view of establishing natural oyster-beds, all of which failed, the last with 50,000 oysters deposited in 1843 near the Island of Rügen, of which only two years afterwards not a single one remained alive. One of the most interesting chapters in the book is the one treating of the increase in the number of oyster-eaters, the rise in the price and the decrease in the quantity of oysters; it contains numerous statistical data showing how, in 1740, fresh oysters were sold at Hamburg at 3*d.* per hundred! Even as late as 1830 they were sold at 1*s.* per tub (about 1,600) at Falmouth; but Prof. Mœbius doubts whether in this age of railways and steamboats we shall ever return to such a state of things. A chapter on the chemical constituents and the taste of oysters, and another on the object and results of a rational culture of oysters, form the conclusion to this clever little work.

Die Naturkräfte. — Die Gesetzmäszigkeit im Gesellschaftsleben. Statische Studien von Dr. Georg Mayr, Ministerialrath und Universitäts Professor. (München: R. Oldenbourg, 1877.)

THIS small and readable volume contains a slight but comprehensive sketch of the main features of political and social statistics. It shows how the necessary data have to be obtained, how they should be discussed, and how the final results may be most clearly published, whether in a graphic or a tabular form. It enters into no technicalities, it is of very little value as a storehouse of information, and it contains perhaps no remarks that are strikingly original, but being written by a very competent statistician it has the merit of giving a good, general idea of the range of statistical inquiry and of its national value. It is well calculated to instruct those who may desire to obtain a broad and just view of the efforts, the difficulties, and the achievements of modern statisticians. F. G.

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. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Potential Energy

MOST persons must agree with your correspondent, "X.," that the term "potential energy" has been used with considerable vagueness and with some difference of meaning by various writers. They may even go further, and doubt at times whether they are quite clear with respect to the cases to which the terms "force" and "energy" are respectively applicable. But this arises, I am inclined to think, from the difficulty of understanding what is force, and would certainly not be removed by bringing these two terms into more frequent and closer juxtaposition than that in which they are now found.

Without attempting to reconcile the somewhat conflicting views of different writers on the subject of potential energy, which, however, I must own, are not so far apart from one another as "X." seems to suppose, I should like to make a few remarks with respect to his proposal to transfer "potential energy" from the body in which it is said to exist to the force to which it owes its existence.

Energy, as generally understood, is of two kinds: the one is energy of motion, and the other energy of configuration. In both cases the system possessing energy has the power of doing work; in the one case actually, in the other potentially. Now it is against this potential power of doing work that "X." protests, for he considers the expression tautological. But here I disagree with him. I can see nothing incomprehensible in the statement that a body has the power of acquiring the power of doing work; and, to restrict myself to the very simple illustration of a stone raised to a certain height, I should say that the system of the stone and earth, by the action of a certain force through a certain distance, had gained the power of acquiring a certain amount of kinetic energy, *i.e.*, the power of acquiring the power of doing a certain amount of work.

This seemingly tautological phrase is more in the language than in the idea; for we often use, with respect to other subjects than physics, similar expressions. We may say that the possession of wealth confers the power of purchasing, and a wealthy man is one who possesses a certain power which he may have gotten himself, or which may have been transferred to him from another. But a youth with a certain education, and placed in a certain position, though not yet wealthy, may be said to be in a position to acquire wealth,—to have in himself the power of acquiring the power of purchasing.

One other point I would notice before considering "X.'s" new proposal.

But first I would say that justice is hardly done to every "doctor" (I am none myself) when we are told, in connection with the projection of a stone upwards, that "the gravitation attraction is usually and conveniently conceived and spoken of as all the earth's; and the stone is usually regarded as being simply attracted," and that "every doctor will frequently speak thus." Certainly one doctor whom "X." has quoted is careful to say that "when a stone has been lifted to a certain height above the earth's surface, the system of two bodies, the stone and the earth has potential energy, and is able to do a certain amount of work during the descent of the stone."[1]

"X." finds considerable difficulty in understanding that if the leaden weight of a clock is raised by winding it up the energy of the clock is thereby increased. He says that "the weight sets-to and works with E., which it has not in possession, but only has the power of acquiring, and which it loses the power of acquiring!!" and in a note we are told that "the weight never acquires more than a quite insensible amount of actual E. so called." This is quite true, because the "actual E." is continuously used up as fast as it is acquired. If the weight could have fallen freely it would have possessed a store of "actual E." at its lowest point; but instead of being able to do this it has been continuously transferring its actual energy to the machinery of the clock which it has set in motion. The weight at its highest point was in a position for doing work, and during its descent work has been done.

Let us see now if there are no difficulties connected with the proposal to call potential energy "energy of tension," and to locate it in the force rather than in the body. We are told if you spend E. "in raising a stone to a certain height, you have bestowed your E. on that attraction, you have transferred your E. to gravity." This is not very clear, but "X." goes on to say "that attraction was beforehand pressing at the stone as hard as it could (this looks as if "X." placed the attraction in the earth only), but it had no power of doing work." Well, why not? Because, practically, there was no force acting on the stone. The force of gravitation was counteracted by the reaction of the surface on which the stone was resting. A force free to act has always the power of doing work; but the existence of a force presupposes the existence of a body, and the confusion is, therefore, considerably increased by speaking of the transference of the power of doing work from a body to a force. There seems to be no harm in speaking of the energy of a force, but then we mean the energy due to a force; and this can be as well said of kinetic as of potential energy.

With the metaphysical difficulty about force staring us in the face, it surely would be very unwise without the gain of some much more solid advantage than "X." has made out, to complicate the idea by giving it the attribute of possessing energy; the connection between force and matter is so intimate that let energy mean what it may, the idea of its transference from

[1] Clerk Maxwell, "Matter and Motion," p. 81.

the one to the other is unintelligible There are many difficulties connected with the subject of potential energy which the progress of science is likely to remove, but they are not to be got over by the verbal alteration proposed by your correspondent. The energy of compressed air was at one time supposed to be potential and is now regarded as kinetic. Further inquiries into the constitution of matter may enable us to see that many forms of energy which are still regarded as potential are really "actual." Meanwhile we may, I think, suppose potential energy to mean the power of acquiring the power of doing work and to be located in the system possessing this power. P. M.

The Arts Club, October 7

Indications of the Ice-age in Shetland

SHETLAND will now be narrowly searched for proofs of glacial action by every tourist who takes an interest in such vestiges of a bygone era. Smoothed surfaces, striæ, and grooves are so abundant and distinct on Mr. Peach's ground—the sandstones on the shores of the Loch of Clickhemin, and of the immediately adjoining bay—as to have long ago suggested the innocent or waggish notion that the last were scratches made by the prows of the Norsemen! Still on the mainland, but some forty miles distant, on the shores of the magnificent bay of St. Magnus, striæ are to be seen on the sandstones of the hääf-fishing station at Stennis, and till, or boulder-clay, lies in patches on the Tuans of Hillswick. Ice has made distinct markings, running east and west on the gneissose rock close by the door of the farm-house of Ailesburgh, which is perhaps about a mile north of the narrow isthmus of Mavis-Grind. The huge moraine-looking mound, which lies between the south-east foot of Ronas-hill and the head of Ronas-voe, claims a special examination by those who wish to be further satisfied as to the former existence, or otherwise, of glacial action in Shetland. G. G.

The Discoverer of Photography

IN your account of the death of Mr. Fox Talbot (NATURE, vol. xvi. p. 464), you state that he first entertained the idea of the art of what is now called photography in 1833, and that it was not till 1839 that he and Daguerre first made known the principles of photography under the name, I think, first of Daguerrotype, followed by Talbotype. I therefore think the following notes concerning Niepce may interest some of your readers :—

I cannot now from memory give exact dates, but I think it was at least ten years previous to 1839 that there lodged in a neighbouring house to where I now reside a Frenchman of the name of Niepce ; he was, I think, engaged on a perpetual motion machine.* He died, which necessitated his brother coming from Paris to Kew. The brother was a theatre scene-painter, and had discovered the art of fixing upon metal the pictures of objects reflected by the sun. On arriving at Kew he put up at the "Coach and Horses" Inn, then kept by Mr. Cusel, and not being able to speak English, Mr. Cusel introduced him to Mr. Francis Bauer, the celebrated botanical artist, then residing at Kew. Niepce had brought with him three pictures, specimens of his discovery, which he showed to Mr. Bauer, who became much interested in them. He deemed the discovery worthy of being made known to the Royal Society, but as the method of obtaining the pictures was not described in the notice sent to the Society, they would not entertain it, and nothing was done in the matter. Niepce returned to Paris, leaving two of the pictures with Mr. Bauer, and the third with Mr. Cusel in part payment of his bill, he being a poor man. Being a frequent visitor to Mr. Bauer, the latter naturally called my attention to the two pictures that hung in his room for at least ten years. In time Niepce let the secret of his discovery become known to M. Daguerre, and in 1839 this discovery came before the public under the name of "Daguerreotype," and about the same time "Talbotype" was announced. This led Mr. Bauer to write a letter to the *Athenæum*, fully explaining all particulars of what I have here stated from memory. In his letter Mr. Bauer said he should be happy to show the pictures to those interested in the subject. Consequently he had many callers, one of the earliest being Dr. Percy, whom I remember coming to me, wanting to know where he could find Mr. Cusel, who had then retired and was living at Richmond. Dr. Percy went off to Richmond with the intention of buying the picture, but I remember telling him Mr. Cusel would not sell it as he was not in need of money. Such was the case, as Mr. Cusel told me some time after "that he would not sell it ; no ! not if he was offered 100*l.* for it." Mr. Cusel is long since dead, and what became of his picture I know not. After Mr. Bauer's death, in 1840, these two pictures came into the possession of his friend, Mr. Robert Brown, and I believe are now in the British Museum.

If you consider what I have now stated worthy of a place in NATURE, it is at your service. J. SMITH

Park House, Kew, October 9

The Portrait of Tycho Brahe

IN reference to the portrait of Brahe engraved in NATURE (vol. xv. p. 406), and to Mr. Dreyer's remarks on it (vol. xv. p. 530), I have the pleasure of sending you the following particulars. In the first place I have permission from Herr Friis, of Copenhagen, the learned editor of *Tichonis Brahei et ad eum doctorum virorum Epistolæ. Havniæ*, 1876, &c., to publish an important letter from himself :—

Copenhagen, June 9, 1877

DEAR SIR,—I have seen in NATURE (vol. xv. p. 405) an article on Tycho Brahe, with a portrait of him after a painting in your possession. On that account I take the liberty of addressing myself to you.

In a book printed in Copenhagen in the year 1668 is mentioned a portrait of Tycho Brahe which once belonged to King Frederick III., and which, no doubt, has had an emblematic figure and inscription similar to that of the portrait you own. The title of this book is "Inscriptiones Haffnienses latinæ, danicæ et germanicæ una cum inscriptionibus Amagriensibus, Uraniburgicis et Stellæburgicis, &c., edi curavit Petrus Johannis Resenius," and in that you read at page 335 the following :—

"Sub pyramide tegumento quodam cooperta ad effigiem ejus quæ in Augustissimi Regis Daniæ Friderici III. Bibliotheca hodie reservatur depicta hæc legitur inscriptio :—

STANS TEGOR IN SOLIDO VENTUS FREMAT IGNIS ET UNDA VANDESBECHI
AN. MDXCVII QUO POST DIVTINUM IN PATRIA EXILIUM DEMUM PRISTINÆ LIBERTATI RESTITUTUS FUI
TYCHO BRAHE, OT.

On leaving Denmark T. Brahe sent his portrait to his friend, the learned Holger Rosenkrantz. This has, I suppose, been one resembling the one you now possess, even if it should not be just the same. Compare T. Brahe, "Astronomiæ instauratæ mechanica." Wandesburgi, 1598, fol 4.

The German letters on the order M. H. Z. G. A. indicate Frederick the Second's motto : My hope (is) in God alone (Meine Hoffnung zu Gott allein), which is often seen in buildings, &c., from his time.

If you will be kind enough to send me a photograph of the before-mentioned portrait, I should feel very grateful to you, as I have made the biography of T. Brahe my special study, and just recently began to publish his correspondence with his learned contemporaries.

Hoping that you will not deny me this favour, I am, dear sir,

Yours obediently,

F. R. FRIIS

Cortadelers Gade, 7, Copenhagen

I have referred to an exquisite copy of the Inscriptiones Haffnienses, from the library of Colbert, belonging to Chetham's Library, in this city, and on the same page referred to by Herr Friis I find a poem by Oliger Rosenkrantz addressed to T. Brahe, and prefixed to the Mechanica, of which the last two lines are very interesting, as alluding, in my opinion, to the emblem on my portrait. They are :—

"Pectora quam Divi dispensant tramite justo,
Stansq. vado fluctus, imbres et flamina temne."

I wish to add a few remarks, and before I proceed farther I would observe that in your engraving the dress of Brahe is not given correctly, not from any fault of yours or of your engraver, but because the detailed drawings sent in answer to a request from him to me for details did not reach him until the plate was too far advanced. I have had the picture re-photographed, the photograph worked upon from the picture in a strong light, and a satisfactory result will be published in the *Memoirs* of the Literary and Philosophical Society of Manchester, and also, I believe, in Herr Friis's very interesting and important work, two fasciculi of which he has kindly sent me.

