THURSDAY, JULY 10, 1879

CLEMENTS' ORGANIC CHEMISTRY

A Manual of Organic Chemistry, Practical and Theoretical, for Colleges and Schools, Medical and Civil Service Examinations, and especially for Elementary, Advanced, and Honours Students at the Classes of the Science and Art Department, South Kensington. By Hugh Clements, of H.M. Civil Service. (Blackie and Son, 1879.)

A GOOD text-book should be correct as to facts and descriptions, so as to leave nothing for the student to unlearn; it should, without being tedious or cumbrous, be minute as to the information it contains, so as to spare the student the necessity of going over the same ground again; its arrangement should be thoroughly logical, building up the science from its first principles, and presenting it to the reader as a connected whole and not as a collection of dislocated and dissevered members; its language should be lucid, terse, and vigorous, in order to relieve the intellect and memory from any unnecessary strain; and, finally, it should be written by a person who not only knows the subject, but knows also how to teach it.

It is greatly to be feared that the encouragement offered by the Science and Art Department to the teaching of the various sciences included in its syllabus has not been productive of unalloyed good; it has called into existence a vast number of presuming and incompetent "science (so-called) teachers," and has undoubtedly been the ultimate cause of the deluge of illogical, incorrect, and imperfect text-books that has for years past flooded the educational market. These worthless and pernicious books naturally divide themselves into two classes, and it is very hard to tell which class is the more mischievous. In the first class we have the books that carry on their very faces conclusive evidence that they are written by individuals who know little or nothing of the subject they are pretending to treat—by men who have an enormous amount to learn before they can have anything whatever to teach. When these *savants* condescend to treat of experimental science, it becomes at once evident that they are writing about experiments they have never performed and apparatus they have never seen.

In the second class we have abler, but certainly not better books—these are the books written by fairly erudite authors, but written with a motive that is a disgrace to the author, an insult to the teacher, and a monstrous injustice to the student—they are the barefaced *cram books*—books written in order to enable the student to pass a specified examination, and not to aid him in obtaining any real knowledge of the subject. We are truly sorry to find that these miserable volumes are very extensively patronised and adopted by teachers, and if we are to judge from recent articles and speeches cramming and "spotting the questions" are considered not only legitimate but praiseworthy proceedings. For the credit of the teaching profession we are happy to say that there are many honest and able teachers with whom a correct and thorough knowledge of the subject is the first consideration, and a "pass" but a subordinate one; yet it must be confessed that an alarming number of teachers seem to think that "science teaching" consists in imparting to their students a few leading facts without any attempt at showing their connection or their bearing upon one another, and in getting them to learn, by *rote*, stereotyped answers to a few stock questions, trusting to chance that in one shape or another a sufficient number of these *stock questions* will turn up to enable their pupils to obtain at least 33 per cent. of attainable marks, and so entitle them to a "second class." Other teachers, considerably more able, but scarcely more conscientious, study the hobbies and the idiosyncracies of the examiners, and in the course of several years' practice manage to attain a wonderful amount of skill and success in securing passes. On the strength of this success they gain a pretty wide reputation as "excellent teachers," while in reality they impart to their pupils little or no knowledge of their subject as a science; all the information is conveyed and accepted on the mere *ipse dixit* of the teacher without any attempt at logical demonstration, and as a natural result teacher and taught get thoroughly imbued with a most pernicious dogmatism, which must be entirely eradicated before either becomes susceptible of any true scientific education. Much of the so-called science teaching has exactly the opposite effect to what the Science and Art Department intended it to have, and the money granted year by year has mostly gone to the pockets of successful crammers, while the honest painstaking teachers have had but a meagre share of the coveted loaves and fishes and a still more meagre share of fame.

Had Mr. Clements's volume been a solitary instance it would not have merited even a passing notice, but when we remember that it is only a specimen, and probably not the worst, of a rapidly-increasing class, we feel that as a representative of that class it deserves a fair and serious consideration. As some of the essentials of a good text-book, we have enumerated correctness and completeness as to facts and descriptions; when an author describes any process he should do it correctly and with sufficient minuteness to enable the student to comprehend every step of it, and, if he possesses the requisite apparatus, to go through it himself without further aid or direction. We shall quote from the book before us a few paragraphs relating to some of the simpler processes of organic chemistry, and let the reader judge how much assistance a student can derive from them. On pp. 3–13 the author gives directions how to perform "combustions" and the quantitative analysis of organic compounds generally. The engraving of the potash bulbs in Fig. 1, p. 4, is certainly misleading, and no one, either from the engraving or the accompanying explanation, could ever find out how the CO_2 finds its way to the bulbs *p*; if it was necessary to put in an engraving and a description of it at all, it was certainly quite as necessary that both should be correct and intelligible; at present they are neither. In his description of the method of determining the C and H in an organic compound, the author has hopelessly mixed up two distinct processes, viz., combustion in a closed tube and combustion in a current of air or oxygen. The tube in the engraving is represented as closed at one end, and there is no reference whatever to a tube open at both ends; consequently we fear that many students would attempt to introduce the platinum boat from the right-hand end of the tube. It may be said that their common sense ought to show them otherwise; but when the author has had some years' practical experience, he will undoubtedly acknowledge that in scientific experiments very little reliance is to be placed on the common sense of beginners. The author says:—

"About one-fourth of the combustion tube is filled with copper oxide, the sugar weighed in a little glass tube, and shaken into the combustion tube and thoroughly mixed with the oxide by raking them together by a wire. The remainder of the tube is filled with oxide; or the sugar may be put in a platinum boat that will pass into the tube."

As an alternative, for *what* may the sugar be put in a platinum boat? It appears from the text that the boat is to be employed instead of filling up the "remainder of the tube with oxide." No further reference is made to the method of determining the C and H in organic compounds except on p. 11, where we are told that in the presence of nitrogenous substances the products of combustion must be passed over heated metallic copper, and we have failed to find a single hint to enable the student to determine the C and H in the presence of Cl, Br, I, S, or alkaline metals. All the processes given in the book, *supposing them to be intelligible to a beginner*, are utterly inadequate.

Referring to the determination of nitrogen, the author states (p. 12):—

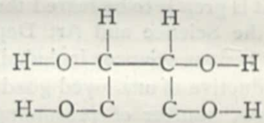
"The ammonia process answers, except in cases where the nitrogen occurs in the form of nitric acid or cyanogen, when this element must be estimated by volume. This method is applicable in all cases. A combustion tube of about 32 inches long is taken, rounded like a test tube at one end. This tube is filled with some carbonate that, when heated, will give off carbonic anhydride, such as manganous carbonate, magnesite or hydric sodic-carbonate, and some mercuric oxide. A weighed portion of the substance for analysis, with upwards of forty times its weight of a mixture of oxide of copper and mercury, the rinsings of the mortar, a plug of asbestos, then about 4 inches of cupric oxide, asbestos and a layer of about 8 inches of metallic copper. The end of the combustion tube is drawn out and connected with a bent delivery tube, dipping beneath the mercury in the trough. When all is ready the carbonate in the tube is heated to generate a current of carbonic anhydride to drive out all the air.

"The metallic copper and copper oxide are heated simultaneously, and when the escaping gas is free from air, insert the end of the delivery tube through the tubulure of the vessel," &c., &c.

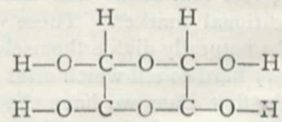
We suppose that Mr. Clements would barely maintain that the N occurs as *nitric* acid in nitromethane or any of its analogous compounds; but we should be very much surprised if he or any one else could make a correct determination of the nitrogen in those compounds by his ammonia method; and would it surprise him to learn that when N occurs as a component of cyanogen it may be correctly estimated by th ammonia method? What is the meaning of the remainder of the preceding extract? Having *filled* the tube with "some carbonate" and mercuric oxide, what is the student to do with the Benjamin's mess, the ingredients of which are enumerated in the next sentence, if a heap of words without a single predicate can be called a sentence? Without doubt the author meant a mixture of cupric and mercuric oxides by "a mixture of the oxide of copper and mercury," but a beginner, we should unhesitatingly say, would mix metallic mercury with oxide of copper if he had no other guide than this book. Then what mortar, trough, tubulure, and vessel are referred to? Where are they to come from, and what are they used for? A chemist may guess what is meant, but heaven help the beginner who tries to make his first nitrogen determination with the sole aid of this new light. We cannot believe it possible for a man who had ever "done a combustion" to have penned these pages 3-13.

We have neither space nor patience for further extracts from the author's description of processes and apparatus, but we would ask the reader to refer to pp. 164 and 165, where Messrs. Frankland and Ward's gas apparatus is described, and after he has read it let him try to find out how it was possible for a person who had ever seen the apparatus to write that description? or even if he had never seen it, how could he ignore the simplest principles of physics and propose to drive the gas from A by simply elevating M? The drawings and explanation are wofully incomplete and misleading.

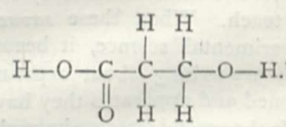
It is needless to point out all the errors of the author, but there is one class we cannot help referring to, as it gives us a fair test of the extent of the author's knowledge of his subject. To translate constitutional to graphic formulæ is considered a very elementary exercise, but in this our author fails miserably; thus he gives (p. 219):—

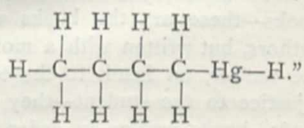
"Succinic Acid $\left\{\begin{array}{l} COHo \\ CH_2 \\ CH_2 \\ COHo \end{array}\right.$  "

where the two lower atoms of C are represented as bivalent. On the same page he gives—

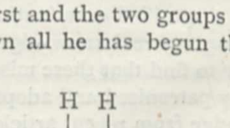
"Tartaric Acid $\left\{\begin{array}{l} COHo \\ CHHo \\ CHHo \\ COHo \end{array}\right.$  "

where, as in the preceding, we have no oxatyl group in the graphic formula, although we have two such in each of the constitutional. Again, on p. 225 we have—

"Lactic Acid $\left\{\begin{array}{l} CMeHHo \\ COHo \end{array}\right.$  ."

"Mercuric Ethide, $HgEt_2$  ."

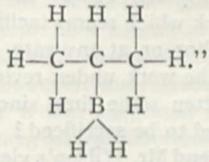
Where is the group Me in the first and the two groups of Et in the second? But to crown all he has begun this glorious page thus—

"Methylic Ether, $\left.\begin{array}{l} CH_3 \\ CH_3 \end{array}\right\}$ O  ."

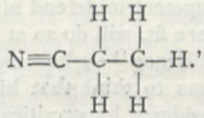
Is it possible that he does not know that this is the graphic formula of ethylic alcohol, EtHo, a very different compound indeed from Me_2O? We will not multiply instances, though we might very easily do so;

but we cannot resist the temptation to cull the two following gems :—

P. 228—
"Boric Methide, $B(CH_3)_3$

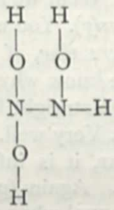


P. 234—
"Allylamine, $N(C_3H_5)H_2$



It is a great pity the author ever meddled with graphic formulæ—he may have some very original notions about the constitution of organic bodies, but for his own credit he ought to have made his constitutional and graphic formulæ agree. The only thing we ever saw at all approaching the preceding in ridiculous incongruity was the following, handed to us by a beginner :—

Ammonic Nitrate, $NO_2(NH_4O)$



We kept this as a curiosity, little dreaming that we should ever live to see it surpassed in a text-book.

In no instance can we say that the information is complete and satisfactory, while in very many cases it is decidedly misleading. We fear that very few of the *model* answers to the questions of the Science and Art Department would have been marked "*excellent*" or even "*good*" by the examiners. For instance—

"30. How can you detect the presence of nitrogen in an organic substance?
Ans. "See the estimation of nitrogen."

We have looked again and again through the pages referred to, and certainly there is nothing there about the detection of nitrogen; does the author know any difference between detection and estimation?

"35. If an alkaline solution of potassic cyanide be boiled what decomposition takes place?
"The formiate of potassium is formed and ammonia thus—$KCN + 2H_2O = KCOHo + NH_3$."

This answer is brief, if not to the point, but what on earth is *KCOHo?*

"74. How would you separate alcohol from acetic acid?
"Acetic acid freezes at 17° C. or under, while alcohol remains liquid at much lower temperatures."

Very simple, but has the author ever tried it?

"99. What chemical changes ensue when a mixture of ethylic iodide and zinc are heated to 150° C. in a sealed tube?
"$2EtI + Zn = ZnI + 2C_2H_5$."

Is that all? We fancied hitherto that the merest tyro in chemistry knew better. We have neither space nor inclination to give further specimens of these answers, but let the reader refer to Nos. 100, 101, 102, &c., and judge for himself if the answers are satisfactory.

If we look at the arrangement of the book we must admit that we can find no sequence or logical connection between one part and another. Terms are employed before being properly defined, and often without being defined at all. We most sincerely pity the students who may attempt to learn organic chemistry by following the order of this book without having many a missing link supplied. Under the head "Alcohols" we have three mentioned—Methylic, Ethylic, and Phenylic; and by referring back to the "Theory of Compound Organic Radicals," we find mention made of several others, but no scientific arrangement in series and no general methods for the synthesis or preparation otherwise of the various terms of each series. The same objection applies more or less to the treatment of the ethers, aldehydes, acids, and anhydrides. By the way, we have not often seen carbamide or urea called a diamine, nor ethylic butyrate, C_3H_7COEtO called "*butylic* ether;" that term is generally reserved for $\left.\begin{matrix}C_4H_9\\C_4H_9\end{matrix}\right\}O$.

There are several pages giving nothing but the names and formulæ of compounds without any attempt to give their properties, their connection with one another, or the methods of preparing them; a few are referred to in other parts of the book, but necessarily they come before us then as isolated units and not as closely allied members of a consecutive series.

As to the language we need say but little. It is generally awkward or ambiguous, and often incorrect. The way pronouns and conjunctions are employed is sometimes alarming; in one paragraph of very moderate length we have the little word *or* occurring at least nineteen times, until we begin to think that the author has been taking the Apostle Paul for his model. In other places the pronoun *it* keeps dancing before our face like some imp, peering out of the most unexpected nooks and corners. Here is a model sentence—"A subsidence of temperature and an almost total absence of precipitated iodine after a few drops of the liquid remaining in the flask is boiled with HNO_3." What *is* boiled? is it the subsidence of temperature?

We have by no means pointed out the worst errors—we have purposely confined our remarks to the most elementary, and we think the reader will now be able to answer for himself whether the present author "knows his subject and knows how to teach it," or not.

One extract more and we have done with the book and its author, who says on p. 61 :—"Nitrous oxide and carbonic anhydride are other anæsthetics." Well, so they are, and we could only wish some people had the toothache "awful" and had the latter anæsthetic administered to alleviate their pain, and *ours*.

As we have said before, we have reviewed this book as a sample—and not the worst—of an ever-increasing class of publications, and we would ask teachers is it any wonder that "science teaching" has in many instances become a byeword and a reproach? Can we expect any different result until all sham-books and cram-books are consigned to the oblivion they so richly deserve?

E. H.

EUCLID AND HIS MODERN RIVALS

Euclid and His Modern Rivals. By Charles L. Dodgson, M.A. (London: Macmillan, 1879.)

Elementary Geometry. Books i.—iv., containing the subjects of Euclid's first six books; following the syllabus of geometry prepared by the Geometrical Association. By J. M. Wilson, M.A. Fourth edition. (London: Macmillan, 1878.)

BY a curious chance these two works reached our hands nearly on the same day, and as Mr. Dodgson devotes a great portion of his space (62 pp.) to the consideration of Mr. Wilson's Geometries, we have thought it well to notice the two authors at the same time. As however it is patent from the fact of Mr. Wilson's work having reached a fourth edition, that his method is not unknown to, and, may we add, not unappreciated by, a large section of mathematical teachers, we shall at once pass on to a consideration of Mr. Dodgson's book, only noticing Mr. Wilson's book in connection with the criticisms put forward in "Euclid and His Modern Rivals."