It is now certain that Brahe, whilst at Wandesbeck, or Wandesburg, near Hamburg, sat to a painter, for here we have evidence in a book published at Copenhagen, in 1668, that King Frederick III. had *that* picture and that it was dated Vandesbechi, 1597; and moreover, that that portrait had an emblem upon it, which, from the motto, was presumably very like that on mine, but the position and the words of the motto differing, the motto and also the inscription on King Frederick's portrait being *below* the emblem, whilst on mine the motto is on a ribbon or label wound round the pyramid, and the inscription is on the other side of the picture. In King Frederick's the emblem consisted of a pyramid with some kind of covering ("sub pyramide tegumento quodam cooperta"), and so it is in mine. That wind, fire, and water were also represented in that emblem, as in mine, is clear from the words "ventus, ignis, et unda" in the motto, which are precisely the words employed in mine, the only difference in the two cases being that in the king's there is the word "fremat," instead of "strepat" as on mine. In my portrait the year 1597 is inferred from the inscription saying "Anno 50 completo," Brahe being fifty years old on December 13, 1596. By a careful examination of Brahe's Latin Life by Gassendi, 1656, I found that Brahe wrote a remarkable poem addressed to Ranzovius, in which the words "exilium in patria" occur; and as he stayed at Ranzovius's from the end of October, 1597, I conjectured (*Proceedings* of Lit. and Phil. Soc. of Manchester, October 31, 1876) that my portrait was painted between that date and his next birth-day (December 13, 1597), a supposition confirmed by Herr Friis pointing out that the lost picture of King Frederick's is dated at Wandesburg (Vandesbechi).

That mine is no copy of that picture is manifest from the differences which the notice in the "Inscriptiones Haffnienses" has enabled me to point out. My conjecture is that Brahe sent his portrait to King Frederick, who is expressly absolved by Brahe from the blame of Brahe's expulsion from Denmark, and that he advisedly wrote "pristinæ libertati" instead of "libertati desideratæ" as on mine; and further I have little doubt that the same artist painted both pictures.

I have examined the portraits in the print room of the British Museum as well as the oil painting at the Royal Society, and have taken much pains to ascertain the existence of any other portrait than mine representing Brahe later than 1587; ten years earlier than mine. That it does not agree with the engraving after Gumperlin's portrait is no proof whatever that mine is not a good representation of him in his fifty-first year, when we consider how much a man's features change in the ten years between forty-one and fifty-one, and moreover Brahe may have been in the meantime to the Promontory of Noses for a fresh one. But whatever be the reasonableness of these conjectures, it is almost certain that he sat twice at Wandesburgh to this portrait painter, and that one of these portraits was considered worthy of a place in the king's library.

SAMUEL CROMPTON

Manchester

Lumière Cendrée

SCHRÖTER pointed out that it is towards the third day of the new moon that the ashy light has the most intensity and that it is stronger before the new moon than after.

Schröter's explanation is that during the waning of the moon the ashy light is stronger because the moon is enlightened by the continents of Asia, Africa, and Europe, but after the new moon by the Atlantic and Pacific Oceans.

Godfray in his Astronomy says:—Supposing this difference to exist, and this explanation to be the correct one, the phenomenon must be just reversed in China and Japan.

Has anything been done to test the accuracy of Schröter's theory? If it is correct the ashy light cannot present the same appearance to an astronomer in New York, because there would be a greater proportion of reflecting surface in the hemisphere of the earth turned towards the moon in the one case than the other.

Schröter, I believe, found that the ashy light was stronger in autumn than in spring. This cannot be accounted for by his explanation, for the distribution of land and water remains the same.

I shall be obliged to any of your correspondents who can tell me where there are any records of observations on this subject.

B. G. JENKINS

4, Buccleuch Road, Dulwich, October 1

Lightning Conductors

IN a paper on lightning conductors, communicated by us to the *Journal* of the Society of Telegraph Engineers, we gave at full length our reasons for believing that the wire cage first suggested some years ago, and recently proposed by Prof. Clerk Maxwell, as a protection against lightning, would not act as a complete protection, since, although there is no resultant force inside a closed conductor due to exterior *statical* electrification, experiment shows the existence of such a force when electric currents are passing either near or through a closed conductor. The recent case of deaths by lightning in a mine, communicated to the Asiatic Society of Bengal, on April 4 of this year, by J. J. Whitty, Esq., superintendent of the Kurhurbari Collieries, Giridhi, India, appears to add experimental proof to the reasoning advanced in our paper. Mr. Whitty says:—"The mine is a shallow one, worked by levels driven on the side of a flat-topped hill, only twenty feet from the surface, which is, therefore, the thickness of rock above the coal-seam. The working-face where the accident occurred is about 130 feet from the opening. There were a number of miners in the drift at the time. Those near the entrance were unaffected. The two who were killed (a man and a woman) were at the working-face in adjoining galleries, separated by about twelve feet of coal. A young *sál* tree, standing as nearly as possible over the position of the accident, was slightly damaged, and in the ground at its base a hole, about one inch in diameter, seemed to have been formed by lightning. The little hill, or plateau, in which the mine is situated is one of a small irregular group in the centre of the coal field, about 200 feet high. It is formed of the coal-measure sandstone. The drainage is thorough, and the mine was quite dry. From the presence of the workmen the sides of the gallery and the air in it were probably damper than the rock. The tree or other vegetation on the hill is scanty. On the day of the accident 0·96 inches of rain fell."

It would therefore appear that the two people who were killed were practically entirely surrounded by a partial conductor in connection with the earth. It will no doubt be objected that twenty feet thickness of coal-measure sandstone, even when damp on the surface, is not a good closed conductor, but we think it is certainly as good a protection as would be afforded by the wires Prof. Clerk Maxwell proposes to lead *merely* along the edges of a building.

JOHN PERRY

W. E. AYRTON

The Imperial College of Engineering, Tôkiô, Japan, August 6

Electric Lighting

I HAVE examined the patent (No. 10,919, November 4, 1845, Edward Augustin King) which Prof. Mattieu Williams drew attention to in NATURE, vol. xvi. p. 459, as anticipating the invention of Lodighin's electric wick, and I think Lodighin has been clearly forestalled in principle, the practical details alone being different in the two cases.

I do not think, however, that Mr. King's patent includes Kosloff's improvement, whatever value may attach to the latter. I think it is very plain that porcelain is employed in King's patent merely as an insulating bar to connect the two forceps rigidly together without shunting any of the current between them past the carbon.

J. MUNRO

West Croydon, October 2

Caterpillars

LAST year (NATURE, vol. xv. p. 7) I communicated the result of some experiments on the caterpillars of *Pieris brassicæ* from which it appeared that, when these are artificially converted from *succincti* into *suspensi* by cutting the loop before the exclusion of the chrysalis, a certain number (a third or fourth of the whole) succeed in attaching themselves to the silk by the hooks in the tail of the chrysalis in the manner of the true *suspensi*. I have repeated the experiment this year with a like result, and I have also had the satisfaction of witnessing the process of successful exclusion, and comparing it with that of the chrysalis of *Vanessa urticæ*. The method is essentially the same, except that the rapid and assured precision with which the Vanessa chrysalis thrusts up its tail and lays hold upon the silk, is replaced in Pieris by long and laborious efforts, as if the tail were just a little too short to reach the silk.

I have likewise made similar experiments with another of the

succincti—Anthocharis cardamines—with the following results:—In seven instances I cut the loop (and sometimes a second one) which the caterpillar had spun; and in all the chrysalis was excluded without falling down; but in no case was the tail of the chrysalis withdrawn from the pocket of the old caterpillar-skin, so that its suspension is directly from the latter. In eleven cases in which I did not interfere, only two chrysalids were excluded in the normal way, *i.e.*, vertically, with the head up, a girdle round the insect and the chrysalis-tail withdrawn from the old skin and attached immediately to the silk on the stem of the plant. In three other cases in which a loop was spun by the caterpillar, the chrysalis seems to have turned upside-down during exclusion, the tail being now uppermost, the *loop twisted*, and the hooks fastened in loose silk upon the plant-stem. Six caterpillars either spun no loop at all or one so insufficient that they became *suspensi* of themselves before exclusion began, and were all but one (which fell down) successfully excluded in this position—the tail of the chrysalis, however, being still retained within the pocket of the old skin.

The most interesting and curious point in the transformation of a caterpillar of the *suspensi* is the manner in which the newly-excluded chrysalis is kept from falling, while its hook-furnished tail is being withdrawn from the old skin of the caterpillar and made fast in the cone of silk to which the latter was attached. I am ignorant whether any other explanation of this process has been given than that, I believe, originally communicated by Réaumur and detailed in Kirby and Spence, vol. iii. pp. 208–209, and repeated in such recent works as Figuier's "Insect World," from the English edition of which work by Prof. P. Martin Duncan (1872), p. 148, I quote the following account of the pupation of *Vanessa urticæ*:—"But here comes the culminating point, the most difficult part of the operation. The chrysalis, which is shorter than the caterpillar, is at some distance from the silky network to which it must fix itself; it is only supported by that extremity of the caterpillar's skin which had not been split open. It has neither legs nor arms, and yet it must free itself from this remaining part of the skin, and reach the threads to which it is to suspend itself. *The supple and contractile segments of the chrysalis serve for the limbs which are wanting to it. Between two of these segments, as with a pair of pincers, the insect seizes a portion of the folded skin, and with such a firm hold that it is able to support the whole of its body on it.* It now curves the hinder parts slightly, and draws its tail entirely out of the sheath in which it was inclosed," &c. (The italics are mine.) How this can be conceived possible, considering the utterly soft condition of the newly-excluded pupa, and that the caterpillar skin is now "reduced to a packet so small that it covers only the end of the tail of the chrysalis" (*loc. cit.*), in which, moreover, there are no longer any free segments, I cannot understand. On the other hand, it is very easy to show that the last and sufficient bond of connection between the chrysalis and the old larva-skin is *a membrane extending from the lining of the latter to the anterior horns of the two lateral ridges bounding the anal area of the chrysalis.* I have prepared several specimens showing this membrane still intact, and should be happy to forward one or two, if required, for inspection. I find it in all three species of butterfly mentioned above, and I believe it is to the persistence of it unbroken that is owing the continued suspension of my chrysalides of Anthocharis. I have tested its strength to sustain the weight of the chrysalis, and the time during which it resists desiccation and the writhings of the insect, the obvious object of which is, not to get rid of the old caterpillar-skin, but to rupture this membrane after the chrysalis has made good its tail-attachment to the silk.

J. A. OSBORNE

Milford, Letterkenny

The Satellites of Mars

IT is not necessary to have an enormous telescope in order to see the outer satellite of Mars. I had a very satisfactory view of it on September 15 at 9h. 20m. with a nine-inch reflector, and only lost it in the planet's glare at about 10h. 50m. I would have written to you on the subject earlier, but was not aware that it was considered so extremely difficult an object until I read the letters in your paper of the 27th ult.

JOHN BRETT

The Lizard, Cornwall, October 6

Rate of Mound-Building

THE papers announce that Mr. Layard has obtained permission to renew excavations in the Mesopotamian Valley. Several other explorations will be in progress during the coming season in countries where no trained labour can be obtained. I write to beg the gentlemen having the work in charge to make some accurate observations as to the amount of dirt which a man can move in a day with rude implements, noting the distance as well. A discussion has sprung up concerning the time required to build our Mississippi Valley mounds. The investigation of which I speak will throw some light on the subject.

Washington, D.C., September 26 OTIS T. MASON

OUR ASTRONOMICAL COLUMN

THE MELBOURNE OBSERVATORY.—The twelfth Report of the Board of Visitors of this Observatory, addressed to the Governor of Victoria, with the Annual Report of the Government Astronomer, is before us. It presents an outline of the work accomplished between June 20, 1876, and May 22, 1877, and of the work in progress and in prospective. With the great reflector, which is in charge of Mr. Turner, the observation and drawing of Sir John Herschel's figured nebulæ has been continued. A finished drawing of the Horse-shoe Nebula, M. 17, has been made, together with drawings of fifty-seven of the smaller nebulæ. The publication of this work is in progress; out of ninety-three drawings which it is intended to publish, sixty-one are already lithographed; they are representations of the nebulæ on a black ground, and Mr. Ellery states that they render the telescopic appearance of the objects in a most effective and truthful style, and if the lithographic printers succeed in obtaining the requisite number of copies as perfect as the proof copies which were submitted to the Board of Visitors, he considers that "the whole difficulty of economically and satisfactorily reproducing these astronomical drawings will be surmounted." The descriptive letter-press will be ready by the time the lithography is finished, and it is expected that before the next annual inspection of the Observatory this first instalment of results furnished by the great telescope will have been distributed over the colonies and throughout Europe and America. With the "South equatorial" Mr. Ellery has been engaged upon a work of no small interest and astronomical value, viz., the re-measurement of the double-stars contained in Sir John Herschel's Cape Catalogue, 1834–38, in which revision he is promised the co-operation of Mr. Todd with the Adelaide refractor. Mr. Ellery further mentions that he hoped to utilise the present opposition of Mars, in connection with northern observatories, for a determination of the solar parallax. The transit-circle observations, which are regarded as the main work of the establishment, are zealously continued. The magnetic and meteorological work is upon the same general plan as hitherto, but the former was likely, at the date of the Report, to suffer some interruption from the necessity of erecting a new magnetic-house.

THE OUTER SATELLITE OF MARS.—Though this object will no doubt be growing fainter with the increasing distance of the planet from the earth, a few positions are subjoined which have been deduced from elements fairly representing measures made by Mr. Common, at Ealing, to the end of September. The two or three days when the moon will be near to Mars are omitted:—

At 8h. 30m. Greenwich Mean Time.

Oct. 11	...	Pos.	69	...	Dist.	66″	Oct. 20	..	Pos.	42	... Dist. 37″
,, 12	...	,,	107	...	,,	38	,, 21	...	,,	80	.. ,, 58
,, 13	...	,,	235	...	,,	51	,, 22	...	,,	168	... ,, 22
,, 14	...	,,	266	...	,,	57	,, 23	..	,,	248	... ,, 58
,, 15	...	,,	23	...	,,	29	,, 24	...	,,	288	... ,, 34
,, 16	...	,,	74	...	,,	64	,, 25	...	,,	53	... ,, 45

At the times mentioned in Lord Rosse's letter (NATURE, vol. xvi. p. 457) the calculated places of the satellite were as follows:—September 8, at 11h. 45m., pos. 70°, dist. 85″, and September 15, at 11h. 30m., pos. 246°, dist. 79″.

The period of revolution given by measures between

August 11 and September 30 appears to be 1d. 6h. 18m. 12s.

THE NEAR APPROACH OF SATURN AND MARS, NOVEMBER 3.—At the times of meridian transit at Greenwich the position of Saturn with reference to Mars near the conjunction of those bodies at the beginning of the ensuing month will be—

November	2	...	Angle	80	...	Distance	24'5
,,	3	...	,,	138	...	,,	9'4
,,	4	...	,,	212	...	,,	22'0

It will be seen that on November 3, about 8 P.M., the distance is about equal to the greatest elongation of the Saturnian satellite Japetus, but the satellite is not on this occasion in a position to be occulted by Mars.

NEW COMET.—A telescopic comet was discovered on the evening of October 2, at Florence, by M. Tempel, to whom we already owed the discovery of the remarkable comet of January, 1866, which is found to be associated with the November meteor-stream, and the comets of short period of 1867 and 1873. Its position at 9h. is stated to have been in R.A. 23h. 51m., N.P.D. 100° 19'. It was observed by Prof. Winnecke at Strasburg on the 6th, and is described by him as pretty bright, about 0".4 in diameter with a star-like nucleus 10'11m., and a faint tail 4' in length on an angle of 25°. The diurnal motion appears to be about 3'5 minutes in R.A. diminishing, and in N.P.D. about 64' increasing.

It may be noted that the position of this comet on October 2 was not far from that which would be occupied by the short-period comet of De Vico, due about this time, if it had arrived at perihelion at the end of the first week in September, but the observed direction of motion of the new comet is contrary to that which De Vico's must have under such condition, so that there can be no suspicion of identity. Prof. Winnecke's observations on October 6 give for the comet's apparent place at 11h. 15m. 5s. mean time at Strasburg, right ascension 23h. 36m. 21'59s., south declination 14° 36' 33".0.

BIOLOGICAL NOTES

THE GOMBI ARROW POISON.—In a recent number of the *Bulletin Mensuel de la Société d'Acclimatation* of Paris, M. M. E. Hardy gives a detailed account of researches and experiments on the active principle of the poison obtained from the seeds of *Strophanthus hispidus*. This plant, which belongs to the poisonous order Apocynaceæ, was first observed by Houdetot, a French naturalist in Senegambia, afterwards by Smeathmann near Sierra Leone, by Baikie at Nupé, by Griffon du Bellay at Gaboon, and by Gustav Mann in Western Tropical Africa. It is a climber with a hollow cylindrical stem, and grows in the forests, where it ascends to the summits of the highest trees. The oblong, nearly sessile, opposite leaves are from ten to twelve centimetres long by five wide, and are covered with hairs, particularly on the under surface. The yellow flowers are borne on terminal cymes. The fruit is a cylindrical follicle somewhat thicker that the thumb, and contains from 100 to 200 oval seeds. By means of a fruit given them by the Paris Society, MM. Hardy and Gallois have discovered that the active principle is not, as was supposed, an alkaloid, and for it the name *Strophantine*, given to it some years ago by Dr. Fraser, is retained. Besides, they succeeded in isolating a substance presenting the characters of an alkaloid, but which did not seem to possess any marked physiological properties; for this they propose the name *Inéine*. The former is very poisonous, a single crystal placed under the skin of a frog's foot causing the cessation of the heart's action in a few moments. Even after this has taken place the animal still possesses the power of motion, and it is only after respiration has become impossible, owing to the interruption of circulation in the nervous centres, that death ensues from paralysis of the heart. These observations, though yet incomplete, accord pretty well with facts recorded by different authors, and seem to prove that *Strophantine* is really the poisonous agent in *Strophanthus hispidus*. The most elaborate experiments on the poison found at the extremity of the arrows (used by the natives both in war and in hunting) are those conducted by MM. Carville and Polaillon in the laboratory of M. Vulpian. They were made on various classes of animals and show that the deadly action is much more rapid in mammals and birds than in molluscs, crustaceans, and fishes. On frogs under the influence of curare the poison acts much more slowly, though the respective actions of the two substances do not neutralise each other.

THE GELADA.—Several living specimens of this extremely rare Abyssinian monkey, first described by Dr. Ruppell in 1835, have quite recently reached this country for the first time, and are being exhibited at the Alexandra Park. The exact affinities of the species have never been fully determined, different biologists placing it, some with the Macaques, others with the Baboons. It is peculiar in that the male is covered with very lengthy air, like that of the Wanderoo, whilst the female is a much more ordinary-looking monkey. In the male, also, there is a bare spot in shape like an inverted T, upon the breast, which is of a bright-pink colour, becoming red and expanded into an inverted heart-shaped patch upon excitement. The tail is long and like that of a lion, having a bushy tuft at the extremity. The colour is a sooty dark-grey brown, verging upon black; the hands and feet are black; the nails are powerful and long. The size of the male is about that of a Chimpanzee four years old. The eyes are close together, and the snout prolonged. The living animal has a habit of everting the whole upper lip when irritated, and thus exposing its formidable array of teeth.

AMERICAN INSECTIVORA.—Precursory notes on American insectivorous mammals, with description of new species, by Dr. Elliott Coues, have reached us. A new sub-genus of *Blarina* is named *Loriciscus*. *Sorex sphagnicola* and *S. evotis* are new species determined by the author, whilst descriptions of *S. pacificus*, *S.* (*Notiosorex*) *crawfordi*, and *Blarina mexicana* are given from manuscripts of Prof. Baird.

COAGULATION OF BLOOD.—We notice an interesting paper by M. Fredericq, "On the Coagulation of the Blood," in the seventh number of the *Bulletin* of the Belgian Academy. The paper deals especially with fibrinogen and its transformation into fibrine. The author having discovered that fibrinogen coagulates at 56° C., *i.e.*, at a temperature far lower than the temperature of coagulation of other albuminoids of the blood, this property of fibrinogen enabled him to study the transformation of that body into fibrine, and to throw some new light on the obscure problem of coagulation of blood. The researches are to be continued.

PERSIAN AND SARDINIAN OPILIONES.—A memoir by Dr. Thorell, professor of Zoology at Upsala, has been published at Genoa containing descriptions of certain species of *Opiliones* from Persia and Sardinia preserved in the museum at Genoa, together with diagnoses of additional forms in the collection of the author, which are interesting, either as being new to science, or as having hitherto been imperfectly known. In order to advance the study of the *Phalangidea* Dr. Thorell has incorporated in this treatise a revision of the European genera, thus rendering it invaluable to every arachnologist who is desirous of studying the group.

THE DAPHNIADÆ.—In the *Berichte der Verhandlungen* of the Freiburg Society of Naturalists Prof. Dr. August

Weismann, the eminent zoologist, and Herr August Gruber publish an interesting article on their joint researches with regard to *Daphniadæ*, a family of *Entomostraca*. These investigations were principally confined to the species *Moina*, of which *M. rectirostris* has been well known for a long time. Weismann now describes two new varieties and names them *M. brachiata* and *M. paradoxa*. Other researches relate to the male forms of the species *Macrothrix* and *Pasithea*.

THE FISHES OF LAKE NICARAGUA.—Drs. Gill and Bransford have recently investigated the fauna of this lake and contributed a paper to the Philadelphia Academy of Natural Sciences. The element of especial interest is the association of characteristically marine forms with fresh-water types. Thus, together with cichlids and characinæ, none of which are marine, we have a species of megalops, a shark, and a saw-fish. A similar combination occurs in the Philippines, where, in a fresh-water lake, a saw-fish and a dog-fish are found. The megalops, however, is not known elsewhere in fresh water so isolated from the sea as Lake Nicaragua. These instances suggest caution in generalising on physiographical conditions from fossil remains. The most probable cause of such a combination is the detention and survival of salt-water fishes in inlets of the sea that have become isolated and gradually transformed into fresh-water lakes.

SOLAR RADIATION AND SUN-SPOTS

IN the year 1875 two articles by Mr. H. F. Blanford on the connection between solar heat and sun-spots appeared in the pages of NATURE (vol. xii. pp. 147 and 188), in which it was shown that Mr. Baxendell's conclusion that the sun's heat undergoes a periodical variation coinciding directly with that of the spots, appeared to be supported by the evidence of observations of the black-bulb thermometer taken at certain stations in Bengal and the neighbouring provinces. My attention has been recalled to the subject by the almost complete failure of the rainy monsoon this year in Upper India, and by the excessively high temperature ever since the middle of June, and I have been thereby led to attempt to discover whether any evidence in favour of Mr. Baxendell's conclusion, or against it, is to be obtained from the registers of meteorological stations in Upper India. I have therefore gone over the registers of certain stations in the North-West Provinces and Oudh, where solar radiation temperatures have been recorded since 1869, and at which not more than one change of instrument occurred in the interval 1869–1876. The inference I draw from these records is exactly the opposite of Mr. Blanford's. They do not afford any support to Mr. Baxendell's theory, but the energy of solar radiation appears from them to be most intense when the spots are fewest.

The reason of this discrepancy in the two sets of results will probably be found in the different modes of treatment we have adopted in extracting from the registers their evidence regarding this question. Mr. Blanford's treatment of the Silchar register, the results of which are given in his first paper, consisted in picking out certain "clear days" on which the mean serenity at 10 A.M. and 4 P.M. was 6-10ths of the expanse, or more, tabulating the maximum temperatures of solar radiation for all these days in each month, and taking the average, neglecting the months of the south-west monsoon which are almost entirely wanting in clear days, as above defined. The results of the examination of the Darjiling register, given in the second paper, were obtained by deducting from the three highest recorded temperatures of solar radiation in each half-month the corresponding maximum temperatures in shade, tabulating these differences for each month, and taking the average. Both these devices, I think, introduce new elements of error, probably as great as those they were intended to obviate; for, as Mr. Blanford himself points out, it constantly happens that the solar radiation thermometer records much higher temperatures when the sky is partly covered with broken cloud than when it is perfectly clear, the reason being, doubtless, that the instrument is then screened to a great extent from radiation into space, while the sun comes out from time to time, and exerts his full heating power upon it. I am therefore inclined to think that the somewhat higher radiation temperatures recorded at the Bengal stations in 1870, 1871, and 1872 were probably due to the larger number of partially cloudy days in those years as compared with the years immediately preceding and succeeding them.

In the clear atmosphere of Upper India the months of March, April, May, October, and November are generally almost without a cloud, the mean serenity at stations on the plains during those months being over 7-10ths. There can, therefore be little error in taking the mean excess of the maximum temperature of solar radiation above the maximum in shade during those months in each year, as the measure of the intensity of solar radiation during the year; for the two irregularities introduced by occasional cloudy days, prevention of direct radiation from the sun to the thermometer and prevention of radiation from the latter into space, will to some extent counterbalance each other.

The following table gives these yearly means for three stations:—Chakráta, lat. 30° 40′ N., long 77° 55′ E., elevation above sea-level, 7050 feet; Roorkee, lat. 29° 52′ N., long. 77° 56′ E., elevation, 890 feet; and Lucknow, lat. 26° 50′ N., long. 81° 0′ E., elevation 370 feet.

	1869	1870	1871	1872	1873	1874	1875	1876
	°	°	°	°	°	°	°	°
Chakráta ...	60·7	57·2	62·7	61·2	63·0	65·4	67·6	64·6
Roorkee ...	51·9	39·0	41·5	47·4	54·0	52·2	51·6	55·9
Lucknow ...	44·5	43·5	47·2	47·6	47·0	47·6	49·1	54·2
Mean ...	52·4	46·6	50·5	52·1	54·7	55·1	56·1	58·2

It will be seen that the lowest of these numbers is that corresponding to the year of sun-spot maximum, 1870, and the highest is that for 1876, a year of very few spots.

Unfortunately none of the thermometers in use at these stations between 1869 and 1876 had been compared either with a standard or with the others, and as the instruments at some of the stations were in the meantime replaced, these results are doubtful within the limits of the error of such thermometers. This error probably never exceeds 5°, but the difference between the numbers for 1870 and 1876, given in the table, amounts, on the average, to 11·6°. It is believed, too, that during the whole period, 1869-76, the thermometer at Chakráta was never changed, and one thermometer was in continuous use at Roorkee from 1872 to 1876. The differences in the table must therefore be the effect either of a real variation in the sun's heat, or of a greater degree of absorption than usual during the wet and cloudy years, about the sun-spot minimum. Lest they should be attributed to this latter cause, I have examined the registers of the same three stations in much the same way as Mr. Blanford did that of Silchar, and find that owing to the proportion of cloud being so very small, especially in October and November, the results are very little changed. The months of the south-west monsoon, June, July, August, and September, and those of the winter rains, December, January, and February, have been left out, and the only days counted during the remaining months are those on which the cloud proportion at four P.M., when the maximum thermometers were read, did not exceed 2-10ths. The only exception to this rule is the hill station Chakráta, where the cloud proportion for the spring months had to be fixed at one-half. The exact temperature of solar radiation thus determined varies also in the way shown above, the only apparent effect of the treatment being the introduction of slight

irregularities for each station which almost disappear when the mean of the three is taken.