A few words by way of introduction. Mr. Dodgson has been a teacher of geometry at Oxford, we believe, for nearly five-and-twenty years, and during that time has had frequent occasion to examine candidates in that subject. For a great part of the above-stated period things went pretty smoothly, and King Euclid held undisputed sway in the "Schools;" but eleven years ago a troubler of the geometrical Israel came upon the scene, and read a paper before the Mathematical Society, entitled "Euclid as a Text-Book of Elementary Geometry." The agitation thus commenced acquired strength, and at length, in consequence of a correspondence carried on in these columns, the Geometrical Association was formed. A prime mover in this matter was that Mr. Wilson who wrote the paper, and subsequently brought out the geometry cited. Mr. Dodgson is one of the gentlemen opposed to this change, and the moving cause of the present Iliad is the "vindication of Euclid's masterpiece." Another consequence of the agitation is that many have tried their prentice hands on the production of new geometries—"rivals," our author calls them—"forty-five were left in my rooms to-day." Can we wonder then, that, his soul being stirred within him, he should overhaul a selection of them to see what blots he could "spot" in them? He might well have taken for his motto one once familiar to us—

> "If there's a hole in a' your coats,
> I rede ye tent it;
> A chiel's amang ye takin' notes,
> An' faith he'll prent it!"

Our author's criticism takes a peculiar form, but we shall not blame him for this, for he has afforded us much amusement, and we quite hold with the Horatian line he cites in extenuation of his mode of procedure: "Ridentem dicere verum quid vetat?" We believe he has made a good many hits, but at times his wit, we think, has led him too far. We shall not, however, here give any account of his plot—we prefer to refer our readers to the work itself—but confine our notice to the remarks upon Mr. Wilson's books, and upon Mr. Morell's "Euclid Simplified." [1]

Mr. Dodgson devotes forty-eight pages to Mr. Wilson's "Elementary Geometry" (second edition, 1869). We can hardly see why so much space should be devoted to a work which seems tacitly to have been withdrawn by the author, or, at any rate, to have been considered inferior to the work under review. Is it that the "scene" was written some time since, and was considered to be too good to be sacrificed? Happily it is not our business to defend Mr. Wilson's views on "direction;" he is perfectly competent to defend his own views, and no doubt, should he see fit, will do so at the right time.

"Minos"—who argues for Mr. Dodgson—himself seems to think that his remarks will now and again be considered hypercritical. Take the following:—

Niemand (the general representative of the "rivals," quoting from the "Elementary Geometry"). Two straight lines that meet one another form an angle at the point where they meet (p. 5). *Min.* Do you mean that they form it "*at* the point," and nowhere else? *Nie.* I suppose so. *Min.* I fear you allow your angle no magnitude, if you limit its existence to so small a locality! *Nie.* Well, we *don't* mean "nowhere else." *Min.* (*meditatively*). You mean *at* the point—and *some*where else? *Where* else, if you please? *Nie.* We mean—we don't quite know why we put in the words at all. Let us say "Two straight lines that meet one another form an angle." *Min.* Very well. It hardly tells us what an angle *is*, and, so far, it is inferior to Euclid's definition; but it may pass. Again (p. 73), *Nie.* reads, P. 5, Ax. 5, "Angles are equal when they could be placed on one another so that their vertices would coincide in position, and their arms in direction." *Min.* "Placed on one another!" Did you ever see the child's game, where a pile of four hands is made on the table, and each player tries to have a hand at the top of the pile? *Nie.* I know the game. *Min.* Well, did you ever see both players succeed at once? *Nie.* No. *Min.* Whenever that feat is achieved you may *then* expect to be able to place two angles "on one another!" You have hardly, I think, grasped the physical fact that, when one of two things is *on* the other, the second is *underneath* the first. But perhaps I am hypercritical.

What the text means is, of course, that *B, C, D* could be placed upon *A* or *A* upon *B, C, D*, so as to coincide. A still more striking instance is p. 160. Mr. Wilson adopts the syllabus-definition, "When one straight line stands upon another straight line and makes the adjacent angles equal, each of the angles is called a *right angle*"—a definition, by the way, remarkably like Euclid's. Minos says, "allow me to present you with a figure, as I see the Syllabus does not supply one—

A Here *A B* 'stands upon' *B C*, and makes the
B adjacent angles equal. How do you like these
C 'right angles?'"

This is a hit, of course, indeed a double hit, the one farcical in its illustration, the other sober enough, for the Syllabus considers that two angles (a major, and a minor, conjugate) are formed by two straight lines drawn from a point. Mr. Dodgson is very amusing upon the "straight" angle, and, no doubt, would be equally so upon the equivalent "flat" angle. A good phrase is still a desideratum, but De Morgan long ago pointed out that "the angle made by a straight line with its continuation is a definite angular magnitude," and considered its half to be the best definition of a right angle.

[1] A work we ourselves had occasion very strongly to condemn—see NATURE, vol. xiii. p. 202.

We pass over many passages we had marked, with saying that in many cases the objections are sound but trivial. Objection is taken to Mr. Wilson's remark, "Every theorem may be shown to be a means of indirectly measuring some magnitude," and Niemand abandons "every." We think, however, that Niemand might have made a better fight of it and suggested that what is intended is that, for instance, all the theorems of the first book are directly or indirectly required for the proof of the 47th Proposition, which is surely a proposition concerned with the measurement of magnitude.

On p. 177 Minos says of the exercise, "Show that the angles of an equiangular triangle are equal to two-thirds of a right angle. In this attempt I feel sure I should fail. In early life I was taught to believe them equal to *two right angles*—an antiquated prejudice, no doubt; but it is difficult to eradicate these childish instincts." Mr. Dodgson was taught that the *three* angles were equal to this magnitude; the question says "angles" surely in the plain sense of each angle being equal, &c. Again, in the construction for proposition corresponding to Eucl. i. 9 objection is taken to "finding a radius greater than half *A B*" (it should be *A C*): "it would seem to require the previous bisection of *A B*" (*A C*). Thus the proof involves the fallacy "*Petitio Principii.*" Surely one can take a line greater than or equal to *A C*; where, then, is the fallacy? Exception is taken to the proposition "the area of a trapezium is equal to the area of a rectangle whose base is half the sum of the two parallel sides, and whose altitude is the perpendicular distance between them" as being "a mere 'fancy' proposition of no practical value whatever." We have met with it in works on co-ordinate geometry and elsewhere. Then again the theorem (Apollonius's) on Mr. Wilson's p. 95 is branded "new," "but even with that mighty name to recommend it, I cannot help thinking it rather more curious than useful." It is our own impression that it is one of the most important "riders" from the second book, and if Mr. Dodgson has been teaching geometry for nearly five-and-twenty years, so have we—but we do not confine our teaching to the text-book only, we devote a great part of our geometrical teaching time to the working of exercises.

Our conclusion from the examination of Mr. Dodgson's objections to Mr. Wilson's last book is that the majority of them can be easily met; indeed, many of them are mere verbal quibbles; the rest arise from the very different standpoints taken up by the two writers, and here there is likely to be "war to the knife."

A word or two on Morell's (J. R.) "Euclid Simplified." It is very easy work to pick this little book to pieces, but we cannot understand a statement of Mr. Dodgson's on p. 148. Of the proposition "Every convex closed line *A B C D* enveloped by any other closed line *P Q R S T* is less than it," he says the method used fails, "as of course all methods must, the thing not being capable of proof." We cannot call to mind any English text-book in which the proposition is proved, but there is what we have thought was a proof in Sannia and D'Ovidio's "Elementi di Geometria," p. 32.

We are bound to say that "Euclid and his Modern Rivals" is not all amusing reading. It alternates

"From grave to gay,"

and more than a third part is devoted to appendices, the third to the sixth of which (73 pages) must have cost the author a great deal of thought and labour. We fear, however, it will not get the attention it deserves. It is hard reading, and one has hardly been led up to it by the amusement provided in the four Acts of the Drama. Some little trouble is involved in mastering the symbols and their significance.

The fourth act considers the objections brought by Mr. Wilson ("Euclid as a Text-Book," &c.) and others against the use of Euclid for junior pupils on the score of unsuggestiveness and want of simplicity of style, the exclusion of hypothetical constructions, &c. We need not consider them here, but refer to two articles by the Rev. Dr. Jones ("On the Unsuitableness of Euclid as a Text-Book of Geometry," *Trans.* of Liverpool Lit. and Phil. Society, published in a separate form; and "Review of Mr. Todhunter's Essay on Elementary Geometry," (*Monthly Journal of Education*, 1875, pp. 97-112, [150-160), neither of which is referred to by our author, though he quotes largely in the appendix from Mr. Todhunter's Essay and also from a review of Mr. Wilson's first Geometry in the *Athenæum* for July 18, 1868, written by Prof. De Morgan. We could instance other geometries which have an equal claim to be considered with any of those criticised by Mr. Dodgson, and we should rather have written "Euclid and *some* of his Modern Rivals."

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.*]

The Papau or Papaye

IN NATURE, vol. xix. p. 447, is a paragraph relative to the singular qualities of the *Carica papaya*. I cannot but think that some of the properties attributed to this vegetal in British Guiana by the natives of that colony are exaggerated somewhat, *e.g.*, the tempering of steel by its sap, &c.

Sir Wyville Thomson, in the first volume of "The Voyage of the *Challenger*," gives a capital representation of a group of these papaw-trees in the garden of the Admiral commanding on the North American station at Clarence Hill, Bermudas, where they seem to abound; I do not know if these diœcious plants are indigenous to these islands or introduced from the West Indies and tropical America. From the cut above mentioned can be seen the quaint growth of these paradoxical trees, which must have been esteemed by the early voyagers, as they have been introduced into all parts of the tropics. The singular-looking straight stems (not unlike the gigantesque tree-cabbage stalks of the Channel Islands) are crowned with a tuft of digitate leaves, somewhat at a distance resembling those of the *Aralia papyrifera*, under which the clusters of black purple fruit protrude. In the islands of Bourbon and Mauritius they make a passable *compôte* of these fruit, which are pulpy and full of black seeds when ripe, and the Creole children eat them raw, with what effect on their insides I know not; the birds, however, will not touch them, and as they fall they rot on the ground beneath. In Mauritius, where we lived principally on ration beef cut from the tough flesh of Malagasy oxen, we were in the habit of hanging the ration under the leaves of the tree itself, and if we were in a hurry for a very tender piece of *filet*, our cook would wrap up the undercut of the sirloin in the leaves, when the newly-killed meat would be as tender as if it had been hung for a considerable time. Whence are these deleterious effects causing rapid decomposition of animal fibre? and are there any other trees which possess similar properties?

The Malabars, who were introduced into Mauritius as Coolies, would not sleep under tamarind trees, on account of their supposed noxious effects; but it is possible that superstition has something to do with their objection.

S. P. OLIVER

On the Origin of Certain Granitoid Rocks

DR. CALLAWAY'S interesting letter with the above heading in NATURE (vol. xx. p. 219) tempts me to send you the following paragraph from my paper in the *Quart. Journ. Geolog. Soc.* for May, p. 286, in which the hälleflintas of the Arvonian there mentioned are first described:—

"The mode of behaviour of the quartz also here is particularly interesting and instructive in regard to the changes which many crystalline rocks have undergone, especially the gneisses. In some cases the quartz is seen in distinct fragments, but yet coalescing, as if attracted together by some natural affinity from the surrounding material. In the next place the grains are so compressed together (and yet distinctly fragmentary) that all other material is removed, and nests of pure quartz grains only are seen, having a very crystalline appearance. By this selective process also the darker material is brought together and made to fold round the nests, so that a banded or imperfect flow-structure is given to the rock. All this looks as if an incipient gneiss was being formed, the metamorphic action being incomplete, a kind of semi-metamorphism and softening having taken place sufficient only to allow the particles to arrange themselves according to their natural affinities."

It will be seen that the conclusions arrived at by Dr. Callaway in his recent examinations of similar rocks in Shropshire are almost identical with those previously formed by myself in Pembrokeshire. The careful microscopical examination of rocks of an intermediate type like these hälleflintas appear to be, cannot fail, I think, to clear up some of the difficulties hitherto experienced in endeavouring to explain the origin of many of the crystalline rocks.

HENRY HICKS

Hendon, July 4

Distribution of the Black Rat (Mus rattus, Linn.) in Italy

IT may interest the readers of NATURE to know that the black rat is very abundant and widely distributed in Italy and her islands. In the Central Collection of Italian Vertebrata which I have founded in the Florence Zoological Museum, I have a large series of specimens from no less than fifteen localities, viz., Domodossola, Casale, Florence, Radda, Arezzo, Castelfalfi, Lecce on the continent, Bastia (Corsica), Cagliari (Sardinia), Castelbuono Madonie (Sicily), and from the islands of Elba, Pianosa, Montecristo, Giglio, and Lipari. On the smaller islands the larger *M. decumanus* does not exist at all, but elsewhere the two species live side by side. In the Florence Museum we have *M. decumanus* in the cellars, and *M. rattus* upstairs. This proves that the black rat is very far indeed from extinction with us; I should say that it is generally more abundant in Italy than its larger congener, at least such is my experience.

I may add that we have *two*, if not three, very distinct varieties of *M. rattus*, viz., the typical *black M. rattus*, the grey and white *M. tectorum*, Savi, and the brown hirsute *M. alexandrinus*. The two former are positively one species, and I have them from the same litter; the latter is, I believe, generally admitted to be specifically identical with *M. rattus*.

HENRY H. GIGLIOLI

Royal Zoological Museum, Florence, July 4

Barbed Hooklets on Spines of a Brachiopod

MR. THOMAS DAVIDSON, F.R.S., describes, on p. 275, and figures, in pl. xxxiv. of the Supplement to his "Carboniferous Brachiopoda," now on the eve of publication, some important points in the structure of *Spirifera lineata*, Martin, which specimens in my collection have revealed. In this species the shell structure is minutely punctate, and the flattened spines, which are usually broken off short, contain in their interior a double canal, that terminates upon the outer surface of the shell in a series of double pores. I have recently been fortunate enough to find a specimen from the High Blantyre limestone shales having the spines in place. It appears that these spines are provided with numerous marginal opposite hooklets usually pointing towards the free end of the spine. So far as I am aware, this structure is unique amongst the brachiopods. Mr. Davidson has kindly undertaken to note this interesting fact in the explanation of the plates of his forthcoming monograph, the text having been printed off before this observation was made; but I should like to draw the attention of palæontologists to the point, as perhaps similar structures may be found in other brachiopods. The materials are in Mr. Davidson's hands for extended notice when his leisure allows him.

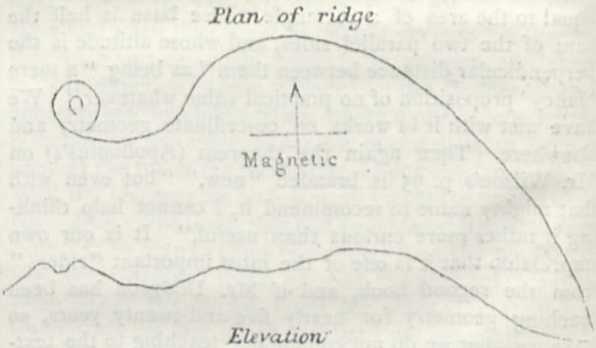
JOHN YOUNG

Hunterian Museum, Glasgow University, June

The Serpent Mound of Lochnell, near Oban

I WALKED over yesterday from here to examine this for myself. I started with some feelings of doubt as to whether it was not one of those fantastic shapes naturally assumed by igneous rocks, seen through the spectacles of an antiquarian enthusiast. I came away quite satisfied that it is an artificial shape, designedly given, and deliberately intended to represent a snake. It partly closes the entrance of a singular little rock amphitheatre with a waterfall at the head (the north end of it), the Loch being to the southward. There is a raised plateau to the northward of the serpent, nearly square. The ground is apparently a rubble of gravel, stones, and dirt, such as is found in moraines. The head of the snake had been opened, and showed a quantity of stones with some indication of a square chamber in the middle.