	1869	1870	1871	1872	1873	1874	1875	1876
	°	°	°	°	°	°	°	°
Chakráta ...	60·6	57·6	65·8	61·6	64·2	67·0	68·3	65·5
Roorkee ...	51·4	38·8	42·8	50·2	53·9	50·6	51·1	53·7
Lucknow ...	44·0	43·0	45·0	48·7	47·8	51·1	49·8	53·6
Mean ...	52·0	46·5	51·2	53·5	55·3	56·2	56·4	57·6

Physicists appear to agree in the opinion that the temperature of parts of the solar atmosphere, as indicated by the great outbursts of hydrogen and other well-known phenomena, must be highest about the time of maximum spot-area; but I think the above figures will show that the question whether the amount of radiation which escapes into space is then at a maximum or not is still an open one. It must, at least, be admitted that the relative darkness of the spots is an indication of low temperature and consequent absorption. The registers of the Indian meteorological stations during the next ten years will probably give the data for determining the question, all the solar thermometers employed since the beginning of the present year having been carefully compared by exposing them side by side with an arbitrary standard before they were issued to the stations. The readings of one year will therefore be strictly comparable with those of another, notwithstanding the fact that breakages frequently occur.

It will probably be said that the very fact, now pretty well established, that rainfall is greatest in maximum sun-spot years argues increased evaporation and increased solar radiation during those years. The stations whose rainfall returns have been examined by Mr. Meldrum and those others who have worked at the subject are, however, not by any means uniformly distributed over the earth. The great majority of them are situated within or near the tropics, or in the maritime districts of temperate regions, and their more abundant rainfall in maximum sun-spot years might be easily explained by the diminished carrying power of the winds at that epoch of the solar cycle. Prof. Köppen has shown that the periods of maximum and minimum terrestrial temperature coincide approximately with the minima and maxima of sun-spots, and that both the maximum and minimum annual temperatures are reached somewhat sooner in the tropics than in the temperate zones. One would think, therefore, that the great convection currents of the atmosphere, depending on differences of temperature, would be least powerful a little after the maximum of sun-spots which is the period of heaviest tropical rainfall, and blow most strongly after the sun-spot minimum, the period of least rainfall in the tropics. The only data I know which would enable one to form an estimate of the rainfall of a large inland area in the temperate zone during a long term of years, are embodied in a diagram of the fluctuations of level of the North American lakes, given in a paper by Mr. G. M. Dawson, in NATURE, vol. ix. p. 506. The diagram shows a remarkable coincidence between the variations of the level of the lakes and those of the sun-spot area, and the inference Mr. Dawson draws from a comparison of the two curves appears to be that high water in the lakes is the result of great solar activity when the spot-area is large. Since the appearance of this paper in 1874, it does not appear to have struck any of the readers of NATURE that, in every instance except one, high water in the lakes preceded the sun-spot maximum by two or three years, and, in like manner, the lowest level was reached several years before the sun-spot minimum; but a reference to the diagram will show that such is the case. It is evident, therefore, that high water in the lakes cannot be a consequence of numerous sun-spots, but it may be a commutative effect of greater evaporation than usual and greater carrying power in the winds during the few years of high temperature succeeding the sun-spot minimum.

I have not at hand any means of ascertaining the relative velocities of the wind at European stations during the years about the maximum and minimum epochs of the solar cycle, but the anemometer records of Indian stations shows that the wind velocity varies directly with the temperature. The following table gives the mean velocity each year at five stations, as measured by a Robinson's small anemometer. The figures represent miles per diem :—

	1869	1870	1871	1872	1873	1874	1875	1876
Calcutta	—	—	122	125	133	140	120	133
Hazáribágh ...	—	—	128	140	157	160	172	188
Benares	79	58	54	68	74	93	116	128
Agra	121	180	100	94	86	97	102	103
Bareilly	124	114	89	64	67	72	75	—

If the yearly average for the first four stations be taken, it will be seen that there is a regular increase in the velocity of the wind from 1871, the probable year of lowest terrestrial temperature, to 1876, which was probably the hottest year of the period. It is, therefore, I think, at least possible that the excess of tropical and oceanic rainfall in maximum sun-spot years may be caused by precipitation near the place of evaporation, owing to the diminished force of the trade-winds and anti-trades at those periods, and that if the *winter* rainfall of Europe and America were examined, it might show an excess in *minimum* sun-spot years, derived from vapour brought by an unusually strong upper current from regions of great evaporation in the South Atlantic.

The registers of nearly twenty years show that the winter rainfall of India, north of the tropic, is probably subject to such a periodic variation, and if this surmise be verified in the future it may prove to be of the greatest economic importance. Last cold weather these rains were unusually abundant, and enabled the cultivators of Northern India to grow a spring crop sufficient not only for their own wants, but for export to Europe as well as to the famine-stricken districts of Madras and Bombay. Both this year and last the regular summer rains have been far below the average, and almost any day since last June the vapour that in an ordinary year would have come down to fertilise the soil might have been seen passing overhead in the form of light cirrus drifted by a strong south-west wind. The moist easterly current from the Bay of Bengal, from which a large proportion of the rainfall of the Gangetic valley is generally derived, has this year scarcely penetrated as far west as Benares. The natural consequence of this failure of the rains will be a famine in Northern India, unless, next cold weather, we get the heavy rains which the experience of past years leads us to expect.

A comparison of the mean temperature, vapour tension, humidity, and rainfall for the month of July in the years 1875, 1876, and 1877, shows that the extraordinary dryness of the present year is the result not so much of the absence of aqueous vapour from even the lowest stratum of the atmosphere as of the abnormally high temperature which prevents its precipitation. This will be seen from the following table :—

	Mean Temperature.	Vapour Tension.	Humidity.	Rainfall.
	°	"	per cent.	inches.
July, 1875 ...	81·4 ...	·984 ...	84 ...	26·33
,, 1876 ...	85·4 ...	·897 ...	75 ...	10·05
,, 1877 ...	90·3 ...	·862 ...	63 ...	2·23

The figures in the table are deduced from observations taken at Allahabad four times daily, viz., at 10 and 4 A.M. and P.M. The year 1875 was marked by unusually heavy local rains in July which laid a great part of the surrounding district under water, so a comparison of 1876 and 1877 with 1875 is hardly fair. The average rainfall of the month is 14·65 inches.

S. A. HILL.

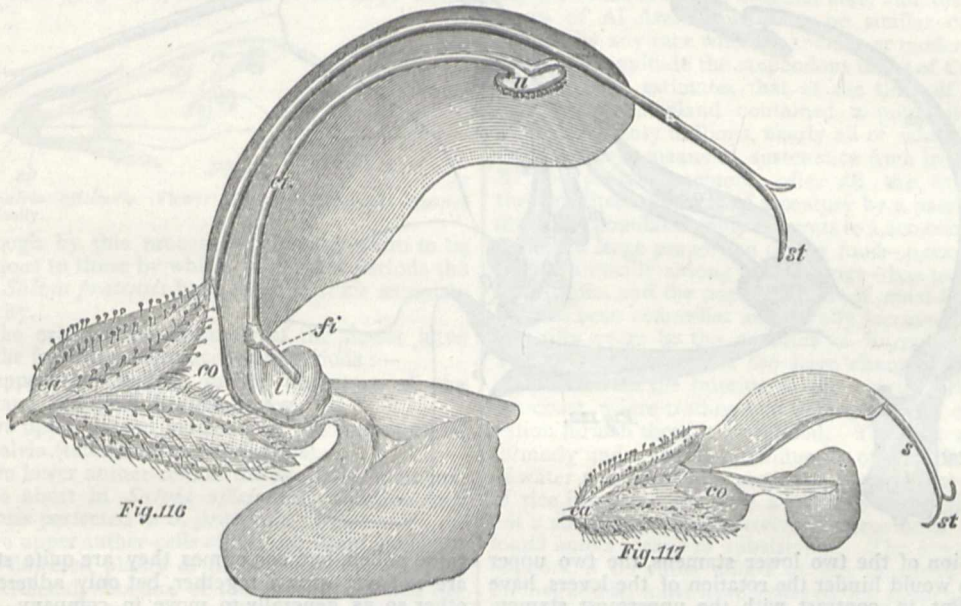
Allahabad, August 29

FERTILISATION OF FLOWERS BY INSECTS[1]

XVII.

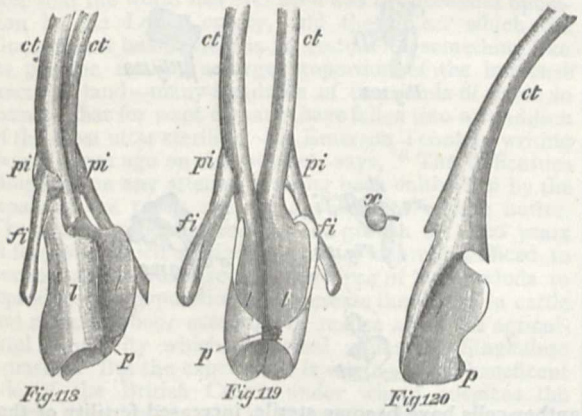
Abortion of all the Stamens in a Flower in Four Successive Periods

IN the theory of the development of the organic world useless and aborted organs are always of especial interest, as no other plausible explanation of them can be given except that they are inherited from ancestors to which, in other conditions of life, they were useful; it may therefore be worth referring to a flower in which, in four successive periods, all stamens have been aborted, and accordingly four different degrees of abortion are to be distinguished. The species in which these flowers are found, *Salvia pratensis*, is a very common one, but the flowers alluded to either do not occur at all in the usual habitats of this species, or have hitherto been overlooked by most botanists. I found them during my last excursions in the Alps in some valleys of Switzerland



FIGS. 116-129.—*Salvia pratensis*.[2] FIG. 116.—Side view of a hermaphrodite flower with the corolla partly removed (3½ : 1). FIG. 117.—Side view of a female flower (3½ : 1). FIG. 118.—Lower part of the two stamens of a hermaphrodite flower viewed obliquely from the front and from the right side (7 : 1). FIG. 119.—Front view of the same. FIG. 120.—Lower part of the left stamen alone seen on the inner side; the filament being hidden behind the connective. FIG. 121.—Right stamen as seen on the outside (7 : 1). FIG. 122.—Side view of a female flower, the half of the calyx and of the corolla having been removed (7 : 1). FIGS. 123-129.—Gradations of abortion of the two last stamens (7 : 1).

(Albula, Julia, Landwasser, and Landquart valley). In these, and probably many other valleys of the Alps up to 1,200–1,400 metres above the sea-level, besides the usual stems of *Salvia pratensis* with large hermaphrodite flowers, other stems with smaller purely female flowers are by no means rare. In these localities, consequently,



Salvia pratensis is in the same state as Glechoma,[3] Thymus, and some other Labiatæ in all or most of their habitats; *Salvia pratensis* is here, as Mr. Darwin calls it, in his late work,[1] a *gynodiœcious* plant. In all other gynodiœcious Labiatæ two abortions of stamens have occurred in two successive periods; in *Salvia pratensis*, as I shall show, four.

1. The Labiatæ, as well as the Scrophulariaceæ, have apparently descended from plants with five stamens. But as soon as the common ancestors of the Labiate family adapted their flowers to cross-fertilisation by bees in such a manner that their stigmas and anthers must necessarily be touched by the backs of these visitors, the uppermost of the five stamens stood in the way of the style, which for the purpose of this cross-fertilisation must stretch along the middle line of the upper side of the corolla and bend one of its two stigmatic branches downwards. Thus the uppermost stamen having become not only useless, but even directly disadvantageous, was doomed to abortion, and in the long time that has elapsed since then, has been so completely eliminated by natural selection, that not the smallest trace of it has remained, and only very exceptionally does it reappear by atavism. In those Labiatæ in which the adaptation described has been perfected, the reappearance of the fifth stamen happens, indeed, so extremely rarely that I have only once had the opportunity of seeing it, in a single flower of *Lamium album*, in which the upper lip was wanting, and, instead of it the fifth stamen was present. In the flowers of Mentha, however, in which the peculiarities of the Labiatæ just-mentioned are much less developed, the fifth stamen, as I am informed by Dr. E. Krause, of Berlin, reappears more frequently.

[1] Continued from vol. xv. p. 475.

[2] In all figures *ca* = calyx, *co* = corolla, *n* = nectary, *ov* = ovary, *s* = style, *st* = stigma, *x* = rudiments of the two aborted upper stamens, *fi* = filaments of the two lower stamens, *ct* = connective, *u* = upper anther-cell, *l* = lower anther-cell, *p* = point of union of the two metamorphosed lower anther-cells, *pi* = point of the filament on which the connective rotates.

[3] See NATURE, vol. viii., pp. 121, 143, 161.

[1] "On the Different Forms of Flowers in Plants of the Same Species."

2. Whilst the flowers of Labiatæ are generally adapted to be fertilised only by bees of a certain size, smaller ones entering the flowers without touching either the stigma or the anthers ; in the genus Salvia, on the contrary, larger and smaller bees have been equally engaged in the service of intercrossing. This has been effected by the following modifications :—The stigma bends further downwards, and the connective of each of the two lower stamens has been transformed to an upright, two-armed lever, which, at its two opposite ends, bears the two anther-cells, and, by a slight pressure on either of them, turns on the filament, so that any bee entering the flower cannot but strike against the two lower anther-cells with its head, cause the connective to rotate, and thus bring the dehiscent surfaces of the upper anther-cells into close contact with its back. In direct connection with this

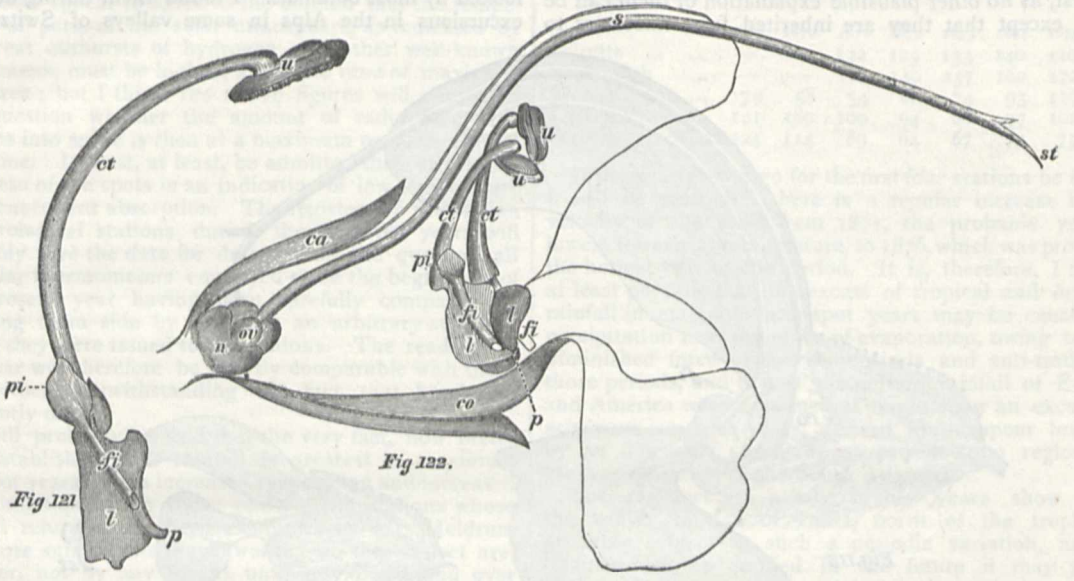


Fig 122.

Fig 121

transformation of the two lower stamens, the two upper ones, which would hinder the rotation of the levers, have aborted. But in contrast with the uppermost stamen, which has become superfluous at a much earlier period in the ancestors of the whole family Labiatæ, and has since completely disappeared, the two upper lateral stamens, which have become useless not earlier than in the ancestors of the genus Salvia, in all or most of the species of Salvia still exist in the form of two little knobs (*x*, Figs. 120-130).

3. By the transformation just-mentioned of the two lower stamens in the genus Salvia not only have the two upper stamens become a hindrance, and thus been aborted, but at the same time the lower anther-cells of the two lower stamens have been alienated from their original function

Fig 123.

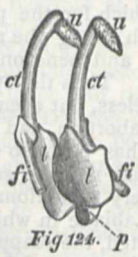


Fig 124.

and engaged in a new service, by which a sterilisation and metamorphosis of these has also been occasioned. *Salvia officinalis* and *pratensis* show us two steps of this further modification. In *S. officinalis*[1] the connective (*ct*, Fig. 130) is but moderately lengthened, the two lower anther-cells, although reduced in size, still commonly produce some pollen, but sometimes they are quite sterile ; they are not yet grown together, but only adherent to each other so as generally to move in company. In *Salvia pratensis*, on the contrary, the two lower anther-cells are not only always completely sterile, but also metamorphosed into two concave plates (*l*, Fig. 118-120) firmly grown together in front (at the point *p*, Fig. 118-120), so that they act as a simple plate, which, when pressed by the head of a humble-bee, causes the two connectives to rotate, and brings the pollen of the two upper anther-cells into contact with the back of the visitor.

4. In the small female flowers of *Salvia pratensis*, also, whatever may have been their origin,[1] the last two

Fig 125

Fig 128

Fig 126

Fig 129

Fig 127

anther-cells have become sterile, increased fertility of the small-flowered plants probably also in this species, as in other gynodiœcious Labiatæ,[2] compensating for the de-

[1] The peculiarities of *Salvia officinalis* have been fully and excellently described and explained by Dr. William Ogle. (*Popular Science Review*, July 1869, p. 261–267.)

[1] I have attempted to give an explanation of the origin of the small-flowered female form of the gynodiœcious Labiatæ in NATURE, vol viii, p. 161. This explanation, however, is not in accordance with Mr. Darwin's views published in his newest work, "On the Different Forms of Flowers."

[2] As shown by Mr. Darwin, "On the Different Forms of Flowers," pp. 299-309.

crease in the size of the flowers and the loss of pollen. With the loss of pollen the whole machinery of the two-armed levers, which had been so gradually acquired and so exactly brought the pollen on the back of the visiting humble-bees, has become useless and begun to abort, and, according to its new origin, this last abortion, as is shown by Figs. 123–129, still offers various gradations from the perfect mechanism to an insignificant little flap. In this gradual succession of more and more reduced stamens of *Salvia pratensis*, we find some forms (Figs. 125, 126) with a striking resemblance to the stamens of *Salvia officinalis* (Fig. 130), and some of the steps which

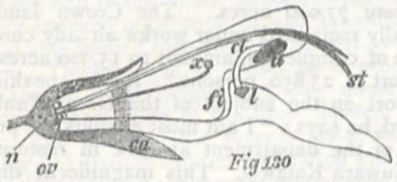


Fig 130

FIG. 130.—*Salvia officinalis*. Flower of *Salvia officinalis* bisected longitudinally.

are run through by this process of abortion seem to be quite analogous to those by which in former periods the stamens of *Salvia pratensis* have reached their astonishing singularity.

Briefly, the original five stamens of the flower have aborted at the following four successive periods :—

1. The uppermost stamen, in the ancestors of the family Labiatæ (complete disappearance).

2. The two upper lateral stamens, in the ancestors of the genus Salvia (reduction to little knobs).

3. The two lower anther-cells of the two lower stamens, beginning to abort in *Salvia officinalis*; abortion and metamorphosis perfected in *S. pratensis*.

4. The two upper anther-cells of the two lower stamens, in the small-flowered plants of *S. pratensis* (abortion of the pollen perfected, abortion of the anther-cells and the whole stamens beginning).

HERMANN MÜLLER

Lippstadt

THE RESTORATION OF THE ANCIENT SYSTEM OF TANK IRRIGATION IN CEYLON

A WORK apparently pregnant with the largest and most beneficent results to the native population of Ceylon is in process of being carried out by the Colonial Government of that island. More than a thousand years ago a system of irrigation, the most complete and remarkable that the world has ever seen was in successful operation in the Low Country, and the object which the Government has in view is to restore to something like its pristine fertility a large proportion of the immense tracts of land—many hundreds of thousands of acres in extent—that for want of water have fallen into a condition of the most utter sterility. Sir Emerson Tennant, writing twenty years ago on this subject, says, "The difficulties attendant on any attempt to bring back cultivation by the repair of the tanks are too apparent to escape notice. The system to be restored was the growth of 1,000 years of freedom, which a brief interval of anarchy sufficed to destroy, and it would require the lapse of long periods to reproduce the population and recreate the wealth in cattle and manual labour essential to realise again the agricultural prosperity which prevailed under the Singhalese dynasties. But the experiment is worthy of the beneficent rule of the British Crown under whose auspices the ancient organisation may be restored amongst the native Singhalese."

The origin of the system of irrigation spoken of dates as far back as the year 504 B.C., when, according to the Singhalese Chronicle, Mahawanso, the first tank was built in the neighbourhood of his new capital, Anuradhapoora, by Panduwasa, the second of the Hindu Kings. This was succeeded about seventy years later by two others formed in the same neighbourhood. In the year 459 A.D. the Kalawewe Tank, the largest of all, was completed. The retaining bund of this immense sheet of water is twelve miles long, and the circumference of the lake which it formed was no less than forty miles, the water being backed up for a distance of fifteen miles and conducted from the tank by means of a conduit sixty miles in length to the capital. Sir Emerson Tennant in describing these remarkable reservoirs, says, "Excepting the exaggerated dimensions of Lake Mœris in Central Egypt, which is not an artificial lake, and the mysterious basin of Al Aram in Arabia, no similar constructions formed by any race whether ancient or modern exceed in colossal magnitude the stupendous tanks of Ceylon." The same author estimates that at the time of its greatest prosperity the island contained a population of from fifteen to twenty millions, nearly all of whom must have derived their means of sustenance from irrigated lands. At the present moment, after all the care bestowed through three-quarters of a century by a paternal government, the population only amounts to 2,400,000, whilst even for this a large proportion of the food—6,000,000 bushels of rice annually among other things—has to be imported from India, and the population itself must be considered to have been somewhat unnaturally increased during the last fifty years by the stimulus of European enterprise. The mass of the people too have changed their place of residence from the interior to the neighbourhood of the sea-coast, where trading and fishing instead of rice-cultivation furnish them a livelihood. The vast areas which formerly under the magic influence of a sufficient supply of water and a hot sun, produced their two or three crops of rice in a year are now absolutely deserted, frequently not a single inhabitant surviving where once a thousand found ample means of subsistence. The city of Anaradhapoora, if its ruins afford us any means of estimating its magnitude, must have covered an immense area—no less than from thirty to forty square miles, and the population living on the spot and drawing its supplies of food from the immediate neighbourhood must have been correspondingly immense. Now it is a mere village in the midst of vast heaps of ruins.

One of the most gigantic of these early irrigation works is supposed to have been originated by Maha Sen about the year 275 A.D., and, having been enlarged by Prakrama, Bahu I., who reigned in 1153, to have received from him the name of "The Sea of Prakrama." It consisted of a series of lakes formed by an embankment twenty-four miles in length and from forty to ninety feet high, by which the water of a large river and many considerable streams was hemmed in along the base of a range of hills and so forced into the valleys that a series of lagoons or lakes was formed extending for the above-mentioned distance and frequently several miles in width. A canal five miles in length conducted the waters of "the sea" to the Minery Lake, another of the works of Maha Sen, to be mentioned presently, and a further canal from Minery led the waters to the neighbourhood of Trincomalie, in all a distance of fifty-seven miles. When it is remembered how sudden and torrential the rains are in a country like Ceylon—the writer has known 18 inches of rainfall in forty-eight hours over a very large extent of country, and at one spot as much as 18·9 inches in twenty-four hours,—we cannot too much admire the vastness of such a work and the skill which enabled the native engineers to use the natural features of the country in such a manner that for a distance of twenty-four miles a single embankment sufficed not only to hem in the water for purposes of irrigation but also to provide a water-way for the transport of produce and merchandise. Along the whole course of this embankment and canal and wherever its tributaries carried the life-giving water there would be without doubt a teeming population; for irrigable land in

Ceylon is capable of supporting, according to official calculation, 1,000 persons to the square mile. In 1855 there was not a single inhabited village, although a few patches of land were occasionally cultivated by people from a distance. The contrast between the remote past and the present condition of this half of the island is a painful one to contemplate, but it is to be hoped that the Colonial Government will never stay its hand until all the useful works of ancient times have been restored and improved—but this will be a work of centuries.

Long before the Christian era the main ambition of the kings of Ceylon appears to have manifested itself in the formation of tanks, and many kings are mentioned in the Mahawanso who, "for the benefit of the country," and "out of compassion of living creatures," built a dozen or more of these splendid, but absolutely necessary, irrigation works. The Minery tank, some twenty miles in circumference, and irrigating an enormous area of fertile land now entirely barren, owed its origin, along with sixteen others, to Maha Sen, who reigned about the year 250 A.D. It is now merely a swamp, resorted to by enormous numbers of wild fowl. Up to the twelfth and thirteenth centuries Ceylon produced her own supplies of food, but in the fourteenth it appears that the island was obliged to import a portion of it from India. In 1301, it is related that there were 1,470,000 villages in Ceylon. In 1410, as many as 1,540,000, the term village implying hamlet, or even a single house where there are people resident. Of the vast majority of these, if they ever really existed, not a vestige is left except the ruined tanks, which show unmistakably where the foci of population formerly were. This was shortly after the conquest of the island by the Malabars, who are believed not to have actually destroyed the fabric of the embankments, but by their system of government to have disorganised the village communities to such an extent that the works connected with the tanks fell into disrepair through neglect, the land became imperfectly irrigated, and the population gradually died out. That this process was a perfectly natural one seems evident from the fact that the tanks do not show any traces of wilful damage, and also from the consideration of the almost innumerable evils resulting in death, of which a scarcity of water in a tropical country like Ceylon is productive. Indeed one of the most frighful diseases that have ever scourged the human race is believed to have been developed in these very localities chiefly through the want of proper food, caused by the absence of a system of irrigation. It is believed, too, and there is strong evidence, based on experience, for the belief that the disease entirely disappears wherever irrigation is restored. It will naturally be asked, "If the advantages of a plentiful supply of water are so enormous, why have not the tanks been restored before this, and what hinders their immediate restoration at the present time?" The reply is, that the creation of this magnificent system of irrigation was not the work of a decade, or even of a century, but of a thousand years of successful national development, and that therefore the restoration of it must be also a work of time.