I do not pretend to any antiquarian knowledge. The impression that it suggested to me, on the spot, was that a party had endeavoured to entrench itself, at the spot, but had been attacked before the entrenchment was complete on more than one face, and that the rampart was then converted into the snake form to commemorate either a successful assault, or the successful defence of an unfinished work.



I inclose you a sketch plan and elevation, of a very rough kind, which I made on the spot and have not retouched since, except by inking over my pencil marks.

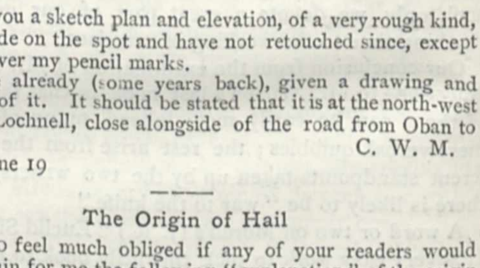
You have already (some years back), given a drawing and description of it. It should be stated that it is at the north-west corner of Lochnell, close alongside of the road from Oban to Callanach.

C. W. M.

Oban, June 19

The Origin of Hail

I SHOULD feel much obliged if any of your readers would kindly explain for me the following "explanation" of the origin of *hail;* which I have come across while reading for an examination:—



"*Hail.*—It consists of concentric layers of ice, and is caused by electricity. Imagine two clouds, A and B, charged with different fluids, and suppose that a drop of water falls from A. Its fall will be very rapid, both on account of gravitation and attraction, and (*a*) *the evaporation will be so great*, that it will be *frozen*. On touching the cloud B it *condenses* (*b*) *part of its vapour*, gets thus a coating of ice, and, having the same fluid as B, it will be repelled towards A, and so on, downwards and upwards, until it becomes heavy enough to fall to the ground."

My difficulties are the following:—Whence comes the evaporation spoken of at (*a*)?

According to the above, when it reaches B it is frozen. What then am I to understand by the "condensation of part of its vapour (*b*)?"

Also, would not the two clouds, A and B, having opposite fluids, themselves unite?

If you will kindly solve me these difficulties you will greatly oblige an IGNORAMUS

Butterfly Swarms

WITH reference to the case mentioned in NATURE, vol. xx. p. 220, I agree with your correspondent that "local fecundity" cannot be the cause of the great number of *Vanessa cardui* observed this year in the south of England, more especially as this species does not emerge from the chrysalis until the end of July at the earliest. It therefore appears to me probable that the specimens observed have migrated (having hybernated) from the Northern Counties or even from Scotland, in consequence of the exceptional severity of the weather this season. I would also suggest that the "periodical abundance" of this butterfly, as also that of *Colias hyale* and *Edusa*, besides several others, may be caused by some peculiarity in the food-plant itself. This is rendered more likely by the fact that both *Colias hyale* and *Edusa*, which feed upon plants of the Leguminous order, and often of the same species, appear in great abundance at the same period.

I may mention that where I reside I observed many specimens of *Vanessa cardui* last year (1878). In the preceding year (1877) both *Colias hyale* and *Edusa* were exceedingly plentiful, whereas last year (1878) I did not see a single specimen of either of these butterflies. F. H. HAINES

The Buses, Edenbridge, Kent, July 7

MR. J. H. A. JENNER says (NATURE, vol. xx. p. 220) that "last season (1878) he saw no specimens of *Vanessa cardui*, nor did he hear of any about Lewes." I would remark that *Vanessa cardui* was exceedingly abundant in the Isle of Wight; I could have caught scores in a few minutes. I would further remark that towards the close of the season I saw beds of nettles, many yards square, literally black with larvæ of *V. cardui*.[1] I anticipated then that they would be abundant this year, and so they are. W. REES SWAIN

Patent Museum, South Kensington, July 4

Intellect in Brutes

As an instance of intelligence in a cat, the following story is, I think, worthy of being recorded in your pages:—

My father, when a boy, kept a tame starling, which, having had its wings clipped, was allowed to hop about the house at random. It had been brought up, so to speak, with a little kitten, and a great friendship had been established between the two, they playing together, drinking out of the same saucer, &c., &c.

One day while the family were at dinner, with open doors, the cat suddenly pounced upon the starling, and every one thought that at last the cat's nature had got the better of its affection; but no. The cat carefully took up the starling, jumped with it on to a table, and leaving it there, rushed out of the room.

A moment after, the sound of a furious fight going on in the hall reached the ears of the astonished family, and it was then found that a strange cat had stolen into the house, with which the starling's friend was fighting. Evidently the house cat heard the approach of the enemy, and having first placed its playfellow in a comparatively safe place, rushed out to expel the intruder. A. DUPRÉ

Kensington, W., July 5

[1] [The larvæ referred to were probably those of *V. atalanta*. *V. cardui* ordinarily feeds on *thistles*.—ED.]

THE letters of X. and of Mr. Henry Clark in NATURE, vol. xx. p. 220, referring to the recognition of portraits by dogs, are, I think, very interesting, as my observations lead me to suppose that it is very rarely that a dog takes any notice of a painting or any representation on the flat. I only know of one instance. A bull terrier of mine was lying asleep upon a chair in the house of a friend, and was suddenly aroused by some noise. On opening his eyes, the dog caught sight of a portrait of a gentleman on the wall not far from him, upon which the light was shining strongly. He growled, and for some little time kept his eyes fixed upon the portrait, but shortly satisfying himself that there was no danger to be apprehended, he resumed his nap. I have often since endeavoured to induce him to pay some attention to portraits and pictures, but without success; but sometimes he will bark at his own reflection in a looking-glass. He knows it to be his own image that he sees, for he very soon tires both of barking and looking. Other authentic instances of this kind would be valuable. J. B. R.

July 4

I SEND the inclosed extract from the *Bedworth Guardian*. I can vouch for the fact, as Hawkesbury Station is near to me, and my son has witnessed the feats of poor Pincher. I trust that it will not be an unwelcome contribution to the interesting series of facts in evidence of animal sagacity recorded in NATURE.

Moat House, Walsgrave, Coventry, July 3

J. S. WHITTEM

"The picturesque little station at Hawkesbury Lane, between Nuneaton and Coventry, has, for some time past, been the home of a fox terrier, known as Pincher, an animal possessing almost human intelligence. Pincher—trained by its owner, Mr. Instone, to do so—would listen with marvellous patience and acuteness for the signal intimating that a train was approaching the station, and then, almost with the speed of lightning, rush to the signal-box, and, seizing the bell between its teeth, shake it heartily, and thus apprise the waiting passengers of the train's approach. This task accomplished, he would descend the steps leading from the box, proudly wagging his tail, and ready and willing, apparently, for any duty he might be called upon to perform. Often, as a train was leaving the station, Pincher would run beside it for about a hundred yards, as though acting under the impression that the engine-driver would be unable to obtain the necessary impetus without his assistance. On Sunday evening last Pincher's career was brought to an untimely end, but he died as became a dog of his attainments and renown, "in harness." Soon after seven o'clock on the evening named, two trains entered the station at one and the same time (Pincher having previously rung the bell), one going towards Nuneaton, the other in the contrary direction. Actuated by some motive or other—probably to see what was going on at the other side of the line—the dog darted under the carriages of the latter train, and one of the wheels passed over his neck, death being instantaneous."

Snails *v.* Glow-worms

WHEN writing on this subject I thought my facts might be questioned, but I did not expect they would be so distorted as they have been by Mr. McLachlan at p. 219.

I simply recorded what I had seen, and in accordance with the request at the head of your column for letters to the Editor, I made my letter "as short as possible."

The heading of my letter was correct, and I described what I certainly saw—a glow-worm in *the inside* of a snail, for when the snail moved its semi-transparent skin was between me and the light. There was no phosphorescent matter on the snail.

If the glow-worm was eating the snail, as both Mr. McLachlan and Mr. Greenwood Penny suggest, then, I conclude, he attacked *the liver*, and not the *lights*, as Mr. Henslow's cat did! At all events my opponents will agree with me in thinking that the snail had a *light* supper! The fact is evidently new to these gentlemen.

I shall feel obliged by any or all of them sending me some glow-worms, and I will try the experiment again, as well as some others. R. S. NEWALL

Gateshead-on-Tyne, July 8

Occurrence of Boar Fish

I RECEIVED several notices of the capture of boar-fish (*Capros aper*), on the south and south-east coasts of England during June last. First from Bournemouth and Weymouth, where they were found not unfrequently dead on the shore. Again, one of the Leigh "shrimpers" took about a dozen specimens in his trawl net near Sheerness, at the mouth of the Thames. Another two specimens were taken likewise in a shrimp trawl off Harwich. None of these survived, no doubt having been too long in the trawl net, which is frequently three or more hours in the water. Dead specimens of these were sent for my observation, by Mr. Andrew, the aquarium fish collector of Southend-on-Sea. He says the Essex fishermen call them red dorees, but none remember having seen them on that coast before this year.

JOHN T. CARRINGTON

Royal Aquarium, Westminster, July 6

Habits of Ants

MY attention was lately called by a friend to the operations of a party of ants. The theatre of their work was a cherry-tree partly decayed in the centre. From this portion of the tree the busy creatures were bringing forth small grains of sawdust-like *débris*. These particles were conveyed to the prominence left by an amputated branch, and thrown over to the ground, a distance of about five feet. The particles were passed on from one ant to another—as water-buckets were at old-time fires. Nor was this all, for on the ground below, another party removed the accumulated material. In this connection the reader should consult a remarkable note on page 21 of Kerner's "Flowers and their Unbidden Guests" to further illustrate the intelligence of ants and their recognition of the principle of division of labour. I am unable to state the species of ant I observed, as I am not an entomologist. It was a rather large red ant.

W. WHITMAN BAILEY

Brown University, Providence, R.I. (U.S.), June 17

WILLIAM FOTHERGILL COOKE

THERE has slipped away noiselessly and quietly one of England's scientific pioneers and one of the world's benefactors. Sir William Fothergill Cooke was the father of electric telegraphy. Born in 1806, educated in Durham, where his father was a professor, he joined the East India Company's military service in 1826, from which he retired in 1835 to study anatomy and physiology in Paris and Heidelberg. He was very clever at wax modelling. In 1836 a lecture on Schilling's telegraph directed his attention to the electric telegraph. His was the active sanguine mind that saw the great future of telegraphy before him, and that, in spite of supineness and unbelief, forced the new agent on an unwilling world. He was not an inventor nor a discoverer, but he was a far-seeing, practical man, with a determined will, indomitable energy, and of great resources. Associated with Wheatstone, he established telegraphy as a commercial undertaking. The first experimental line in England was put up in 1837. The first Electric Telegraph Company was incorporated in 1844. The first cable was laid in 1851. Now the world is one network of wires, and while the pioneer of this great system is carried to his grave, representatives from every civilised nation of the earth meet in telegraphic parliament in London without heaving one sigh or casting one thought

"O'er the grave where our hero we buried."

THE COMPARATIVE ANATOMY OF MAN[1]

II.

The Andaman Islanders (*continued*)

HITHERTO the osteological characters of these people have only been known from one skeleton, briefly described by Prof. Owen, two crania by Mr. Busk, and two by Prof. Quatrefages. During the last half year, the College museum has received a valuable series of skeletons, collected, at the request of Sir Joseph Fayrer, by the late Dr. J. Dougall, senior medical officer at Port Blair; others have been lent for the purpose of illustrating this course by Professors Rolleston and Allen Thomson, amounting altogether to nineteen skeletons, and about thirty crania.

[1] Abstract of Prof. Flower's Hunterian Lectures, delivered at the Royal College of Surgeons, commencing on Wednesday, March 5. Continued from p. 225.

The common estimate among Europeans, which is fairly correct for averages, is that the length of the femur is to the height of the living person as 275 is to 1,000. Only one of the above-mentioned Andamanese skeletons has been articulated, but this shows exactly the same proportion. Calculated on this basis, the average height of the skeletons of males would be 4 feet 9 inches, the tallest being 5 feet 3 inches, and the shortest 4 feet 6 inches. The average height of the ten skeletons of females would be 4 feet 6 inches, the tallest being 4 feet 10 inches, the shortest 4 feet 3 inches.

Attention was first drawn to the fact that the proportions of the different segments of the limbs might differ in various races by the announcement in 1799, by White, of Manchester, since amply confirmed, that the forearm of the Negro is proportionally longer than that of the European. Unfortunately, skeletons of most races are so rare in collections, that we have at present but few reliable data on this subject, and it is only when a sufficient number can be obtained, on which to found a fair average, that any satisfactory law can be established.

The first ratio, or index, is that obtained by the comparison of the entire upper and lower limbs with each other, the *intermembral index*, or the length of the humerus and radius added together, as compared with that of the femur and tibia, the latter being taken as 100. This ratio, in the nineteen Andaman skeletons, is 68·3; in fourteen Europeans, measured in the same manner, 69·2, showing a slight diminution in the length of the arm of the former, as compared with the latter. This has been also found by Broca, to be the case with African Negroes. The *femoro-humeral index* is the ratio of the humerus to the femur, the latter being taken as 100. In Europeans, according to Prof. Flower's and Broca's measurements, this is 72 to 73; in Negroes, according to Broca, 68·9; in the Andamanese, 69·8; showing that in both the latter races the humerus is relatively shorter than the femur. The *femoro-tibial index* is the length of the tibia to the femur, the latter being 100. In Europeans, this is 82; in Negroes, according to Prof. Humphry, 84·7; in the Andamanese, almost exactly the same, 84·5. The *humero-radial index*, or the length of the radius, compared to the humerus is, perhaps, the most important, as being subject to greater variations in different races. In nine Europeans measured by Broca, it is 73·9; in fourteen Europeans in the College Museum, it is exactly the same; in fifteen Negroes measured by Broca, 79·4; in the nineteen Andamanese, 81. Thus the differential characters of the Andamanese, as compared with Europeans, in respect to the proportions of the limb-bones, lie mainly in the greater length of the distal segment of each limb as compared with the proximal segment, a peculiarity most especially manifested in the upper extremity.

In the *Bulletin* of the Paris Anthropological Society of last year, Broca called attention to the form of the scapula as a race-character, and showed that one of the principal modifications of the form of this bone could be expressed by an index formed of a ratio between the two chief diameters of the bone, *i.e.*, the length from the posterior superior angle (C) to the inferior angle (D), and the breadth from the middle of the posterior margin of the glenoid cavity (A) to the point on the posterior or vertebral border from which the spine arises (B). The ratio of the length (C D) to the breadth (A B), the latter being 100, is called the *scapular index*. In the anthropoid apes the index varies between 70 and 100, and in most of the lower forms of monkeys and other mammals, it is considerably higher. A high index is, therefore, a sign of inferiority. Broca found that the average in twenty-three Europeans was 65·91, and in 200 scapulæ of Europeans, measured by Dr. Garson, the average index was 65·2. The twenty-five Negro skeletons in the Paris Museum gave an average scapular index of 68·16, and the six scapulæ of the three Negro skeletons in the College Museum, 71·7. Australians give an average of about 68·9. Of the Andaman skeletons, the twenty-one scapulæ which have the epiphyses united give an average index of 69·8, and thus, in this character also, they stand in close relationship to the Negro and to the Australian. Another sign of inferiority in the scapula of the Andamanese is the almost constant absence of the supra-scapular notch.

The pelvis is also very important for comparison, and the difference that is most obvious and easily estimated lies in the form of the superior aperture or brim, which is always more elongated from before backwards, and narrowed laterally in the apes than it is in man. The relation of the antero-posterior to the transverse diameter of the brim, the latter measurement being taken as 100, gives the *pelvic index*. In the anthropoid apes the antero-posterior diameter is always the larger, and in infancy and childhood in our own race the pelvic index is also as high as, or above, 100. In adult man, except in rare cases, the transverse diameter is the greater, and the index consequently below 100, in the female being lower than in the male. In Europeans the average pelvic index is about 81 for the male and 78 for the female sex. The average of 17 male Negroes, according to Verneau, is 89; of ten Australians, according to Prof. Flower, 98; but the Andamanese give the highest figure of all, the average index of 8 males being 101, the maximum being 116 (the highest index of a human pelvis recorded), the minimum 92·6. Of the 9 females the average index is 95·2, the maximum 107·8, the minimum 86·4. No race, of which a sufficient number of pelves to give fair averages have been measured, has shown a form of the pelvis departing so widely from the European type. It should be noted, however, that the difference between the sexes is as fully, or even more fully, pronounced than it is in the higher races, contrary to an idea which has been sometimes held, based, however, upon an insufficient number of observations.

Cranial Characters.—The following observations are founded upon twenty-four specimens, all adults, of which twelve belong to the male and twelve to the female sex. They all present a very considerable general resemblance. They present a peculiar combination of characters, which distinguish them from the crania of all other races, unless it may be some of the closely allied Negrito population of the Indian Archipelago. Among these twenty-four skulls none present any artificial or pathological deformation.

In general size the skulls may be considered as belonging to the smallest, or nearly the smallest, of any race. The cranial capacity of the males ranges between 1,150 and 1,360 cubic centimetres, the average being 1,244 c.c. (76 c. ins.); that of the females between 1,025 and 1,250 c.c., the average being 1,128 c.c. (69 c. ins.), the proportion between the two sexes being, therefore, as 1,000 to 906, almost exactly the same as that between English men and women. The average circumference in the male is 480 millimetres; in the female, 462 millimetres.

The general form of the cranium is short and round, and the parietal region is greatly developed at the expense of the frontal, and especially of the occipital regions. The relation of the greatest transverse breadth in the parietal region to the length is expressed by the *latitudinal index* (sometimes called "cephalic index"). This in both sexes averages 820, and they are therefore, as a race, truly brachycephalic, all those skulls, the index of which is above 800, coming into this category. The average index of height—*altitudinal index*—in both sexes is 775, being 770 in the males and 779 in the females. In only one out of the twenty-four skulls is the breadth less than the height; they thus differ greatly from the Papuans and Melanesians.

The sutures of the cranium are, as in most inferior races, rather simple. *Metopism*, or persistence of the mid-frontal suture throughout life, occurs in four out of thirty-four known cases of skulls of Andamanese, and thus seems rather more frequent than among Europeans; this is rather surprising, as it is a character which generally accompanies superiority of development. More skulls, however, must be examined to establish the actual frequency of its occurrence in the race. The disposition of the sutures in the region called *pterion* by Broca, where the frontal, parietal, squamosal, and alisphenoidal bones meet, is always worthy of note in estimating the differential characters of races. In many inferior races the interval between the frontal and squamosal bones is greatly diminished, and often, especially among the Melanesians, disappears altogether, the squamosal then directly uniting with the frontal. Very frequently small independent ossicles, or *epipteric bones*, are interposed.

In the Andamanese the pterion is usually very narrow, but in six only out of forty-six cases examined (taking both sides) did the squamosal reach the frontal. In eight cases epiteric bones were developed. The general surface of the cranium is smooth, and the muscular ridges little pronounced. The forehead is rounded and even, and the glabella and superorbital eminences are always very little developed. The interspace between the orbits is wide and flat, and the orbits are round, the average index, or the ratio of height to width of margin, the latter taken as 100, being as high as 910. The nasal bones are straight, with nearly parallel sides, and not prominent. The width of the nasal opening brings the Andamanese into the mesorhine category of Broca, though approaching the platyrhine, the average index being 512. Of the twenty-four skulls, five are platyrhine, seventeen mesorhine, and two leptorhine. With regard to the projection forward of the jaws, eleven are decidedly prognathous, eight mesognathous, and five orthognathous.

Comparison with other Races.—With the Australians, the Andamanese have very little affinity; it is to the other wooly-haired races that we must naturally turn in endeavouring to find their nearest relatives. The typical Melanesians and Papuans differ greatly in their principal cranial characters; the Tasmanians, also, differed widely from the Andamanese. Many of the African Negroes, again, although usually dolichocephalic, extremely prognathous and platyrhine, have the smooth brow and round orbit seen in the Andamanese, and not generally met with in the true Oceanic Negroes.

The natives of the Andaman Islands, with whom may probably be associated the less known Aetas of the Philippines, the Semangs of the Malay Peninsula, and some other scattered races of the Indo-Malay Peninsula, thus constitute a race apart, to which the name *Negrito* may properly be applied. At first sight, they appear in their craniological characters to present little affinity to either of the other woolly-haired races, but it is probable that they represent a small or infantile type of the same primary group. It is very possible, but this is purely hypothetical, that the Andamanese may be the unchanged or little modified representatives of a primitive type, from which the African Negroes, on the one hand, and the Oceanic Negroes on the other, have taken their origin, and hence everything connected with their history or structure becomes of the greatest interest to the anthropologist.

The Inhabitants of India

By their physical characters, the various populations which inhabit the great continent of Asia attach themselves more or less to one or other of two very distinct types:—I. The *Mongolian*; and II. That which for want of a better name must still be distinguished by the title applied to it by Blumenbach, the *Caucasian*.

Roughly speaking, a line striking northward from the head of the Bay of Bengal, to the Himalayas, then turning westward and skirting the southern flanks of that great mountain-chain, passing north of Cashmere, and in a westward direction to the Sea of Aral, the Caspian, and the Ural Mountains, divides the area occupied by people of each type, those to the east and north of this line being mainly Mongolians, and those to the south and west mainly Caucasians.

The people of India proper, except in the extreme north and north-east, belong mainly to the Caucasian division. It has been thought that other races have contributed a share to the composition of the present population of the Peninsula, having been the earliest inhabitants of the land, and forming, as it were, a substratum of the existing population; these are :—I. Negritos, allied to the Andaman Islanders: II. Australoids, allied to the modern Australians. The search for evidence for or against the existence of these elements in the population of India must naturally be sought for among the tribes which retain more or less of their barbarous condition.

With these must be classed the Veddahs of Ceylon. Many of these people have become civilised, but the wild or "Rock Veddahs" live in a most primitive state of social culture, without clothing, agriculture, or fixed dwellings. They are a dwarfish, stunted race, of blackish complexion. and with straight, though generally unkempt and shaggy hair. The condition of their bones and other physical characters give the impression of their being a race degenerated and enfeebled by generations of privation and other circumstances adverse to full development. There are no Veddah skeletons in the College Museum, but as many as seven crania; one of them, that of a woman, is the smallest adult skull in the whole collection, its cerebral capacity measuring only 960 c.c. (58·6 c. ins.). They are all dolichocephalic, the average latitudinal index being 71·1, and the average altidudinal index 86·1. Their prognathism is not very marked, and the nasal index is medium, averaging 50·3. They enter rather into the type of the lower grades of the inhabitants of Bengal.

The present population of India, excluding the Mongoloid people of the north and east, is separated by language into two great divisions—(1) The Aryans, and (2) The Non-Aryans, the majority of whom speak one of the agglutinative tongues collectively called *Dravidian*. The Aryans came into India by the north-west by way of the Punjaub, about 1,500 years before our era, as is supposed. They now occupy the great alluvial plains of the Indus and Ganges between the Himalayas and the elevated plateau of Central India, and have spread southwards along both coasts as far as Ceylon.

The Dravidians, who occupy the greater part of the country southwards from the Nerbudda River, are supposed to be descended mainly from the people who inhabited the country before the Aryan immigration. They are again divided into two groups—(*a*) The civilised Dravidians, speaking Tamul, Telugu, Canarese, &c., and (*b*) The wild tribes of the mountainous districts of the interior. These "Hill Tribes," as they are often called, are of great interest to the ethnologist, as they represent the oldest stratum of the population. By their languages they are divided into two groups—(1) Those that speak Dravidian, the Gonds, the Khonds, the Oraons, &c.; (2) The Munda or Kolarian family, composed of numerous tribes called Coles, Hos, Moondahs, Santals, Billahs, &c. Very little is known of the physical characters of these people.

Dr. John Shortt has lately sent to the Museum a series of twenty skulls belonging to the tribes of Maravars, who inhabit the Madura district in the south of the peninsula. He has also sent a series of equal number to the Museum of the Paris Anthropological Society, which has been described by M. Callamand in a recent number of the *Revue d'Anthropologie*. As regards the capacity, the average in the Paris skulls is 1,281 c.c., in those sent to the Museum, 1,268 c.c. The average lengths are respectively 174·5 and 175·6, but in the former the projection of glabella is included. The average breadth is 131 in both; the latitudinal index is 746 in the one and 751 in the other series; the altitudinal, the nasal, and the orbital indices are respectively 752 and 758, 521 and 510, 839, and 854. These skulls, on the whole, differ totally from those of the Andamanese, especially in the great development of the occipital region. Nor do they present any striking resemblances either to those of the Australians, or to any of the Mongoloid races. Their characters do not differ much from those of the mixed population of Bengal generally. These Maravars may not belong to the races among which the characters of the original hill-tribes should be looked for, and no evidence has yet been found of cranial conformation bearing out the view of the Australian affinities of these people, derived from external appearance. The presence of a Negrito, *i.e.*, woolly-haired and brachycephalic, element in the population of India, is also based at present on very slender evidence.

(*To be continued*)

ON THE SECULAR EFFECTS OF TIDAL FRICTION [1]

IN three papers, read at different times before the Royal Society, the author has considered the theory of the tides of a viscous spheroid, and the perturbations of the rotation of the spheroid caused by the attraction of the tide-raising satellite; the direction of that investigation was governed by considerations of applicability to the case of the earth, moon, and sun.

In the paper, of which we are here giving an account, the question is considered both from a more general and from a more special point of view than in the previous papers. For it is here supposed that there is only a single tide-raising body or satellite which moves in a circular orbit in the equator of the planet, but the orbital motion may be either consentaneous with or adverse to the planet's rotation. The tides supposed to be raised in the planet by the attraction of the satellite are of any kind whatever, provided that there is a frictional resistance in the planet to the tidal motion. The results are therefore applicable alike to the hypothesis of bodily tides, or to that of oceanic tides.

It results from a general mechanical principle that in whatever way the satellite and planet interact, the whole moment of momentum of the rotation of the system must remain constant; whilst, as there is a frictional resistance in the planet to the tidal motion, the whole energy of the system, viz., the sum of the potential and kinetic energies, must diminish. The method employed to trace the effects of tidal friction consists in drawing two curves, one of which represents the constancy of the moment of momentum, and the other of which gives the energy of the system for each configuration.

Then if we conceive a system of a planet and satellite started in such a way as to be represented by a given point on the curve of conservation of moment of momentum; and if we imagine this point linked to its corresponding point on the curve of energy, since the energy must degrade, the point on the curve of energy must always slide down a slope and carry with it the point on the curve of momentum.

It is thus possible to track the nature of the changes in the configuration of the system, but the method gives no clue to the time occupied by those changes. This comparison of the energy with the moment of momentum of the system by a graphical method was suggested to the author by Sir William Thomson.

[1] A paper read before the Royal Society on June 19, 1879, by G. H. Darwin.

A third curve is also introduced which represents such a rotation of the system that the planet always shows the same face to the satellite, just as we always see the same face of the moon; this curve is called the curve of rigidity, because when the motion is of this kind, the system moves as though the planet and satellite were parts of one rigid body.

It appears from a consideration of these three curves that if the whole momentum of the system be less than a certain amount, then it is not possible to set a given planet and satellite in rotation, so that the planet shall always show the same face to the satellite; but if this can be done at all, it can be done in two ways, and one of those ways corresponds to a maximum amount of energy of the system, and the other to a minimum. Moreover the configuration of maximum energy is one of dynamical instability and the system may degrade in either of two ways from that state. In one of these modes of degradation the satellite approaches and falls into the planet, and in the other it recedes from the planet.

Part of the author's previous papers consists in tracing backwards the moon's motion from its present condition to that configuration of maximum energy; and it was found that that state corresponded with a rotation of the earth and moon, like the parts of one rigid body, in about five hours. This rapid periodic time of the moon corresponds with only a few thousands of miles intervening between the earth's surface and that body. Since the tides on the earth must be subject to friction, it follows inevitably that, if time enough has elapsed since the origin of the moon and earth, the present state must be a degradation of the configuration of maximum energy, which cannot itself be a degradation of a previous state. And therefore it was maintained that this closeness of the two bodies points to the community of their origin.

In this mode of evolution we see that the rotation and revolution of the two bodies was primitively such that the month and day were of equal length (about five hours), and that in the future they will again come to equality, each being then about fifty of our days long. From this it follows that the system must pass through some phase in which there is a maximum number of planetary rotations during one revolution of the satellite, or shortly there must, at some time, be a maximum number of days in the month. Numerical calculation shows that for the earth and moon that maximum number is about 29, and that at present, when we have $27\frac{1}{3}$ days in the sidereal month, we have slightly passed that maximum.

From a further consideration of the figures it appears that if the planet and satellite are set in motion with opposite rotations, the satellite will fall into the planet if the moment of momentum of orbital motion be less than or equal to, or only greater, by a certain critical amount than the moment of momentum of planetary rotation; but if it be greater by more than a certain critical amount the satellite will approach the planet, the rotation of the planet will stop and reverse, and finally the system will come to equilibrium when the two bodies move round as a rigid body, with a long periodic time.

If the rate of the planet's rotation be less than that of the satellite's revolution, so that the sidereal month is shorter than the day (as with the inner satellite of Mars), then the satellite will either approach the planet and ultimately fall into it, or will approach the planet and will finally move round the planet at the same rate as the planet rotates. It depends on the nature of the system, as to which of these two cases will be the result.

The method is then extended to the case where the satellite, instead of being merely an attractive particle, is also a spheroid rotating about an axis perpendicular to the plane of the orbit. In this case the graphical illustration is by means of surfaces, there being one surface representing conservation of moment of momentum, and another representing the energy of the system. Each point on one surface has a corresponding point on the other surface, and the point on the energy surface must always slide down hill. It is not necessarily the case that the descent should be down a line of greatest slope. Illustrations are given to show that a point on an energy surface may sometimes depart from the bottom of a furrow, or may descend a ridge on the surface. The path to be followed by the point on the energy surface depends on the nature of the tides raised in the two bodies. Thus the solution in this case is not determinate, without some further knowledge of the system.

MORE NOTES FROM KILBURN

THE gas and petroleum-engines make a fair show. The Otto silent gas-engine, however, seems still to hold its own, other constructions having, so far as one can judge from a short inspection at Kilburn, some defect or other, such as noisy working, or a dangerous-looking outside flare of the ignited gas. One striking novelty is shown in this section, namely, an invention of Mr. Dugald Clerk, whereby the gaseous mixture is lighted by a cage of platinum wire, which retains heat enough from one ignition to the next to be effective for this purpose. It is stated that 400 ignitions have been made in the cylinder of an engine of this type in one minute. There are other distinctive contrivances in this gas-engine, which, by the by, is the manufacture of Messrs. Thomson, Sterne, and Co., and altogether shows great ingenuity. One of the engines exhibited by this firm is described as a "Domestic Motor," of $\frac{1}{10}$ horse-power, costing but 15*l.*, and deriving its power from steam generated by the ignition of air and gas. Such an engine seems admirably fitted for private use in laboratories and small workshops as well as in houses.

Self-binding harvesters, in which wire is used for the automatic tying-up of the sheaves, are attracting much attention, now that millers have adopted the use of magnets, preferably electro-magnets, to separate any bits of iron wire that may happen to get mixed with the grain.