The object of this paper is to draw attention to the fact that the experiment of restoration is at the present moment in process of being tried, and bids fair, after the lapse of half a century or so, to alter entirely the character of the island. The most remarkable success has already attended the efforts to afford irrigation facilities to the Singhalese on the East Coast. Where but a few years ago the natives where half-starved and the land apparently in a hopeless condition, the re-introduction of irrigation through the assistance of the Government, has transformed not only the people, but the country, as if by magic. Rice-fields, palms, and other fruit-trees abound, and the population is increasing at a rapid rate. Of this particular district the present Governor of Ceylon (Sir William Gregory), reported some four years ago to the Legislative Council of the island in the following terms:—"In the month of April I visited the rice-growing regions of the Eastern Province, which are the creation of the irrigation works carried out by the Government. I never before saw such an unbroken sheet of grain. Save where some isolated trees, part of a recent forest broke the view, the eye wandered over some 20,000 acres of green paddy. I saw, wherever I went, a sleek, vigorous, well-fed, and thoroughly healthy population. Up to 1864 the lands under cultivation in this province were 54,000 acres, the chief impetus to the irrigation scheme having been given in 1857. In 1871 the lands in cultivation were 77,000 acres. The Crown lands to be additionally reclaimed under works already completed or in course of completion, amount to 15,900 acres, equal to the support of 23,850 persons." Again, speaking in the same report on the subject of the Great Tank already mentioned, he says: "I am most anxious to put the full strength of the department at work in restoring irrigation to Nuwara Kalawia. This magnificent district has the strongest claims upon us. It was once the granary of the island. It is now utterly neglected. It has a population of 60,000 persons and over 1,600 villages, which have each of them their tank. There are at least 1,700 of these tanks, and I am credibly informed not one of them has a sluice in order. I trust that a few years hence the population may present the same vigorous and thriving appearance as the population of the Eastern Province, and from the same causes—namely, good and plentiful food." Of this same district a gentleman of very great experience told the writer that in travelling through it many years ago he came to a village where, of the thirty inhabitants, only one of them was able to carry water, all the others having been stricken down by hunger or disease. This destitution was caused by the failure of three successive rice-crops, and was not specially exceptional, but fairly representative of what takes place frequently in the district. If we compare the scenes of plenty and contentment as they exist in the Eastern Province at the present moment with what meets us in the Wanni, or in any of the northern districts, where tanks have not been extensively repaired, the contrast is most striking. We find an almost depopulated country, with here and there a wretched village peopled by a few miserable and more than half-starved inhabitants, who, in times of scarcity, which are not infrequent, are obliged to live on roots and wild herbs, who are periodically decimated by a frightful disease, yet who seem bound to the spot where they were born, and prefer to die there rather than move away to a more fertile and healthy district. It is, indeed, this disinclination which possesses the agricultural Singhalese to move more than a day's journey from his home that presents the greatest of all difficulties to the scheme for the restoration of the tanks. It is on this account that the process of restoration is always in advance of the supply of natives to take up the new land, unless the works happen to be in the immediate neighbourhood of population. The only plan, therefore, that has proved really successful under present conditions is to restore the tanks in the vicinity of villages, and induce the population to creep slowly onwards step by step, cultivating the more fertile pieces of ground as it advances, until the depopulated districts shall have been partially reclaimed, when the completion of the work will be a matter of comparative ease. Two typical instances of this mode of procedure have been mentioned to me by an official high in the Government service, as showing the effect of a well-regulated expenditure of labour and money in restoring irrigation works. In the year 1854 Mr. Bailey, whose name will ever be associated with this scheme for benefiting the natives, spent less than 100*l.* on a canal some miles to the north of Matalé, a country town a few miles north of Kandy. The village thus supplied with water had previously dwindled away until only three houses

were left, the rice-fields were deserted, and the famine-stricken inhabitants declared that they would die where their fathers had lived and died rather than migrate to a part of the country that was unknown to them. Ten years after the improvement was made the spot had become a little oasis in the desert; nearly 200 acres of rice were under cultivation, yielding about thirty bushels per acre, and supporting a population of several hundreds.[1] Almost in the same neighbourhood a sum of between 200*l.* and 300*l.* was spent on an old canal fifteen miles in length by the same zealous Government official already mentioned. Many hundreds of acres were brought under cultivation, and in ten years' time, instead of a starved and fever-stricken population of 150 inhabitants, no less than 500 able-bodied men were on the list as liable to the road-tax. The changes in these, as in other instances, took place as if by magic, yet the means employed in effecting them were of the most limited and simple nature. The secret of the success lay in the fact that a famishing and disease-smitten population was within a few miles of the spot, and the remnants of ancient engineering skill were ready at hand to guide the labourers on to certain success. Since the above tentative experiments were made, very great changes for the better have taken place in the condition of the agricultural part of the native population. The carrying out of the scheme for the restoration of irrigation works is recognised as one of the chief duties of the Colonial Government, and there is little danger that, after the real success which has attended it so far, any future Government will allow it to be interrupted. The policy of the Colonial authorities may be summed up in the pregnant words of Sir Wm. Gregory's address to the Legislative Council in 1876:—"I consider that at least 100 tanks should be supplied with sluices, and properly repaired each year; and I have asked the Secretary of State to furnish me with an additional number of well-trained officers, by whom these works will be carried on with vigour. There is no boon which the Government can confer on the villagers more legitimately than this. It is a reward for their own exertions, and I am confident that each year, as it becomes better understood, it will be more appreciated, and that it will be recognised everywhere that the Government have no other object in it than to increase the comfort and resources of the people." It will appear, from what has been quoted, that the tanks are not repaired free of cost and then handed over gratuitously to the villagers, but the natives are required to give a certain amount of labour in restoring the tanks, and also to pay a small rent or tax on the land cultivated, so that, whilst the native cultivator is the chief gainer by the undertaking, the Government is no loser. If there could have been a doubt as to the wisdom of the Tank Restoration scheme, the experience of the last three years must have dispelled it and proved how absolutely necessary a system of irrigation is to the welfare of the natives. In the address above quoted, whilst speaking of the cholera and other diseases which had visited several of the provinces, the Governor says:—"It is remarkable that the inhabitants of the Eastern Province enjoyed perfect immunity from epidemics of all kinds. It is an interesting question, on which I do not give an opinion, whether this general immunity from disease in the Eastern Province is due to the abundant supply of food throughout the populous part of it, the result of irrigation works." At the same time he speaks of the restoration of two of the large tanks as complete. One of these will irrigate 23,000 acres, equal to supporting a population of 35,000 persons; the other will bring large tracts of magnificent land into cultivation, and dissipate the unhealthiness of the district which has hitherto prevented settlement.

[1] Irrigated rice-lands in the low country will support population at about the rate of 1,000 persons to the square mile.

To look back over the early history of the attempts under Sir Henry Ward to restore the above system of irrigation, is like reading the accounts of the commencement of a successful campaign. The difficulties encountered were sufficient to discourage even enthusiastic philanthropists, chief amongst them being the utter disorganisation of the village communities through the abolition of compulsory labour and the rooted dislike of the natives to migrate from one spot to another. For the recent part of the evil caused by this disorganisation the British Government was alone to blame, for in abolishing Rajekaria they abolished the right of compelling villagers to keep their tanks and watercourses in repair. By doing this they practically placed the distribution of the most valuable property of which the natives were possessed in the hands of the strongest, and consequently the most unscrupulous, inhabitants of each district. In a dry season, when there was barely sufficient water to irrigate the fields along the course of a canal, those who who were nearest to the source of supply would probably get more than their share, whilst those who were furthest from it and had an equal claim on it might get none; but, generally, the strongest party would get the advantage, to the ruin of the weaker. Dams would be built at various points along the course of the stream by one party, and as quickly destroyed by another. Interminable feuds were the results, and appeals to the courts of law, which, not being guided by native customs, only made matters worse. The canal, too, which ought to have been kept in proper repair by the united efforts of all who benefited by it, was allowed to fall year by year into a more ruinous condition, after compulsory assistance had been abolished, the residents on the upper portion of it refusing to aid those on the lower to repair the breaches made by the annual floods. Consequently the work that was done was ill done, and only of a temporary character. Soon it became beyond the power of isolated communities to effect the necessary repairs; the lands fell out of cultivation, and the population, after a long struggle with their neighbours, either died out or sought a living elsewhere. The early legislation in 1856 was based on a revival of the native customs and a compulsory distribution of the necessary work among th different villages, a majority of two-thirds of the inhabitants being enabled to place the lands under the Irrigation Ordinance, and to compel the assistance of all who benefited by the supply of water. The scheme resulted in complete success. It met the great want of the natives and the interminable disputes about boundaries and rights of water, which was as much property to the natives as the land itself, soon ceased. The Government claimed its own and sold large portions of it by auction at a very reasonable rate, the upset price being generally 1*l.* per acre, the land continuing to be chargeable with a yearly tithe to the Government of from 3*s.* to 4*s.* per acre. In special cases the Government granted even easier terms in order to induce the natives to settle in particular localities. Newly-purchased land was allowed to be free from tithes for four years, and the purchase-money was spread over an equal period from the time of sale. The pecuniary result was most gratifying to the Government, and the benefit conferred on the natives inestimable.

A few words will be sufficient to describe the character of the cultivation which this system of irrigation is intended to promote. A crop of rice, or paddy, as the undressed grain is called, requires about ninety days to come to perfection, and during this time it must be supplied with about thirty inches in depth of water, or a little over 4,000 cubic yards to the acre. The first and second watering of the paddy takes place within a fortnight of the sowing of the seed, and the water is only allowed to remain on the land for a short time. The three subsequent waterings take place about the twentieth, the

fortieth, and the sixtieth days after sowing, from eight to ten inches of water being used each time, and the water is allowed to remain on the land until it has evaporated. This system, though more or less modified according to the climate and the supply of water, is fairly representative of rice-cultivation in the lowlands of Ceylon. The official estimate of the produce is about thirty bushels per acre. It is probable that exactly the same system existed in the very earliest times, and that the Singhalese engineers were able to regulate the flow of water through the tank sluices just as they wished. It certainly seems unreasonable to suppose that the men who could design such a vast irrigation system with no better means of levelling than that of leading water by actual experiment from one point to another, should fail in minor matters such as sluice-gates. Yet the writer believes that nothing is known as to the manner in which the flow of water was regulated. It is true that in some of the sluices a square masonry well is found leading upwards from the sluice soon after it has entered the embankment from the tank, but there is nothing left to show how it was used. Captain Sim, R.E., some years ago suggested that it was intended to break the force of the water rushing in flood-time towards the sluice and reduce the velocity of the water in the sluice to that due to the pressure in the well only. I am however inclined to think that a frame of wood somewhat in the shape of a box strongly braced together was fitted into the well so that it could rise and fall readily under the influence of the water in the tank, and that by placing weights on the top the frame might be forced down so as to cut off either partially or wholly the water issuing through the sluice. Wherever rocky foundations could be found for a dam or a ledge of rocks for a spill-water, the native engineers, as if distrusting artificial constructions, would be sure to utilise them. In some cases, where it was possible to include masses of rock in the embankment, the sluices themselves would be cut out of the solid gneiss and the work thereby rendered as indestructible as the rock itself.

It will no doubt be somewhat surprising to persons who are only acquainted with the system of rotation of crops in vogue in Europe, that these rice-lands can be made to produce year by year for hundreds of years consecutively, one or two crops of grain annually without the land becoming exhausted or requiring to be continually renovated by manure. The explanation, however, seems to be that sufficient vegetable matter is carried down from the hills partly in solution and partly in suspension in water to supply all the waste produced by the continuous cropping. Those who have visited the richest alluvial valleys of California and Australia will no doubt have been struck by the fact that the most fertile soil is always found where the alluvium has been deposited in extremely fine particles and in water practically at rest, conditions which obtain in the paddy fields of Ceylon, and must have obtained formerly on the Hunter River in New South Wales, and in the valleys opening on the Bay of San Francisco.

I cannot better conclude this paper than with an extract from a minute by Sir Henry Ward, after a tour of inspection in 1859 :—

"The village of Samantorre is a very fine one, and stands on the borders of the richest plain in Ceylon, containing, as it does, nearly 15,000 acres of paddy. Mr. Birch and Mr. Cumming informed me that the scene of joy and excitement exhibited by the whole population when the water first came down from the Ericammam, in July, 1858, and saved a magnificent crop from destruction by drought, was one of the most striking things ever witnessed. Hundreds of people had collected at Samantorre as soon as they knew that the sluices were to be opened ; and when the water was actually seen advancing down the bed of the dried-up river, the shouts, the firing of guns, the screams of the women, the darting off of messengers bearing the news in every direction, made a deep impression on all who saw it. They felt that a great work had been done, a great benefit conferred. But I feel also that under British rule this benefit ought to have been conferred thirty years ago upon a people so capable of appreciating it. Indeed, knowing what I now know of the history of the Eastern Province, I hold that what the Government is doing in 1859 is simply the payment of a debt incurred by our rash interference with a people of whose habits and wants we knew nothing. This error is now in part repaired. 44,000 acres of land are already under paddy cultivation, and I see reason to believe that the amount will be not less than 60,000 acres in 1861, when the irrigation works have obtained their full development. But this will require constant attention on the part of the Government and of its local representative. The maintenance of the *system* must never be lost sight of, and should unforeseen demands for assistance arise they must be met liberally and promptly." The words of so successful a governor have not been forgotten. The present governor, Sir William Gregory, has devoted all his energies to the carrying out of what was so well begun. The survey and engineering staff of the colony has been considerably increased, and the restoration of nearly the whole of the ancient irrigation works, besides the creation of new ones, may now be considered to be only a question of time.