The machinery and implements employed in butter-making and cheese-making afford a striking example of the advantages resulting from the application of scientific exactness to a most useful art. The question of temperature in every operation of the dairy is now recognised as of extreme importance. The thermometer reigns supreme in the interesting tent where dairying is shown. The material, the depth, and the diameter of the pans for "setting" milk have been duly studied. Though the processes and instruments exhibited in action are few in comparison with those at the previous shows at Hamburg and other special gatherings, yet the exhibits of Mr. E. Ahlborn and of the Aylesbury Dairy Company are worth attentive study. We noted especially an ingenious butter-squeezer or presser, which removes in the most effectual way that very variable and often excessive quantity of butter-milk and water and of interstitial air which occur in ordinary butter, even when quite genuine. Not only is liability to change and decomposition much lessened by this operation, but constancy of composition is secured, and we no longer find the proportion of water in fresh butter ranging between 6 and 20 per cent.

Messrs. F. H. Atkins and Co. show some good models and examples of their water-filters and other sanitary appliances in connection with water supply. One of their contrivances is specially clever. The surfaces of filtering media of course become rapidly clogged and useless when the water supply is particularly turbid. The vertical surfaces of Atkins's cloth filters are so arranged as to be capable of rotation against a rotating cylindrical brush, set vertically, and accommodating itself perfectly to the surface to be cleansed.

An instructive section of the Kilburn Show is that devoted to hops. From a paper issued by Messrs. John

Barth and Sons, of Nuremberg, we glean some interesting data as to the hop production of the world; this firm also exhibits a diagram of hop-prices from 1798 to 1878. Some samples of hops preserved for two years or more by a process, of which the nature is kept secret, are perfect in aroma and colour. Compression, cold, and exclusion of air are elements of the process but do not suffice to account for its success. The total amount of hops grown in the world in 1878 is stated by Messrs. Barth to be—

	cwts.
England	650,000
Continental Europe	619,000
America	220,000
Total	1,489,000

Many most instructive data as well as specimens, models and instruments, frequently showing novel applications of scientific principles, may be studied at the Kilburn Show. We had noted for remark the malt-cake exhibited on Stand 586, and the splendid collection of seeds, roots, and models shown by Sutton and Sons of Reading, but the limit of the space at our disposal preclude us from further dwelling upon this exhibition, with its perplexing but most interesting collections.

OUR ASTRONOMICAL COLUMN

THE NEW COMET (SWIFT, JUNE 20).—From observations at Strasburg by Prof. Winnecke on June 21, 26, and July 2, Dr. Küstner, one of his pupils, has computed the following elements of this comet, taking account of all the small corrections:—

Perihelion passage, 1879, April 27·3357 M.T. at Berlin.

	° ′ ″	
Longitude of perihelion	42 28 30·8	Mean equinox 1879·0.
,, ascending node	45 33 36·6	
Inclination to ecliptic	72 59 52·5	
Log. perihelion distance	9·948935	

Motion—retrograde.

From this orbit it appears that on Tuesday next, July 15, the comet will make an exceedingly close approach to the pole of the equator; at 10h. G.M.T. its calculated position is in right ascension 15h. 20m., and declination 89° 42′, but earlier in the evening its distance from the pole may be little over 10′.

We extract the following positions from an ephemeris for Berlin midnight, communicated by Prof. Winnecke:—

1879.	Right Ascension. h. m. s.	North Declination. ° ′	Log. distance from Earth.	Log. distance from Sun.
July 11	2 57 59	85 59·2	0·2209	0·1940
12	2 58 6	87 4·8		
13	2 57 40	88 10·3	0·2226	0·2010
14	2 53 50	89 15·6		
15	15 18 0	89 39·2	0·2247	0·2080
16	15 6 32	88 34·3		
17	15 5 33	87 29·6	0·2271	0·2148
18	15 5 36	86 25·0		
19	15 5 56	85 20·7	0·2300	0·2216
20	15 6 25	84 17·0		

TEMPEL'S COMET, 1867 II.—In a letter addressed to *The Observatory*, communicating his observations of this comet made during the present reappearance, at Florence, Dr. Tempel remarks: "Since it will approach Jupiter nearer in the year 1882 than in the year 1870, we shall probably have difficulty in seeing it again, if we ever do so." This statement must rest upon some misconception or error of calculation. The mean daily motion at the perihelion passage in the present year would not differ materially from 593″·18 as fixed by M. Raoul Gautier, and the perihelion passage having taken place about May 6·98 G.M.T., it will appear that when the comet is next in aphelion (which is about the nearest point of approach to the orbit of Jupiter) early in May, 1882, the actual distance between the two bodies is rather more than 0·75 of the earth's mean distance from the sun, though in the actual orbit it might happen that at this point the comet and planet approach within 0·3. Neglecting the effect of perturbation in the interim, it will be found from M. Gautier's elements that the nearest approach of the comet to Jupiter during the next revolution will occur in October 1881, when their mutual distance will be rather less than 0·58. In January 1870, according to Dr. Seeliger's computation this distance was only 0·32. Although, therefore, the perturbations during the ensuing revolution may be very sensible, they will not produce so great an effect upon the elements of 1879 as to bear out Dr. Tempel's statement.

Observations of this comet have been made at the Observatory of Rio de Janeiro, where the comet was found independently by M. Cruls. The Emperor of Brazil, who appears to take a personal interest in the proceedings of his astronomical establishment, has communicated these observations to the Paris Academy of Sciences, of which his Majesty is a Corresponding Member.

THE VARIABLE-STAR PIAZZI XIII. 126.—Mr. Burnham draws attention to an interesting discovery he has made respecting this object, viz., that it is really a close double star, the components of nearly equal magnitude 6·2 and 6·5, at a central distance of 0″·48 on an angle of 80°·4 for 1879·4. Attention was first directed to its variability by Dr. Julius Schmidt, of Athens, in June, 1866. On the 6th of that month he found it 5·4m. more conspicuous than *i* Virginis, with a yellowish white light contrasting with the orange tinge of the latter star. Piazzi estimated it 6·7m. and 7m., not 8m., as given in his Catalogue; Lalande called it 6·7, Brisbane 6, Heis 6·7, and it is 7m. on Bremicker's chart; it is No. 1,342 of Lamont, who estimated it only 8m. It is worthy of note that the star occurs in the Uranometry of Al Sufi, translated by Prof. Schjellerup in 1874; it is No. 19 of the constellation Virgo in the catalogue of the Persian astronomer, and rated 5·6m. As Mr. Burnham remarks, it will be easy to determine which, if only one, of the stars is variable. The star is B.A.C. 4,531 and No. 1,244 of the new Greenwich Nine-Year Catalogue. Its position for 1880·0 is in R.A. 13h. 28m. 18s., N.P.D. 102° 35′·9.

GEOGRAPHICAL NOTES

A PRIVATE letter received at Carlscrona from the commander of the steamer *Vega* reports all on board in good health. The *Vega* left the mouth of the Lena on August 27. At first she made tolerably good progress, although she had to contend with ice and shoals. The voyage was continued to Cape Yakow, but there she was stopped for three days. The steamer got away from there on September 11, and after a difficult passage reached Cape North on the 13th, where she remained beset until the 18th. After that date the steamer could only now and then make progress on account of the ice. On September 28 the expedition attained this present position, which is situated in lat. 67° 6′, long. 173° 30′. If the *Vega* had got there two days earlier she would have reached Behring Straits. The ship is not lying in a harbour, but alongside a very low sandy shore, made fast to the ground ice. Every one was well, and there was a good supply of provisions and enough coal on board to steam 2,000 miles. One or two villages had been passed, the inhabitants of which are Tschutsches. Their complexion is tawny and their hair and eyes are black. They dress in clothes made of reindeer skin, reside in skin tents, and live on seal blubber. They are singularly amiable and obliging; the women have their faces tattooed, but the men have not. Their language is very hard to understand, but the explorers have learnt it, and have compiled a Swedish Tschutschisk lexicon of over 300 words. There are three Tschutschisk villages in the neighbourhood of the *Vega*. The temperature in September seldom went down below 3 deg., and the lowest was 5 deg. (Centigrade). On the darkest day of the year, December 21, the sun was above the horizon. The letter was sent off from the *Vega* by a chief who was on a visit, and who lives near Anadyrsk. The explorers expected to get free about July 1, and to reach Japan about August 15.

MAJOR SERPA PINTO, the Portuguese African explorer, of whose journey we gave some account last week, arrived in London on Monday last. We understand that the Royal Geographical Society do not contemplate holding a special meeting in Major Pinto's honour, but that he will be entertained by the Earl of Northbrook, President of the Society, at a private reception on July 16, to which the leading geographers have been invited.

NEWS has arrived at Lisbon that the Portuguese explorers Capello and Ivens, who started with Major Pinto, were on the margin of the river Lucala on April 5, studying the regions crossed by the river Cubango. They had explored the Cubango from its source to the eighth parallel.

THE steamer *Jeannette*, with the Arctic Exploring expedition of the *New York Herald*, sailed on Tuesday from San Francisco for the Arctic seas, *viâ* Behring Straits. The commander is Lieut. De Long, and among the scientific staff is Mr. J. J. Collins, who expects to obtain important data in meteorology to the north of Behring Straits. The detailed plans of the expedition are purposely kept secret.

IN the current number of the *Church Missionary Intelligencer* we find an interesting account, by the Rev. C. T. Wilson, of his voyage across the Victoria Nyanza, from Uganda to Kagei, in the course of which he was able to make some important additions to our knowledge of the geography of the large group of islands at the north-western corner of the lake. He proved conclusively that Mr. Stanley is in error in placing one large island there, to which he gives the name of Sesse, as in reality there are about 150 islands. Passing down the western coast, Mr. Wilson came to the Kagera, or Kitangule River, the Alexandra Nile of Stanley. South of this, he says, the scenery underwent a great change. Previously the shore had been low, clothed with dense forest, and often fringed with beds of papyrus, while to the south the country consisted of high downs, ending in abrupt precipices, 300 or 400 feet high, which sometimes descended sheer down into the lake, and at others had a low strip of alluvial land at their base, dotted with villages. The geological formation also changed. North of the Kagera the rocks were mostly a hard conglomerate, the matrix being clay iron ore, in which quartzose pebbles were imbedded, but on the south they were clay slate, with red sandstone, the strata being inclined in a westerly direction at an angle of about 15°. Besides occasional descriptions of the country and scenery, Mr. Wilson's journal contains some interesting notes on natural history and on the customs of the people.

MR. SANFORD FLEMING, C.M.G., the engineer-in-chief, has just issued his annual report in reference to the Canadian Pacific Railway, illustrated by an interesting map of the prairie region. Mr. Fleming has endeavoured to collect all known information respecting the country within the limits of the prairie region, and, to make it easy of reference, the whole region has been subdivided into blocks, bounded by each separate parallel of latitude and longitude; the descriptions of scientific travellers and all available statements made on reliable authority are placed side by side. Much still remains to be discovered respecting large tracts of country, and Mr. Fleming suggests that the information should be obtained during the present season by careful explorations of the sections where our knowledge is deficient. On the map an attempt has been made to indicate generally the character of the soil, separating that of more or less value from tracts which are comparatively worthless.

IN the fifteenth part of the great map of Switzerland recently published at Berne, the following sheets will be found useful by English tourists in the coming season:—No. 263, Glarus; 367, Wimmis; 429, St. Maria, and 429 *bis*, Stilfser Joch (giving the Swiss portion of the Stelvio); and 526, Martigny, 529, Orsières, and 532, Grand St. Bernard (giving the whole of the Swiss side of the St. Bernard Pass). The present issue is in no respect inferior to the earlier ones, which, we have frequently pointed out, have been remarkable for their uniform excellence. When all the sheets are published, and this will occur in about twelve years' time if the present rate of issue is maintained, Switzerland will be able to boast of a map of a far higher and more useful order than is possessed by any other country in the world.

M. DE LESSEPS gave a long address at the last sitting of the Paris Geographical Society on the Panama Canal. He announced that he had entered into a contract with the Société d'Études for purchasing their rights so as to have the whole of the affair in his own hands. He stated that he had paid a deposit of 80,000*l.* to the Venezuelan Government, and his intention was to establish a public subscription of 16,000,000*l.* He thought that sum should be sufficient with the sale of land conceded by the local government, and that the canal should be finished in less than eight years. In his speech M. de Lesseps narrated a circumstance quite unknown of the career of Napoleon III. When he was a prisoner in Ham he sent one of his friends to survey the canal by Nicaragua. He was so well satisfied with the results of the inspection that he wrote a petition to the Government asking to be liberated from his life confinement, in order to devote his activity to the establishment of this great work, pledging his word of honour that he should no more meddle with politics. The petition was left unanswered. He was ready to go to Nicaragua in order to execute his long-cherished scheme, when the Revolution of 1848 broke out and changed his plans.

THE New York *Nation* records with great satisfaction the formal presentation to the U.S. Government of the invaluable collection of Indian portraits and curiosities made by the late George Catlin. This collection was, a generation ago, one of the standing attractions of London, was afterwards exhibited in Belgium, and there fell into the hands of the late Joseph Harrison, Jun., of Philadelphia, who not only helped Mr. Catlin out of his financial straits by the purchase, but intentionally preserved for his country this most remarkable record of the American aborigines. His widow has now offered it to the National Museum, where it will be duly displayed.

M. DE BRAZZA, the explorer of the Ogowé, and gold medallist of the French Geographical Society, has been summoned to Rome, where he received from the Italian Geographical Society another gold medal for his exploring work. M. de Brazza is an Italian by birth, having become French by naturalisation.

THE new *Bulletin* of the Antwerp Geographical Society contains a geographical sketch of Afghanistan, accompanied by a map, by Lieut.-Col. Adan, who appears to be the mainstay of both the Belgian societies.

THE telegraph line between Tientsin and Taku, in Northern China, was completed on May 8.

THE Japanese Government intend to connect the Loochoo Islands with Japan by a submarine telegraph cable to Kagoshima.

MOLECULAR PHYSICS IN HIGH VACUA[1]

II.

I HAVE hitherto spoken of and illustrated these phenomena in connection with *green* phosphorescence. It does not follow, however, that the phosphorescence is always of that colour. This coloration is a property of the particular kind of glass in use in my laboratory. I have here (Fig. 7) three bulbs composed of different glass: one is uranium glass (*a*), which phosphoresces of a dark green colour; another is English glass (*b*), which phosphoresces of a blue colour; and the third (*c*) is soft German glass—of which most of the apparatus before you is made—which phosphoresces of a bright apple-green colour. It is therefore plain that this particular green phosphorescence is solely due to the glass which I am using. Were I to use English glass I should have to speak of blue phosphorescence, but I know of no glass which is equal to the German in brilliancy.

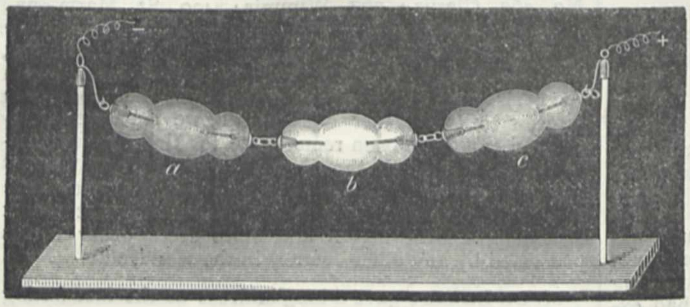


FIG. 7.

My earlier experiments were almost entirely carried on by the aid of the phosphorescence which glass takes up when it is under the influence of the electric discharge *in vacuo*; but many other substances possess this phosphorescent power, and some have it in a much higher degree than glass. For instance, here is some of the luminous sulphide of calcium prepared according to M. Ed. Becquerel's description. When it is exposed to light—even candlelight—it phosphoresces for hours with a rich blue colour. I have prepared a diagram with large letters written in this luminous sulphide; before it is exposed to the light the letters are invisible, but Mr. Gimingham has just exposed it in another room to burning magnesium, and now it is brought into the darkened theatre you will see the word "φῶς,"—*light*, a very suitable word for so beautiful a phosphorescence—shining brightly in luminous characters. The first letter, φ, shines with an orange light; it is a sulphide of calcium prepared from oyster-shells. The other letters, shining with a blue light, are sulphide of calcium prepared from precipitated carbonate of lime. Once the phosphorescence is excited the letters shine for several hours. I will put the diagram at the back, and we shall see how it lasts during the remainder of the lecture. This substance, then, is phosphorescent to light, but it is also much more strongly phosphorescent to the molecular discharge in a good vacuum, as you will see when I pass the discharge through this tube (Fig. 8). The white plate (*a*, *b*) in the centre of the tube is a sheet of mica painted over with the luminous sulphide of which the letter φ was composed in the diagram you have just seen. On connecting the poles with the coil, the mica screen glows with a strong yellowish green light, bright enough to illuminate all the apparatus near it. But there is another phenomenon to which I now desire to draw attention: on the luminous screen is a kind of distorted star-shaped figure. A little in front of the negative pole I have fixed a star (*c*) cut out in aluminium, and it is the image of this star which you see on the screen. It is evident that the rays coming from the negative pole project an image of anything that happens to be in front of it. The discharge, therefore, must come from the pole in straight lines, and does not merely permeate all parts of the tube and fill it with light as it would were the exhaustion less good. Where there is nothing in the way the rays strike the screen and produce phosphorescence, and where there is an obstacle they are obstructed by it, and a shadow is thrown on the screen. I shall have more to say about this shadow presently; I merely now wish to establish the fact that these rays driven from the negative pole produce a shadow.

FIG. 8.

I must draw your attention to an important experiment connected with these molecular rays, but unfortunately it is a very delicate one, and very difficult to show to many at once; but I hope, if you know beforehand what to look for, you will all be able to see what I wish to show. In this pear-shaped bulb (Fig. 9A) the negative pole (*a*) is at the pointed end. In the middle is a cross (*b*) cut out of sheet aluminium, so that the rays from the negative pole projected along the tube will be partly intercepted by the aluminium cross, and will project an image of it on the hemispherical end of the tube which is phosphorescent. I think you will all now see the shadow of the cross on the end of the bulb (*c*, *d*), and notice that the cross is black on a luminous ground. Now, the rays from the negative pole have been passing by the side of the aluminium cross to produce the shadow; they have been hammering and bombarding the glass till it is appreciably warm, and at the same time they have been producing another effect on that glass—they have deadened its sensibility. The glass has got tired, if I may use the expression, by the enforced phosphorescence. Some change has been produced by this bombardment which will prevent the glass from responding easily to additional excitement; but the part that the shadow has fallen on is not tired—it has not been phosphorescing at all, and is perfectly fresh; therefore if I throw this star down—I can easily do so by giving the apparatus a slight jerk, for it has been most ingeniously constructed with a hinge by Mr. Gimingham—and so allow the rays from the negative pole to fall

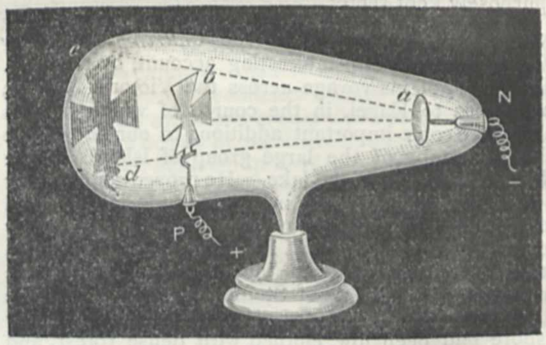


FIG. 9 A.

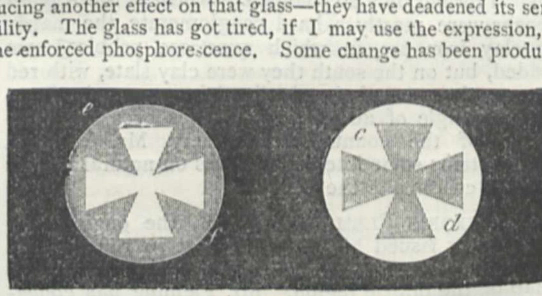


FIG. 9 B.

[1] A short-hand report of a lecture delivered at the Royal Institution on Friday, April 4, 1879. By William Crookes, F.R.S. Contributed by the author. Continued from p. 231.

uninterruptedly on to the end of the bulb, you will suddenly see the black cross (*c*, *d*, Fig. 9B) change to a luminous one (*e*, *f*), because the background is only faintly phosphorescing, whilst the part which had the black shadow on it retains its full phosphorescent power. The luminous cross is now dying out. This is a most delicate and venturous experiment, and I am fortunate in having succeeded so well, for it is one that cannot be rehearsed. After resting for a time the glass seems to partly recover its power of phosphorescing, but it is never so good as it was at first.

We have, therefore, found an important fact connected with

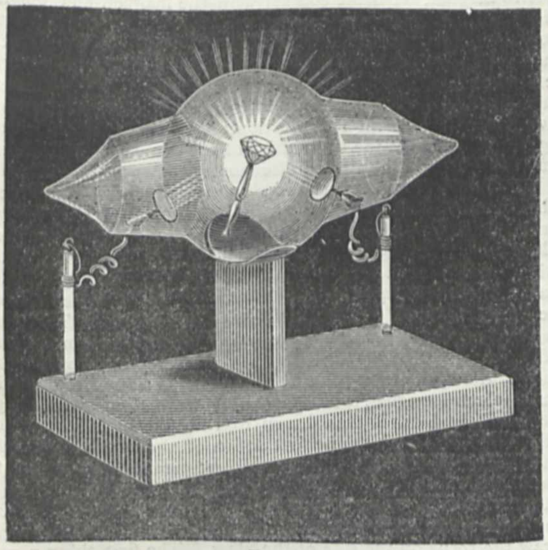


Fig. 10.

this phosphorescence. Something is projected from the negative pole which has the power of hammering away at the glass in front of it, in such a way as to cause it not only to vibrate and become temporarily luminous while the discharge is going on, but to produce an impression upon the glass which is permanent. The explanation which has gradually evolved itself from this series of experiments is this:—The exhaustion in these tubes is so high that the dark space, as I showed you at the commencement of this lecture, that extended round the negative pole, has widened out till it entirely fills the tube. By great rarefaction the mean free path has become so long that the hits in a given

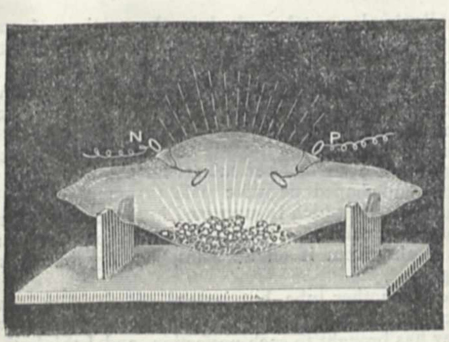


Fig. 11

time may be disregarded in comparison to the misses, and the average molecule is now allowed to obey its own motions or laws without interference. The mean free path is in fact comparable to the dimensions of the vessel, and we have no longer to deal with a *continuous* portion of matter, as we should were the tubes less highly exhausted, but we must here contemplate the molecules *individually*. At first this was only a convenient working hypothesis. Long-continued experiment then raised this provisional hypothesis almost to the dignity of a theory, and now the general opinion is that this theory gives a fairly correct explanation of the facts. In these highly exhausted vessels the mean free path of the residual molecules of gas is so long that they are able to drive across from the pole to the other side of the tube with comparatively few collisions. The negatively electrified molecules of the gaseous residue in the tube therefore dash against anything that is in front, and cast shadows of obstacles just as if they were rays of light. Where they strike the glass they are stopped, and the production of light accompanies this sudden arrest of velocity.

Other substances besides English, German, and uranian glass, and Becquerel's luminous sulphides are also phosphorescent. I think, without exception, the diamond is the most sensitive substance I have yet met for ready and brilliant phosphorescence. I have here a tube, similar to those already exhibited, containing a mica screen painted with powdered diamond, and when I turn on the coil, the brilliant blue phosphorescence of the diamond can be seen, quite overpowering the green phosphorescence of the glass. Here, again, is a very curious diamond, which I was fortunate enough to meet with a short time ago. By daylight it is green, produced, I fancy, by an internal fluorescence. The diamond is mounted in the centre of this exhausted bulb (Fig. 10), and the negative discharge will be directed on it from below upwards. On darkening the theatre you see the diamond shines with as much light as a candle, phosphorescing of a bright green.

In this other bulb is a remarkable collection of crystals of diamonds, which have been lent me by Prof. Maskelyne. When I pass the discharge over them I am afraid you will only be able to see a few points of light, but if you will examine them after the lecture, you will see them phosphoresce with a most brilliant series of colours—blue, apricot, red, yellowish green, orange, and pale green.

Next to the diamond the ruby is one of the most remarkable stones for phosphorescing. In this tube (Fig. 11) is a collection of ruby pebbles, for the loan of which I am indebted to my friend Mr. Blogg, of the firm of Blogg and Martin, who placed a small sackful at my disposal. As soon as I turn on the induction spark you will see these rubies shining with a brilliant rich red colour, as if they were glowing hot. Now the ruby is nothing but crystallised alumina with a little colouring-matter, and it became of great interest to ascertain whether the artificial ruby made by M. Feil, of Paris, would glow in the same manner. I had simply to make my wants known to M. Feil, and he immediately sent me a box containing artificial rubies and crystals of alumina of all sizes, and from those I have selected the mass in this tube which I now place under the discharge: they phosphoresce of the same rich red colour as the natural ruby. It scarcely matters what colour the ruby is, to begin with. In this tube of natural rubies there are stones of all colours—the deep red ruby and the pale pink ruby. There are some so pale as to be almost colourless, and some of the highly-prized tint of pigeon's blood; but in the vacuum under the negative discharge they all phosphoresce with about the same colour.

As I have just mentioned, the ruby is crystallised alumina. In a paper published twenty years ago by Ed. Becquerel,[1] I find that he describes the appearance of alumina as glowing with a rich red colour in the phosphoroscope (an instrument by which the duration of phosphorescence in the sunlight can be examined). Here is some chemically pure precipitated alumina which I have prepared in the most careful manner. It has been heated to whiteness, and you see it glows with the rich red colour which is supposed to be characteristic of alumina. The mineral known as corundum is a colourless variety of crystallised alumina. Under the negative discharge in a vacuum, corundum phosphoresces of a rose-pink colour. There is another curious fact in which I think chemists will feel interested. The sapphire is also crystallised alumina, just the same as the ruby. The ruby has a little colouring-matter in it, giving it a red colour; the sapphire has a colouring-matter which gives it a blue colour, whilst corundum is white. I have here in a tube a very fine crystal of sapphire, and, when I pass the discharge over it, it gives alternate bands of red and green. The red we can easily identify with the glow of alumina; but what is the green? If alumina is precipitated and purified as carefully as in the case I have just mentioned, but in a somewhat different manner, it is found to glow with a rich green colour. Here are the two specimens of alumina in tubes, side by side. Chemists would say that there was no difference between one and the other; but I connect them with the induction-coil, and you see that one glows with a bright green colour, whilst the other glows with a rich red colour. Here is a fine specimen of chemically pure alumina,

[1] *Annales de Chimie et de Physique*, 3rd series, vol. lvii. p. 50, 1859.

sent me by Messrs. Hopkin and Williams; by ordinary light it is a perfectly white powder. It is just possible that the rich fire of the ruby, which has caused it to be so prized, may be due not entirely to the colouring-matter, but to its wonderful power of phosphorescing with a deep red colour, not only under the electric discharge in a vacuum, but whenever exposed to a strong light.

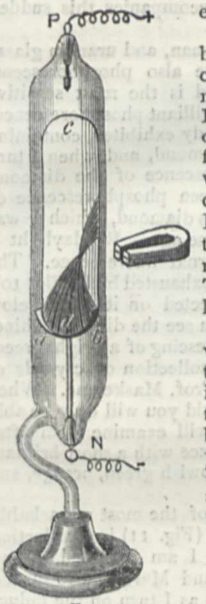


FIG. 12.

The spectrum of the red light emitted by all these varieties of alumina—the ruby, corundum, or artificially precipitated alumina—is the same as described by Becquerel twenty years ago. There is one intense red line, a little below the fixed line B in the spectrum, having a wave-length of about 6895. There is a continuous spectrum beginning at about B, and a few fainter lines beyond it, but they are so faint in comparison with this red line that they may be neglected. This line may be called the characteristic line of alumina.

I now pass on to another fact connected with this negative discharge. Here is a tube (Fig. 12) with a negative pole (*a*, *b*) in the form of a hemi-cylinder, similar to the one you have already seen (Fig. 3), but in this case I receive the rays on a phosphorescent screen (*c*, *d*). See how brilliantly the lines of discharge shine out, and how intensely the focal point is illuminated; it lights the whole table. Now I bring a small magnet near, and move it to and fro; the rays obey the magnetic force, and the focus bends one way and the other as the magnet passes it. I can show this magnetic action a little more definitely. Here is a long glass tube (Fig. 13), very highly exhausted, with a negative pole at one end (*a*) and a long phosphorescent screen (*b*, *c*) down the centre of the tube. In front of the negative pole is a plate of mica (*b*, *d*) with a hole (*e*) in it,

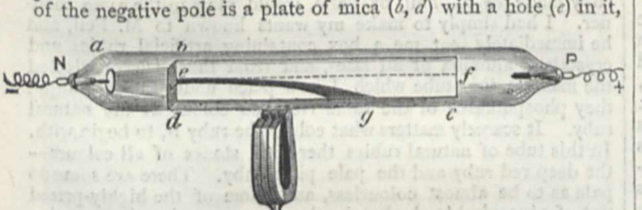


FIG. 13.

and the result is that when I turn on the current, a line of phosphorescent light (*e*, *f*) is projected along the whole length of the tube. I now place beneath the tube a powerful horse-shoe magnet: see how the line of light becomes curved under the

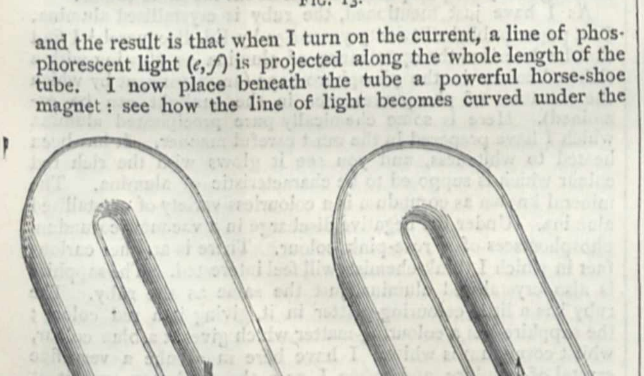


FIG. 14.

magnetic influence (*e*, *g*), waving about like a flexible wand as I move the magnet up and down. The action of the magnet can be understood by reference to this diagram (Fig. 14). The north pole gives the ray of molecules a spiral twist one way, and the south pole twists it the other way; the two poles side by side compel the ray to move in a straight line up or down, along a plane at right angles to the plane of the magnet and a line joining its poles.

Now it is of great interest to ascertain whether the law governing the magnetic deflection of the trajectory of the molecules is the same as has been found to hold good at a lower vacuum. The former experiment was with a very high vacuum. This is a tube with a low vacuum (Fig. 15). On passing the induction spark it passes as a narrow line of violet light joining the two poles. Underneath I have a powerful electro-magnet. I make contact with the magnet, and the line of light dips in the centre towards the magnet. I reverse the poles, and the line is driven up to the top of the tube. Notice the difference between the two phenomena. Here the action is temporary. The dip takes place under the magnetic influence; the line of discharge then rises, and pursues its path to the positive pole. In the high exhaustion, however, after the ray of light had dipped to the magnet it did not recover itself, but continued its path in the altered direction.