R. ABBAY

NOTES

THE *Times* devoted a leading article last Thursday to Mr. Forster's remarkable speech at Bradford, in which he attempted to indicate the latest ideal of what elementary schools and universities ought to be. The *Times*' summary of the points of Mr. Forster's address is very satisfactory. "Mr. Forster's notion of a public elementary school is very unlike that which has been commonly entertained. The school is to be for the benefit of all classes. All subjects are to be taught at it, with no other limitation than such as may be imposed by the wants or capacity of the scholars. The secondary school is to supplement the teaching of the primary school, and to do for boys of a more advanced age the same sort of work which the primary school has done for them up to the age of thirteen or fourteen. That science should be introduced as a regular part of the school course is, in Mr. Forster's opinion, most desirable. History and geography he considers, indeed, as of even greater importance than science, but he places the claims of science above those of grammar, and seemingly above those of the study of language in any form. He is very hopeful that the older universities will consent to model themselves on the plan he suggests, and to grant degrees for science without insisting on Greek and Latin in addition to it. If they will not do this, or if they are very long about it, he will look to younger bodies, untrammelled with literary traditions, to take their place in this matter. What Oxford and Cambridge may refuse, Manchester and Leeds will make no difficulty in granting, and a combined university for the North of England is to be set up accordingly and invested with the necessary powers." The *Times* does not seem to know very well its own mind on the subject referred to by Mr. Forster. It clings to the old ways, and virtually confesses that the new ways are as indispensable as the old, that some knowledge of science is now indispensable to all. Mr. Forster declares we have no right to erect Board Schools and compel children to attend them, only to give them a smattering of the three R's. The purpose of these schools—which he, with many others, thinks ought to be open to all classes, and afford an elementary education which would be considered adequate by any class—is to fit the children who attend them to make a fair start in life, and in this scientific age, as the *Times* virtually admits, no one can be said to have a fair start if he be ignorant of at least some of the results of science. Mr.

Forster rightly believes that science affords at least as good a mental discipline as the study of languages as the latter is carried on at our schools and universities; and indeed, there need be no dispute on the matter as there now exists abundance of material for comparing the mental power of the scientific man with that of the pure literary man. We need scarcely repeat the argument that to omit science from education either in the school or university, is to leave at least one half of the mind untrained, and that too in more respects than one, the most important half. In the issue of the *Times* that contains the leader referred to, it is reported that the School Board for London is to move Government to establish one or more secondary schools in each School Board district, to which such children may be transferred as prove an aptitude for carrying their studies further. Thus so experienced a body as the London School Board are driven to the conclusion that elementary education as at present conducted is an inadequate provision for the wants of our youth. It is simply a question of time, and a very short time too, the introduction of science into schools of all grades. The old universities have been driven to it, and even Mr. Forster is struck with their modern liberality.

THE French Geological Society has appointed a large committee of organisation in connection with the International Geological Congress to be held in Paris in 1878, the plan of which we described in vol. xv. p. 87. The president of the committee is Prof. Ed. Hébert, and the secretary Dr. Jannettaz. We trust that English geology will be well represented at this congress. At the recent meeting of the American Association Prof. Sterry Hunt presented the report of the general committee of the proposed congress. A circular in English, French, and German, had been sent by the secretary to the principal scientific societies and academies, as well as to the workers in geology throughout the world. The response to this invitation has been most gratifying. The Geological Society of France has formally recognised the great importance of the objects proposed, and promised its hearty co-operation. Spanish and Italian geologists have translated and published the circular in their respective languages, and have communicated to the secretary their strong approval of the plan. The Geological Society of London and the Geological Survey of Great Britain have also formally signified their approval of the objects, and the co-operation of Norway, Sweden, Russia, and Austro-Hungary is promised. It is to be regretted that Germany has declined to take a part in the International Exhibition of 1878, but it is hoped that this will not prevent her geologists from joining in the proposed congress. The director of the Geological Survey of Japan promises to take a part in the work, and the same assurance comes from Brazil, where the circular has been translated into Portuguese. Chili and Mexico have also responded, and promise an ample representation of their geology at Paris next year; while Canada, both through her Geological Survey and in the person of Dr. Dawson, will probably be represented. The Government of the United States has as yet failed to accept the invitation of France to take part in the Exhibition of 1878, so that American geologists are not certain that they will be able to participate in the International Geological Exhibition. In any event it is probable that several members of the American committee will be present at the proposed Geological Congress. It is recommended by the Standing Committee of the Association that in addition to the names of Prof. J. P. Lesley, of Philadelphia, and Prof. A. C. Ramsey, Director of the Geological Survey of Great Britain, already added to the International Committee, the presidents for the time being of the Geological Societies of France, of London, Edinburgh, and Dublin, of Berlin, of Belgium, Italy, Spain, and Portugal, and of the Imperial Geological Institute of Vienna, be invited to form part of the committee.

THE subscription list for the Liebig Memorials is now closed. For that at Munich, 5,750*l.* has been subscribed, and for that at Giessen, 1,200*l.*

DR. HERMANN KARSTEN, Professor of Mathematics and Mineralogy in the University of Rostock, died on August 26.

IT may interest mathematical readers to know that the lecture given by Prof. Voss, of Darmstadt, on the occasion of the Gauss centenary, has been published by Bergstraesser of Darmstadt.

DR. WERNER SIEMENS has contributed to the *National Zeitung* some very interesting notes on the history of the torpedo. Dr. Siemens maintains that the first idea of protecting navigable waters by means of sinking mines is due to C. Hemly, Professor of Chemistry at Kiel, along with whom he laid the first submarine mines in Kiel Bay, during the Schleswig-Holstein war. The service of Prof. Jacobi, of St. Petersburg, who was not aware of the earlier works at Kiel, consisted in the introduction of contact-torpedoes, and the application of the name torpedo to submarine mines.

M. FAYE, who is a candidate for the post vacant by the death of M. Leverrier, is a Government candidate at the present election.

PREPARATIONS are being actively made for Prof. Nordenskjöld's voyage along the north coast of Europe and Asia, and out by Behring's Straits, which even in summer are by no means free of drift ice. Already a steamer, the *Vega*, has been purchased for the expedition. The greater part of the cost of the undertaking will be defrayed by Mr. Dickson of Gothenburg, King Oscar of Sweden being also a contributor to a considerable amount.

A PARIS telegram states that Capt. Wiggins's vessel, the *Thames*, after wintering at Jenissei, grounded at the mouth of the river on starting, and has not yet been floated, though its cargo was thrown overboard, including, it is feared, the collection of Mr. Seebohm, the English naturalist, who was a passenger.

IT is stated that it is the intention of Sir Allen Young to have the *Pandora* refitted, with a view to another start for the Arctic regions next spring. Sir Allen will most probably try the Spitzbergen route in preference to Smith's Sound. Should Sir Allen decide on carrying out his views, the *Pandora* will be fitted with a hurricane deck over her spar deck, and undergo a variety of alterations which the great experience of her owner has shown to be necessary.

MR. BARCLAY, a naval officer recently arrived in South Australia, has been engaged to take charge of a party about to explore the country from Alice Springs, on the telegraph line, towards Queensland.

ON October 2nd, the Annual *Conversazione* of the Chester Society of Natural Science was held in the Town Hall of that city. The objects exhibited were of great interest, illustrating the work of the members in examining the natural history, geology, and botany of the Society's district, and were well appreciated by a very numerous gathering. During the evening a bust, executed by Mr. Belt, of the late Canon Kingsley, was unveiled by the Dean, who announced the conditions under which a "Kingsley Memorial" prize and medal are offered annually to residents in the Society's district for research into the botany, geology, and natural history of the area in question, these subjects being taken in rotation. There can be no doubt a stimulus will be given by these prizes to original and local research, which will be the means of not only increasing the taste for natural science in the district, but of yielding results of real scientific value.

THE observatory on the Pic du Midi, France, has been connected with Bagnères by an electric telegraph, and Gen.

Nansouty has resumed his former post with the power of sending warnings to the lowlands. The telegraphic line from Bagnères to the Pic is 28,000 metres long; the altitude of the Pic is 2,866 metres, and of Bagnères about 550; consequently, the difference of altitude exceeds 2,300 metres. The laying of the telegraph was a very difficult operation, and a portion of the wire has been placed underground. A number of lightning-conductors have been established for protection, and the extremity of the line has been immersed in the lake of Oncet at a small distance from the final slope. Warnings and regular observations will not be sent to the international head office at the observatory, until a final decision has been made as to Leverrier's successor and the organisation of French meteorology. Great efforts are being made by the Meteorological Society to establish a special meteorological office.

BUNSEN'S "Gasometrische Methoden" have appeared in a second revised and enlarged edition.

THERE was a severe earthquake shock at Geneva on Monday morning. Clocks were stopped, bells were rung, buildings cracked, and the English and Russian churches were rather shaken. No great damage was done. The shock extended to Berne, Mulhouse, and Malesina in North Italy.

THE meeting of the Sanitary Congress at Leamington last week was decidedly successful so far as the value and appropriateness of the papers read are concerned, and we hope that substantial practical results will soon follow. A very interesting paper was read by Surgeon-Major De Chaumont on the effects of climate upon health. His conclusions were:—(1) That with proper hygienic precautions there is hardly a place on the earth where man may not enjoy good health, and that where this is not found possible it is from the existence of malaria; (2) that, admitting this much, there are, however, still differences existing which render residence in certain climates more desirable than in others, as most conducing to the fullest health and vigour; (3) that the possibility of acclimatisation has been greatly exaggerated, but that there still remains a residuum of truth in the idea; (4) that there is still a certain importance to be attached to the climatic treatment of disease, although the particular factor or factors that produce the influence are still involved in much obscurity.

THE Prefect of the Seine has issued a decree forbidding bakers and pastrycooks to burn in their ovens wood which had been painted or impregnated with any metallic salt. This measure has been taken in conformity with the advice of the Council of Hygiene, which is said to be giving other signs of its renewed life and activity.

M. GASTON TISSANDIER and his brother have made an ascent from Giffard's aëronautical gas-works, for the purpose of collecting the dust floating in the atmosphere. The method employed has been to condense the moisture of the air and analyse the water and ice thus obtained with a microscope.

THE English price of the *International Review* has been reduced from 4*s.* 6*d.* to half-a-crown. This is presumably done to bring it on a level with the *Contemporary* and *Nineteenth Century* in price as well as in general aim.

THE *Gentleman's Magazine* for October contains an account, with a map, of the missionary colony, Livingstonia, on Lake Nyassa, by Mr. F. A. Edwards.

THE members of the Woolhope Club, struck with the absence of any good illustrated English work on the apple and pear, have decided to publish a "Pomona," in which a carefully-coloured illustration will be given of all the best varieties of apples and pears grown in Herefordshire—and therefore in England—so as to call the special attention of all fruit-growers to those varieties which are most worthy of cultivation. Every apple or pear described will have its outline and coloured representation, whilst the descriptive letterpress and general production of the work will be under the supervision of Robert Hogg, LL.D., F.L.S., &c., &c. The Woolhope Club proposes to publish the "Herefordshire Pomona" in annual parts, of full quarto size, one at the close of each year. Each part will consis of six or more coloured plates, according to the amount of annua subscriptions received. The Club guarantees the publication of the first part at the close of the present year, 1877, and it will contain an introductory paper on "The Early History of the Apple and Pear," and also one on the "Life of Thomas Andrew Knight," president of the Royal Horticultural Society, "and his Work in the Orchard."

IN a new form of the Sprengel air-pump described in a paper at the British Association by C. H. Stearn and J. W. Swan, the mercury reservoirs at the top and bottom of the pump are closed so that the external atmosphere exerts no pressure on the surface of the mercury contained within them. In consequence of this the fall-tube may be much shortened while the efficiency of the instrument is retained. At the commencement of the exhaustion of a receiver the mercury supply reservoir is filled to the top and closed by a stopper; a small exhausting syringe attached to the reservoir at the bottom of the fall-tube is then set in action, which removes a considerable portion of the air from the receiver to be exhausted, and also very much reduces the pressure on the mercury in the lower reservoir; the flow of mercury through the pump rapidly completes the exhaustion. A small vacuum tube with aluminium wires a quarter of an inch apart was exhausted in twelve minutes to such an extent that an induction coil giving sparks half an inch long in air failed to produce the faintest luminosity, the fall-tube of the pump being only nine or ten inches long.

AT one of this year's meetings of the Dresden Naturalists' Society "Isis," Herr Schuster read an interesting extract from a chronicle of the town of Meissen, dating from the year 1590, and written by Peter Albinus, in which the mines in the environs of Meissen are described. Amongst the *natural* products of the district the author mentions the numerous vases and urns which were frequently excavated, and were superstitiously believed to have grown in the ground. People at that time believed them to be inhabited by dwarfs, and that when winter approached they sank down deeper into the earth; while in spring, and particularly in May, they again rose to the surface, and thus formed a flat little cone above themselves. Although Albinus himself thinks this belief rather too coarse, and ventures his opinion that the objects in question are artificial—thus showing that already three hundred years ago the interest in these remains of prehistoric times was a vivid one—it is to be regretted that the superstition we have mentioned has even up to this day not yet died out entirely, since a great part of the uneducated masses in Saxony are still of the same opinion with regard to the vases and urns.

AT another meeting of the same society some interesting statistical data were given showing the total quantities of the various products obtained from a single Saxon mine, the *Himmelfahrt Fundgrube*, near Freiberg, since its opening in the year 1524. This mine up to the end of 1875 had yielded about 535 tons of silver, 54,125 tons of lead, 1,785 tons of copper, 13,585 tons of sulphur, 2,175 tons of arsenic, and nearly the same quantity of zinc.