During these experiments another property of this molecular discharge has made itself very evident, although I have not yet drawn attention to it. The glass gets very warm where the green phosphorescence is strongest. The molecular focus on the tube, which we have just seen (Fig. 12) would be intensely hot, and I have prepared an apparatus by which this heat at the focus can be intensified and rendered visible to all present. This small tube (*a*) (Fig. 16) is furnished with a negative pole in the form of a cup (*b*). The rays will therefore be projected to a focus in the middle of the tube (Fig. 17, *a*). At the side of the tube is a small electro-magnet, which I can set in action by touching a key, and the focus is then drawn to the side of the glass tube (Fig. 17, *b*). To show the first action of the heat I have coated the tube with wax. I will put the apparatus in front of the electric lantern (*d*), and throw a magnified image of the tube on the screen. The coil is now at work, and the focus of molecular rays is projected along the tube. I turn the magnetism on, and draw the focus on the side of the glass. The first thing you see

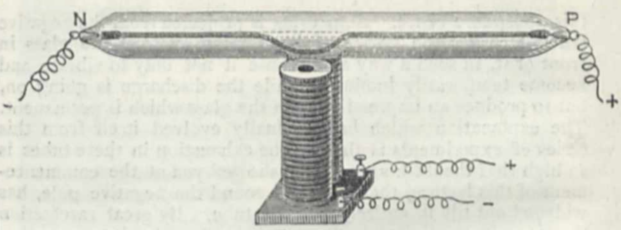


FIG. 15.

is a small circular patch melted in the coating of wax. The glass soon begins to disintegrate, and cracks are shooting starwise from the centre of heat. The glass is softening. Now the atmospheric pressure forces it in, and now it melts. A hole (*e*) is perforated in the middle, the air rushes in, and the experiment is at an end.

Instead of drawing the focus to the side of the glass with a magnet, I will take another tube (Fig. 18), and allow the focus from the cup-shaped negative pole (*a*) to play on a piece of platinum wire (*b*) which is supported in the centre of the bulb. The platinum wire not only gets white-hot, but you can see sparks coming from it on all sides, showing that it is actually melting.

Here is another tube, but instead of platinum I have put in the focus that beautiful alloy of platinum and iridium which Mr. Matthey has brought to such perfection, and I think that I shall succeed in even melting that. I first turn on the induction-coil slightly, so as not to bring out its full power. The focus is now playing on the iridio-platinum, raising it to a white heat. I bring a small magnet near, and you see I can deflect the focus of heat just as I did the luminous focus in the other tube. By shifting the magnet I can drive the focus up and down, or draw it completely away from the metal, and render it non-luminous. I withdraw the magnet, and let the molecules have full play again; the metal is now white-hot. I increase the intensity of the spark. The metal glows with almost insupportable brilliancy, and at last melts.

There is still another property of this molecular discharge, and it is this:—You have seen that the molecules are driven violently from the negative pole. If I place something in front of these molecules, they show the force of impact by the heat which is produced. Can I make this mechanical action evident in a more direct way? Nothing is simpler. I have only to put some easily moving object in the line of discharge in order to get a powerful mechanical action. Mr. Gimingham, with great

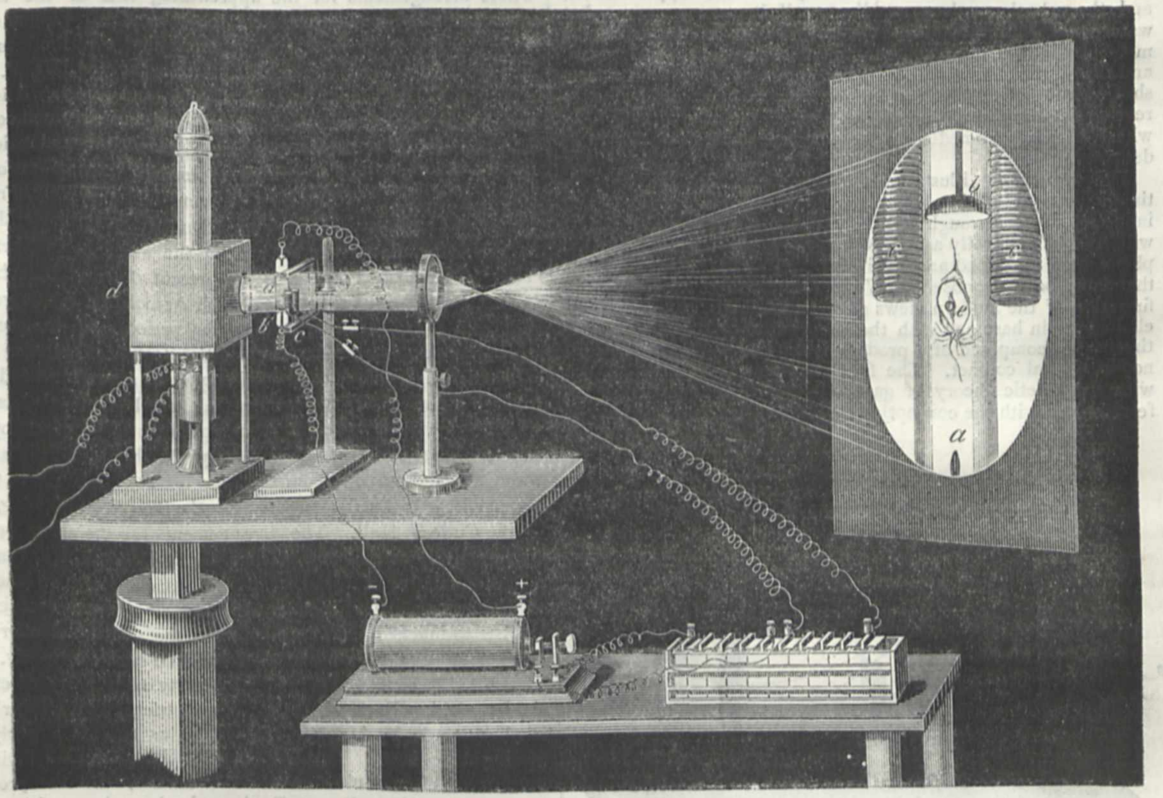


FIG. 16.

skill, has constructed a piece of apparatus which I will presently put in the electric lantern, so that all will be able to see its action. But first I will explain the construction by means of this diagram (Fig. 19). The negative pole (a, b) is in the form of a very shallow cup. In front of the cup is a mica screen

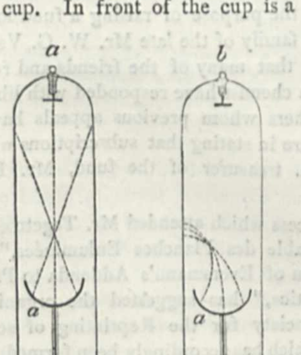


FIG. 17.

(c, a), wide enough to intercept nearly all the molecular rays coming from the negative pole. Behind this screen is a mica wheel (e, f) with a series of vanes, making a sort of paddle-wheel of it. So arranged, the molecular stream from the pole $a\,b$ will nearly all be cut off from the wheel, and what escapes over and under the screen will hit the vanes equally, and will not produce any movement. I now put a magnet, g, over the tube, so as to

FIG. 18.

deflect the stream over or under the obstacle $c\,d$, and the result will be rapid motion in one or the other direction, according to the way the magnet is turned. I now throw the image of the apparatus on the screen. The spiral lines painted on the wheel show which way it turns. I arrange the magnet to draw the molecular stream so as to beat against the upper vanes, and the wheel revolves rapidly, as if it were an over-shot water-wheel. I now turn the magnet so as to drive the molecular stream underneath; the wheel slackens speed, stops, and then begins to rotate the other way, as if it were an under-shot water-wheel. This can be repeated as often as I like to reverse the position of the magnet, the change of rotation of the wheel showing immediately the way the molecular stream is deflected.

This experiment illustrates the last of the phenomena which time allows me to bring before you, attending the passage of the induction spark through a highly exhausted atmosphere. It will now be naturally asked, What have we learned from the phenomena described and exhibited, and from the explanations that have been proposed? We find in these phenomena confirmation of the modern views of matter and energy. The facts elicited are in harmony with the theory that matter is not continuous but composed of a prodigious number of minute particles, not in mutual contact. The facts also are in full accordance with the kinetic theory of gases—to which I have already referred—and with the conception of heat as a particular kind of

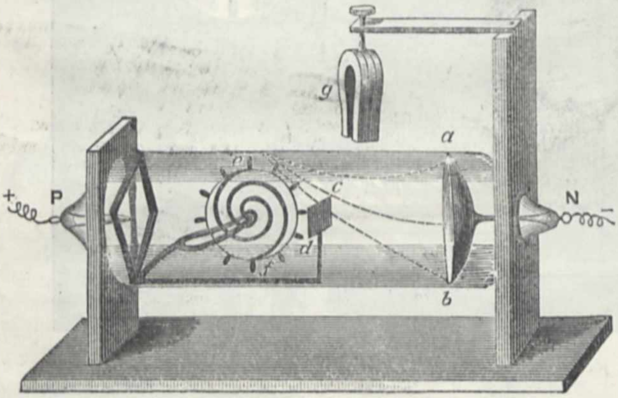


Fig. 19.

energy, expressing itself as a rapid vibratory motion of the particles of matter. This alone would be a lesson of no small value. In science every law, every generalisation, however well established, must constantly be submitted to the ordeal of a comparison with newly-discovered phenomena; and a theory may be pronounced triumphant when it is found to harmonise with and to account for facts which, when it was propounded, were still unrecognised or unexplained.

But the experiments have shown us more than this: we have been enabled to contemplate matter in a condition hitherto unknown—in a fourth state—as far removed from that of gas as gas is from liquid, where the well-known properties of gases and elastic fluids almost disappear, whilst in their stead are revealed attributes previously masked and unsuspected. In this ultra-gaseous state of matter phenomena are perceived which in the mere gaseous condition are as impossible as in liquids or solids.

I admit that between the gaseous and the ultra-gaseous state there can be traced no sharp boundary; the one merges imperceptibly into the other. It is true also that we cannot see or handle matter in this novel phase. Nor can human or any other kind of organic life conceivable to us penetrate into regions where such ultra-gaseous matter may be supposed to exist. Nevertheless, we are able to observe it and experiment on it, legitimately arguing from the seen to the unseen.

Of the practical applications that may arise out of these researches, it would now be premature to speak. It is rarely given to the discoverer of new facts and new laws to witness their immediate utilisation. The ancients showed a perhaps unconscious sagacity when they selected the olive, one of the slowest growing trees, as the symbol of Minerva, the goddess of Arts and Industry. Nevertheless, I hold that all careful honest research will ultimately, even though in an indirect manner, draw after it, as Bacon said, "whole troops of practical applications."

NOTES

A MEETING of the Executive Committee having charge of the whole arrangements for the approaching visit of the British Association to Sheffield was held the other day. In connection with the Guide Book it was reported that contributions were arranged from Prof. Green, Mr. Arthur Jackson, Mr. F. Brittain, Mr. G. R. Vine, Mr. J. D. Leader, and others. It is proposed to issue the guide books at 1*s*. each, and they will contain scientific and other information suitable for visitors and residents. Dr. Sorby stated that a number of eminent men from foreign countries, including representatives from Germany, Italy, France, Belgium, the United States, and other parts of the world, had accepted invitations to take part in the meetings in Sheffield. These distinguished visitors will represent different branches of science; and from France the British Association is this year to be honoured, after the lapse of a long period, with the presence of the President of the Academy of Sciences, M. Daubrée. The Mayor (Ald. Ward) is to give a banquet to a number of distinguished guests in the banqueting hall of the Cutlers' Company on Saturday, August 23. A reception is to be given by the Master Cutler and Cutlers' Company, which will take place in the Cutlers' Hall on Thursday, August 21. A *soirée* is to be arranged by the local committee for the Tuesday following, also in the Cutlers' Hall. The arrangements for the excursions are being actively carried out. The Duke of Devonshire has invited a limited number of Members of the Association to a luncheon at Chatsworth. Earl Manners has invited a number of excursionists to luncheon at Thoresby, with the additional offer that they should be driven round the forest and park afterwards. Sir Joseph Whitworth has offered hospitality to a party of excursionists visiting Darley Dale and the district, and a similar offer has been made by Mr. F. C. Armitage, as regards a party exploring Arborlowe. The Rev. A. W. Hamilton-Gell invites a number of excursionists to Stanton-in-Peak, with the promise that they should see Router Rocks and other places of interest. Sir John Lubbock is to be asked to give an address at Arborlowe on the interesting Druidical remains there to be seen. Generally the arrangements were reported to be in a very satisfactory state.

SOME weeks since we stated that a committee had been formed for the purpose of raising a fund for the benefit of the widow and family of the late Mr. W. G. Valentin, F.C.S. We understand that many of the friends and former pupils of this well-known chemist have responded with liberality, but as there may be others whom previous appeals have not reached, we have pleasure in stating that subscriptions will still be received by the hon. treasurer of the fund, Mr. F. W. Bayly, Royal Mint, E.

THE success which attended Mr. Tegetmeier's reprint of Boddaert's "Table des Planches Enluminées," and Mr. Dresser's reproduction of Eversmann's Addenda to Pallas's "Zoographia Rosso-Asiatica," has suggested the organisation of a "Willoughby Society for the Reprinting of scarce Ornithological Works," which has accordingly been formed, with every prospect of success. The annual subscription is 1*l*., and no copies of the works reprinted will be sold. The selection of the works to be reprinted by the Society has been intrusted to a committee consisting of the past and present editors of *The Ibis*, and Tunstall's "Ornithologia Britannica" will be the first work reproduced. Particulars may be obtained from the secretary, F. D. Godman, Esq., 10, Chandos Street, Cavendish Square, W.

THE death is announced of Dr. Johann Karl Friedrich Rosenkranz, Professor of Philosophy at Koenigsberg University. Dr. Rosenkranz published a number of philosophical treatises, and was well known through his excellent edition of the works of Immanuel Kant. He died at the age of seventy-four on June 14.

THE monument of the late eminent botanist, Prof. Alexander Braun, was unveiled on June 17 at the Botanical Gardens of Berlin. The granite pedestal is by Prof. Adler, the bust of the deceased, which is said to be an excellent likeness, by the well-known sculptor Prof. Schaper.

ACCORDING to the resolution passed at the last International Congress of Americanists at Luxemburg in 1877, the city of Brussels will be the meeting-place for this year's (third) congress. It will be held from September 23-26 under the protectorate of the King of the Belgians and the honorary presidency of the Count of Flanders. We have before stated the objects of the Congress, which will again be occupied by the consideration and discussion of a series of questions relating to the history, archæology, anthropology, ethnography, linguistics, and palæography of North and South America.

PROF. VIRCHOW, Dr. Schliemann's companion and coadjutor in the latest excavations in the Troad, has written to the eminent Homeric archæologist, informing him of a concurrence of geological opinion at Berlin in the conclusion that all the building stones, fragments of which the professor brought home from Hissarlik, are of fresh-water formation. This conclusion is thought to be decisive against those who affirm the impossibility of identifying Hissarlik with the Homeric Troy, on the ground that at the time of the great epic war the site must have been covered by the sea.

IN the Paris Academy of Sciences M. Dausse has been elected a Corresponding Member in the Section of Mechanics, in succession to the late General Didion.

THE French Minister of Fine Arts has placed at the disposition of the War Office fourteen cups of Sèvres china to be offered in competition to the societies of carrier-pigeon breeders.

THE *Times* Paris correspondent states that Dr. Krauss, at a scientific meeting at Stuttgart a few days ago, referred to the recent swarms of the *Vanessa cardui* butterfly. A like phenomenon occurred in Piedmont in 1741, 1826, and 1857. This year a swarm passed through Turin on June 2, through Switzerland from the 2nd to the 9th, Alsace, France, and Spain from the 5th to the 10th, and Würtemburg from the 11th to the 21st. Prof. Eimer, of Tübingen, found that eighteen out of nineteen specimens were females full of eggs, and he attributes the march to the search for a place to deposit their eggs; a march directed by their keen scent. Caterpillars have already been found on thistles in the districts visited, and a large number may be looked for.