A THIRD note of interest read at a meeting of the same society was by Herr L. H. Zeitteles, and treated of the prehis-

torical ancestors of our common house-dog. The author, who studied the subject for eleven years, arrived at the conclusion that neither wolves nor foxes had any part in the phylogeny of the dog, but that jackals and the so-called Indian wolf, *Canis pallipes*, Sykes, were the original ancestors of *Canis familiaris*.

THE first volume of the *Annals* of the Royal Belgian Museum of Natural History contains the first part of Van Beneden's work, "Description des Ossements fossiles des environs d'Anvers," which deals with the Pinnipeds, and is illustrated by fourteen engraved plates.

THE additions to the Zoological Society's Gardens during the past week include a Grivet Monkey (*Cercopithecus griseo-viridis*) from West Africa, presented by Mr. R. Dudgeon; a Lion (*Felis leo*) from Persia, presented by Mr. F. Pollock; a Common Seal (*Phoca vitulina*) from the British seas, presented by Mr. G. Mellin; a Great Kangaroo (*Macropus giganteus*) from New South Wales, presented by Mr. T. Phillips; a Collared Peccary (*Dicotyles tajaçu*) from South America, presented by Mrs. E. J. Barrett; two Emus (*Dromæus novæ-hollandiæ*) from Australia, presented by Lord Francis Conyngham, M.P., F.Z.S.; two Peregrine Falcons (*Falco perigrinus*), European, presented by Mr. Darill Stephens; a Black-headed Partridge (*Caccabis melanocephala*) from Hedgar, a Hyacinthine Porphyris (*Porphyrio hyacinthinus*) from Mesopotamia, presented by Capt. Burke, S.S. *Arcot*; a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, an Arabian Gazelle (*Gazella arabica*) from Arabia, deposited.

AMERICAN SCIENCE

IN the last number of the *American Journal* Mr. Charles Wachsmuth continues his notes on the internal and external structure of palæozoic corals, and discusses the construction of the summit and its value in classification. He believes that while the construction of the ventral disc or actinal side of the calyx has not received the attention it deserves, it affords a clear and important distinction between recent and ancient crinoids. Commenting on Rœmer's classification of "the true crinoids which are supported by an articulated or jointed column" given in *Lethæa geognostica*, 1855, Mr. Wachsmuth says he expects from a dissection of *Synbathocrinus* that in other of the Cupressocrinidæ the central opening was closed, and that the consolidating plates were further overlaid with plates forming the floor of a passage in connection with the arm furrows and visceral cavity. In speaking of the Cyathocrinidæ he refers to the covering of Cyathocrinus, as throwing light on the summit structure of other genera, and remarks: "It is worthy of note that the Cyathocrinidæ, in the structure of their vault, bear closer resemblance to the recent crinoids than almost any other group, and seem to hold an intermediate position between modern and palæozoic types. The Cupressocrinidæ and Cyathocrinidæ thus fall naturally into a group by themselves, having the vault supported by consolidating plates and covered by an immovable arch of small plates." In the Taxocrinidæ Mr. Wachsmuth has found that there are solid plates, though they have been before described as covered by some soft material. Among the spheroidæ, which range from the silurian to the subcarboniferous, the summit is found well preserved in most genera. Besides details of obsevations some generalisations are added. "Closely related as the recent crinoids are to their palæozoic ancestors in some points, the solid vault of the latter cannot in the remotest degree be homologised with the soft peristome of the former." Many facts tend to prove that the palæozoic crinoids embracing therein all true crinoids in which the actinal side is closed, represent the young stage of growth of living types. They form a distinct group of crinoids, and it is proposed to call these paleocrinoideæ.

Prof. Draper advocates the use of the cylinders of zirconia for the oxyhydrogen light in such cases as the employment of the microscope to throw objects on a screen for lecture demonstrations. A high brilliancy with the least variability in the light, and a fixity of its position in the optical axis of the apparatus, are needed for success. Prof. Draper gives his reasons for believing that the oxy-zirconium light fulfils all requirements better than any other known light. "It has the intrinsic brilliancy, the invariable brilliancy, the fixity of position in the optical axis of the apparatus, and it does not volatilise under the heat employed. The condensing lenses remain free from deposit, and after the light is once adjusted the experimenter can carry on his demonstrations without the distraction of his attention that attends the use of the other lights." He gives direction for the preparation of zirconium oxide, and for the preparation of the cylinders.

Mrs. M. S. Cheney and Mrs. Ellen S. Richards, dating from the women's laboratory, Massachusetts Institute, describe a new and ready method for the estimation of nickel in pyrrohotites and mattes.

Prof. J. D. Dana is publishing his conclusions as to the relations of Vermont and Berkshire geology, and Ed. S. Dana has recently described garnets from the trap of New Haven.

Mr. G. B. Grinnell, who has devoted attention to the annelids of the Cincinnati group, describes a new genus from the Lower Silurian. They have hitherto been inferred from their trails, and the hard chitinous parts now found do not seem to belong to any recognised genus.

Mr. Joseph Le Conte, criticising Dr. Hermann's paper on "The Passage of Luminous Pencils obliquely through Lenses and on a Related Property of the Crystalline Lens of the Human Eye," points out that the periscopic structure of the lens is useless, because periscope perception of the retina is wanting. It must be regarded as an example of a structure which has outlived its usefulness.

Prof. O. C. Marsh (in the Appendix to the September number of the *American Journal*) describes new fossil mammals, birds, reptiles, and fishes, from the Rocky Mountain region. Among the mammals are two miocene edentates, the first detected in the country, and a third species from the lower pliocene. The names of the new species are *Moropus distans*, *Moropus senex*, *Moropus elatus*, *Amynodon* (gen.), *Tapiravus rarus*, *Bison ferox*, *Allomys nitens*, *Graculavus lentus* (a bird the size of a duck), *Diplosaurus felix*, *Crocodilus solaris*, *Nanosaurus agilis* (a dinosaur no larger than a cat), *Nanosaurus victor*, *Apatodon mirus*, *Heliobatus radians*.

We have already referred to an important exploration of the natural history and ethnology of the West Indies, now in course of prosecution by Frederick A. Ober, under the auspices of the Smithsonian Institution. Some interesting collections of specimens have already been received at Washington from Mr. Ober, embracing particularly a series of the birds of the island of Dominica, including several species new to science, and others of excessive rarity. Among the latter is a huge parrot, one of the largest of its genus. The latest advices from Mr. Ober are dated Antigua, August 6. He was then about proceeding to St. Kitts, and thence through the chain of English islands to Granada, including the Dutch islands of Saba and Eustatius. The region to be explored by him extends over six degrees of latitude, and will occupy him at least two years. Not the least important results of Mr. Ober's work have been the studies made during a long residence among the Carib tribe of Dominica. He has been able to secure numerous photographs of this little-known people, and many illustrations of their manners and customs, all of which will be hereafter the subject of a popular article for some one of our leading journals.

The Kansas University scientific expedition of 1877 has found a number of a very rare species of beetle of the genus *Amblychila*, the acquisition of which has long been an object by collectors of coleoptera. For the purpose of securing funds to defray the expenses of their explorations, the authorities of the university offer specimens for sale at a moderate price.

A precious limestone has been found at Tehachepa, Kern County, California, which is said to be identical with the "giallo antico" (ancient yellow) marble of Italy. The latter is highly prized by antiquarians, as the location of the quarry from which it was procured has been unknown for several centuries. The California stone is described as white with amber-coloured veins. A specimen has been presented to the State Geological Society.

Mr. Edward Bicknell, a gentleman well known among American microscopists, died on March 19, at Lynn, Massachusetts, at the age of forty-seven. Originally a resident of Salem, he joined the scientific corps of workers at the Museum of Comparative Zoology in Cambridge, with which he was

connected until the death of Prof. Agassiz. His sections of shells and rocks were of extraordinary beauty, and he was also specially skilled in the preparation of injected objects.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The Oxford University Commissioners will sit for a fortnight at Oxford, from the 22nd of this month. They will occupy rooms at the Clarendon Hotel, the University being unable to place sufficient accommodation at their disposal. It is understood that evidence will be received during this sitting as to the requirements of the University. The *Academy* states that it is rumoured that the Oxford University Commissioners propose to devote the first year to taking evidence; they will then lay down principles, and, lastly, will receive and adjudicate upon the schemes of the various colleges.

CAMBRIDGE.—Mr. William James Sell, B.A., Scholar of Christ's College, has been appointed joint demonstrator of Chemistry in the University in conjunction with Mr. Hicks.

Mr. J. Aiken, of Liverpool, who a few years ago gave a donation of 1,000*l.* to the Association for the Higher Education of Women at Cambridge, has signified his intention of placing at the disposal of the Association an exhibition of 30*l.* for two years.

MANCHESTER.—The session of the Owens College was opened on Tuesday, the 2nd inst., with an introductory address by Prof. Williamson, F.R.S., on the present aspect of the evolution theory. So far as can yet be judged the attendance of students promises to be very good during the session.

IRELAND.—The thirteenth annual meeting of the Convocation of the Queen's University in Ireland was held on October 5 in Dublin Castle, under the presidency of Sir Dominic Corrigan, Vice-Chancellor. The annual report referred to the great necessity that now was manifested for the supply of central buildings for the University in the Irish metropolis. The report was unanimously adopted, and it was urged by the speakers that a representation should be made to the Government for a grant in aid of the erection of necessary buildings. A motion in favour of the admission of women as medical students to the colleges of the University was lost.

GLASGOW.—It is stated that Dr. Cleland, of Galway, has been appointed to the Chair of Anatomy in Glasgow University, recently vacated by Dr. Allen Thomson.

Mr. A. Orr Ewing, M.P. for Dumbartonshire, has announced his attention of founding, in connection with the Glasgow University, four bursaries of 25*l.* per annum each, tenable for four years. Mr. Orr Ewing expressly declares this to be an experiment to test the working and results of the bursary system before resolving upon a permanent endowment. To this end he has decided to place the sum of 1,600*l.*, payable in seven annual instalments, at the disposal of the Senatus.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 1.—M. Peligot in the chair.—The following papers were read:—On the order of appearance of the first vessels in the shoots of Lysimachia and of Ruta, by M. Trécul.—Reply to M. Angot's last note on the system of winds in the region of the Algerian chotts, by M. Roudaire.—Boric acid; methods of investigation; origin and mode of formation, by M. Dieulafait. *Inter alia*, he considers (in opposition to some high authorities) that the boric acid and accompanying substances in the *lagoni* of Tuscany and in analogous beds, are (with exception of the carbonic acid) products exclusively sedimentary, their mode of formation being fully explained from a study of the mother-waters of salt-marshes. It is unnecessary to call in any volcanic action. Boric acid seems to have existed in seas from the earliest ages, and to have been deposited wherever portions of sea got separated under suitable conditions. This occurred on an immense scale at two epochs widely apart, viz., in the trias, and at a certain horizon of the tertiary formation. It is in the *last* mother-waters of salt-marshes that boric acid is concentrated.—Employment of pyritous earths for treatment of phylloxerised vines, by M. Dufresnoy.—Integrals of oblique developers of any order, by Abbé Aoust.—Discovery of oxygen in the sun, and new theory of the solar spectrum, by Prof. Draper.—Note on the magnetisation of tubes of steel, by M. Gaugain. If a neutral cylindrical bar of steel, at ordinary temperature, be introduced into a magnetised tube of steel and withdrawn after a few seconds, it will be found weakly magnetised in the same sense as the tube. But if, after insertion, the system be heated with a lamp to about 300 deg., allowed to cool, and the core then drawn from the tube, the tube will be found to have lost a large part of its original magnetism, and the core to have taken an inverse magnetism.—On the exact measurement of the heat of solution of sulphuric acid in water, by M. Croullebois. The hitherto divergent results are attributed to a fact observed by M. Kirchhoff, viz., that the thermal effect is intimately connected with the tension of aqueous vapours emitted by the solution, and consequently with the temperature. Taking this into account the author gives a table of calories corresponding to different temperatures from 10° to 24°.—Continuation of researches on the effects of electric currents of high tension, and their analogies to natural phenomena, by M. Planté. This relates to effects had on placing the positive electrode of a battery of 800 secondary couples in distilled water, and bringing the negative platinum wire near the surface, a column of water having been inserted in the circuit to obviate fusion. A small globe of fire appears, taking an ovoid form when the electrode is raised a little, while a number of blue luminous points in concentric circles are seen at the surface of the water. Rays presently start from the centre and join the points; they go into gyration in one direction or the other, and describe spirals; sometimes they disappear on one side. Lastly, with increased velocity of gyration, all vanish, and only the blue concentric rings are left. The experiment bears on the formation of globular lightning.—Some new researches on the metal davyum, by M. Kern. New researches on the density confirm the former. From preliminary experiments the equivalent is shown to be greater than 100, and probably near 150-154.—New modes of formation of oxide of ethylene, by M. Greene.—Note on the wire-drawing of platinum, by M. Gaiffe. He has got stronger fine wire by excluding atmospheric dust more completely.—On the fecundation of echinoderms (continued), by M. Fol.—Metamorphoses of cantharides (*Cantharis vesicatoria*), by M. Lichtenstein.—On the mutual antagonism of atropine and muscarine, by M. Prevost. He asserts (contrary to some) that large doses of muscarine will produce toxical effects in animals previously atropinised.—Trajectory of the bolide of June 14, 1877, by M. Gruey.—Meteorological observations in a balloon, by MM. Tissandier. They found a layer of air 400 m. thick, at a height of 400 m., moving pretty rapidly between two other layers almost motionless; a rare phenomenon.—On a halo observed at Brest on August 31, 1877, by M. Salicis.—Reflections on the meteorological works of M. Brault, by M. Buys-Ballot.

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