THE thirty-sixth annual congress of the British Archæological Association is to be begun at Great Yarmouth on August 11, and continue until the 20th, the last three days, commencing on Monday, August 18, being passed at Norwich. Lord Waveney will deliver an inaugural address at the Town Hall, Great Yarmouth, as president of the meeting, on Monday, August 11, and the following days up to Saturday the 16th will be dedicated to a variety of interesting excursions.

IN connection with the celebration of the fiftieth anniversary of the Paris Central School of Arts and Manufactures, the *Gazzetta d'Italia* states that the meeting of engineers connected with the Florentine branch was held on Sunday, and that a banquet was given by the president, Commendatore Prof. Vegni. After dinner those present visited the Workshop Galileo, in which so much is being done for the resuscitation of mechanical art in Florence, with no aid either from Government or the Municipality. Over the door of the workshop is a clock so ingeniously constructed that it has gone now for fourteen months with a loss of only five seconds. A chronograph was exhibited capable of registering the thousandth part of a second, and applicable to the measurement of the velocity of projectiles; a cathetometer capable of measuring heights to the 1,200th of a millimetre, a new electric machine by induction, and a most efficient pneumatic machine, the invention of the eminent Padre Cecchi.

WE daresay most of our readers will be pleased at the result of the motion by Mr. S. Lloyd in the House of Commons, on Tuesday, in favour of appointing a Minister of Commerce and Agriculture. The motion was agreed to by a fair majority, among which were members of both sides of the House. This is a step in the right direction.

THE Giffard captive balloon has begun its series of night ascents by an experimental trip, which was made on June 30 with great success. The court of the Tuileries was lighted by ten Jablochkoff lamps. It is proposed to carry an electric lamp on the car if the sixty portable Bunsen elements which are in preparation can be carried without inconveniencing passengers. Captive ballooning is making its way in foreign lands. A captive balloon is being fitted up in one of the places of resort round New York; the balance for registering the levitation has been constructed in Philadelphia. It can register accurately 10,000 pounds, and is built for sustaining 25,000.

THE Paris Exhibition of Sciences Applied to Industry will be opened on the 24th inst. The preparations are being made with great activity in the Palais de l'Industrie. M. Jules Simon, the President of the Council, and M. Nicol, the Director, had an interview, on June 29, with the President of the Republic, to suggest a series of measures intended to promote the success of the exhibition.

MR. F. W. MOORE, eldest son of the late Dr. Moore, has been appointed Curator of the Botanic Gardens, Glasnevin, Dublin. Mr. Moore has been for some time curator of the College Botanic Garden, Dublin.

A SELECT Committee of the House of Commons, of which Mr. A. Pell was chairman, have concluded their consideration of the Bill promoted by the Liverpool Corporation, to give power to adopt and supply for public and private purposes lighting by electricity. The committee had intimated their decision to pass the Bill if amendments were made in the preamble, the effect of which would be to limit the power of the Corporation to making a scientific experiment, and not allow them to make it a commercial undertaking for purposes of profit, or to compete with the gas company. Amendments were proposed by the Corporation in this direction, and the committee passed the Bill.

IT is stated that the Council of India, despairing of obtaining the repeatedly asked-for assistance of the Imperial Government towards defraying the cost of the India Museum, have decided to break it up and to distribute the collections between the British and South Kensington Museums and Kew.

FROM the report on the forests and plantations in the Island of Mauritius for 1878 we learn that many of the trees which were introduced from India a few years ago have thriven beyond expectation and have in some instances already reached the size of useful timber trees. Among those which have done best are mahogany, teak, and eucalyptus. The last named (*E. calophyllus*) is found to grow with remarkable vigour, and produces fertile seed at a very early age. The severe hurricanes which sweep over the island commit great devastation among the plantations of eucalyptus and other fast-growing trees, and the Government this season intend to plant out a large number of the young gum trees to be grown as large as bushes. In this form they are expected to be able to withstand the force of the wind, and form a screen for the protection of young plantations of timber trees.

ON Saturday the Geologists' Association have an excursion to Tunbridge Wells and Crowborough Beacon. On Monday, July 21, and five following days the same society intend to have an outing in the neighbourhood of Ledbury; the Malvern Hills and Woolhope Valley being included in the programme.

IN the *Journal de Physique* for June M. Cornu gives an account of his spectroscope designed for observation of ultra-violet radiations. It resembles the common two-prism spectroscope, except in the materials employed, the ordinary materials, crown-glass and flint-glass, absorbing ultra-violet radiations at least from the line O, *i.e.*, from wave-length = 340 millionths of a millimetre. M. Cornu uses quartz for the prisms, and the objective of the collimator (as also of the telescope) is made achromatic; it consists of a biconvex lens of quartz and a divergent plane concave lens of Iceland spar, both cut perpendicularly to the optic axis.

PHOSPHORIC acid has the property of hindering the precipitation of albumen by tannin, but is without action on gelatine. M. Ador lately had the curiosity to try its effect in the tanning of skins, starting with the idea that the pores of skin would remain more open and that the solution of tannin would thus more rapidly coagulate the gelatinous substances, within the skin, producing a more rapid tanning. His experiments, both in the laboratory and on a large scale, are described in the *Moniteur Scientifique* for June. They show that the anticipated effect was realised, and that it allows of the use of a much stronger juice; but there is danger of a loss of weight if the liquids be agitated, by reason of coagulation, outside of the tissues, of a certain quantity of albuminoid principles dissolved by the phosphoric acid, and removed from the skin. He recommends manufacturers to experiment further in the same direction.

M. ROBIN, the anatomist, who is the only member of the Academy of Sciences who is also in the French Senate, has proposed a bill for instituting an inquiry into the means of increasing the fish production of the French rivers.

IN the aëronautical ascent made at Rouen, referred to in our last number, the altitude was 1,200, not 12,000, metres.

THE New York correspondent of the *Daily News* telegraphs that Mr. Edison states that since the patents for his electric light were issued he has improved the standard meter for measuring the electricity fed to the burners, and has perfected a method of insulating and conveying the wires from the generating stations to the houses of the consumers. He is satisfied that this generator cannot be improved. 94 per cent., it is said, of horse-power is set free in the electric current, and 82 is delivered in the wire outside of the machine. Eight-ninths of the current is used for the light, and one-ninth is lost in the machine. Mr. Edison's latest experiments give seven gas jets per horse-power, and he expects to increase the number to ten. He says the platinum burner is a settled thing; but, so long as he sees his way to getting more light out of the horse-power, he will continue his experiments. He expects to perfect his experiments within four weeks.

A CATASTROPHE similar to the one which was happily averted at Teplitz is now feared at the well-known watering-place of Baden, near Vienna. An official investigation committee has been formed, comprising several members of the Geologische Reichsanstalt, and has already begun examining the springs threatened with exhaustion.

WE continue to receive the numbers of the *Revista de Canarias*, to which we referred some weeks since. We trust it will meet with the support it deserves, as it is evidently making honest attempts to spread a knowledge and cultivate a taste for science among the inhabitants of the favoured islands. The last number, June 8, contains an article on the Palæontology of the Canaries, by Miguel M. y La-Roche; one on the Hygiene of the Potato, by Lorenzo Lapuyade; another on Primary Instruction in the Canaries, by Juan de la Puerta Causeco.

A VIOLENT earthquake is reported from Agram on June 21 at 8.55 A.M., which was repeated on the 22nd at 1.42 A.M. On both occasions the phenomenon consisted of several shocks proceeding in the direction from west to east.

WE learn from a Queensland paper that Mr. Walter Hill has been sent on a tour of inspection to Great Sandy, or Fraser, Island, a large irregular-shaped island lying off the coast to the north of the twenty-sixth parallel of south latitude, where it is reported that some valuable timbers flourish, notably the kaurie pine. For some time past the curator of the Botanical Gardens has been giving his attention to the propagation of some of the most valuable timbers indigenous to the colony, and at one place he has formed a nursery of red cedar trees, in which 30,000 plants have been successfully reared and are now all in a flourishing condition. It is believed that a part of Mr. Hill's mission to Fraser Island is to look for suitable sites for arboriculture, with the view of utilising the large number of red cedar plants he has reared. The red cedar takes from sixty to one hundred years to attain its best development, and this care for distant posterity is probably due to thoughtfulness on the part of the authorities who view with alarm the wholesale devastation and waste of the timber which from time to time take place in the colony. It is said that there are yet plenty of cedar trees in the Queensland forests, but quite recently several million feet of this timber were swept out to sea in consequence of a fresh in the Mossman, Daintree, and Johnston rivers.

CAREFUL statistics have been taken in Paris of the cases of rabies observed in 1878. The total number of cases reported to the Prefecture has been 440 dogs, 68 bitches, and 3 cats. Out of these 511 cases 390 were biting rabies. The number of wounds inflicted on persons was 103, and the number of deaths 30—about 1 to 3. This is the same proportion as resulted from previous inquiries. Almost all these cases have been reported from Paris out of a population of 2,000,000. The number of animals which have been bitten by mad dogs is 342 dogs and 24 cats. 234 animals were taken to the veterinary school of Alfort either for autopsy or for inspection.

IT is stated that in consequence of the auriferous indications in the Cooktown district, the Queensland Government will offer a reward of 5,000*l.* to stimulate the discovery of a gold-field rich enough to pay the cost of working.

PART V. just issued of the past *Transactions* of the Leicester Literary and Philosophical Society contains the papers read from June, 1850, to June, 1855.

THE additions to the Zoological Society's Gardens during the past week include a Grand Galago (*Galago crassicaudata*) from East Africa, presented by Mr. W. Jenkins; a Grivet Monkey (*Cercopithecus griseo-viridis*) from North-East Africa, presented by Mr. R. M. Courage; a Rhesus Monkey (*Macacus erythræus*) from India, presented by Mr. Jas. Bartle; a Puma (*Felis concolor*) from Buenos Ayres, presented by Lord Lilford, F.Z.S.; a Blue-eyed Cockatoo (*Cacatua ophthalmica*) from the Solomon Islands, presented by Lieut.-Col. Arbuthnot, 14th Hussars; a Common Boa (*Boa constrictor*) from South America, presented by Dr. A. Stradling; a Black-faced Spider Monkey (*Ateles ater*), three Red-billed Tree Ducks (*Dendrocygna autumnalis*) from South America, a Collared Fruit Bat (*Cynonycteris collaris*), captured in the Red Sea, two White Storks (*Ciconia alba*), a Common Whimbrel (*Numenius phæopus*), European, a Reticulated Python (*Python reticulatus*) from Manilla, purchased; an Axis Deer (*Cervus axis*), born in the Gardens.

THE GENESIS AND MIGRATIONS OF PLANTS

SUCH is the title of a paper, in a recent *Princetown Review*, by Prof. Dawson, whose intention in writing has been to place clearly and concisely before his readers the facts, as he interprets them, connected with the fossil floras of the Arctic and North American regions. The necessity to do so became apparent, he states, from the time that Heer described the cretaceous[1] Vancouver Island flora as miocene, and yet more when the Devonian Bear Island flora was described as carboniferous. The present publication, however, was immediately induced by Saporta's very remarkable essay on the northern origin of plant species and Hooker's latest anniversary address to the Royal Society.

The Professor commences the present essay by recalling that Asa Gray had, as early as 1867, suggested that the related floras of North America and Eastern Asia had a common northern origin; and that in 1872 he further developed this theory, embracing in it the work of Heer and Lesquereux on the tertiary floras.

He then proceeds:—

"Between 1860 and 1870 the writer was engaged in working out all that could be learned of the Devonian plants of Eastern America, the oldest known flora of any richness, and which consists almost exclusively of gigantic, and to us grotesque, representatives of the club mosses, ferns, and mares'-tales, with some trees allied to the cycads and pines. In this pursuit nearly all the more important localities were visited, and access was had to the large collections of Prof. Hall and Prof. Newberry in New York and Ohio, and to those made in the remarkable plant-bearing beds of New Brunswick by Messrs. Matthew and Hartt. In the progress of these researches, which developed an unexpectedly rich assemblage of species, the northern origin of this old flora seemed to be established by its earlier culmination in the north-east, in connection with the growth of the American land to the southward, which took place after the great upper silurian subsidence, by elevations beginning in the north while those portions of the continent to the south-west still remained under the sea.

"When, in 1870, the labours of those ten years were brought before the Royal Society of London in the Bakerian lecture of that year, and in a memoir illustrating no less than one hundred and twenty-five species of plants older than the great carboniferous system, these deductions were stated in connection with the conclusions of Hall, Logan, and Dana, as to the distributions of sediment along the north-east side of the American continent, and the anticipation was hazarded that the oldest Palæozoic floras would be discovered to the north of Newfoundland. Mention was also made of the apparent earlier and more opious birth of the Devonian flora in America than in Europe, a fact which is itself connected with the greater northward extension of this continent."

The memoir was not published by the Royal Society, and some little disappointment, he says, was thereby occasioned, but it appeared shortly after, although in a less perfect form.[2]

In the next place he contends that Heer was in error in supposing that the Bear Island plants are of carboniferous age, and attributes to Heer the responsibility of having led other European geologists to infer that the whole group of beds from the Hamilton to the Chemung were carboniferous, although they underlie the oldest beds of that stage and contain a Devonian fauna. He continues:—

"In 1872 I addressed a note to the Geological Society of London on the subject of the so-called 'Ursa stage' of Heer showing that though it contained some forms not known at so early a date in temperate Europe, it was clearly Devonian when tested by North American standards; but that in this high latitude, in which, for reasons stated in the report above referred to, I believed the Devonian plants to have originated, there might be an intermixture of the two floras. But such a mixed group should in that latitude be referred to a lower horizon than if found in temperate regions. In the discussion of these papers, both Sir C. Lyell and Dr. Carruthers argued that the Bear Island flora is truly Devonian.

"Passing over the comparatively poor flora of the earlier mesozoic, consisting largely of cycads, pines, and ferns, and as yet little known in the Arctic, though represented, according to Heer, by the supposed Jurassic flora of Cape Boheman, we find, especially at Komé and Atané in Greenland, an interesting occurrence of those earliest precursors of the truly modern forms of plants which appear in the Cretaceous, the period of the English Chalk and of the New Jersey greenlands. There are two plant-groups of this age in Greenland; one, that of Komé, consists almost entirely of ferns, cycads, and pines, and is of decidedly mesozoic aspect. This is called lower cretaceous. The other, that of Atané, holds remains of many modern temperate genera, as *Populus*, *Myrica*, *Ficus*, *Sassafras*, and *Magnolia*. This is regarded as upper cretaceous. Resting upon these upper cretaceous beds, without the intervention of any other formation,[1] are beds rich in plants of much more modern appearance, and referred by Heer to the miocene period, a reference warranted by comparison with the tertian plants of Europe, but, as we shall see, not with those of America. Still farther north this so-called miocene assemblage of plants appears in Spitzbergen and Grinnell Land; but there, owing to the predominence of trees allied to the spruces, it has a decidedly more boreal character than in Greenland, as might be anticipated from its nearer approach to the pole.[2]

"If now we turn to the cretaceous and tertiary floras of Western America, as described by Lesquereux, Newberry, and others, we find in the lowest cretaceous rocks there known—those of the Dakota group—which may be in the lower part of the middle cretaceous, a series of plants[3] essentially similar to those of the so-called upper cretaceous of Greenland. They occur in beds indicating land and fresh-water conditions as prevalent at the time over great areas of the interior of America. But overlying this plant-bearing formation we have an oceanic limestone (the Niobrara), corresponding in many respects to the European chalk, and extending far north into the British territory,[4] indicating that the land of the lower cretaceous was replaced by a vast Mediterranean Sea, filled with warm water from the equatorial currents, and not invaded by cold waters from the north. This is succeeded by thick upper cretaceous deposits of clay and sandstone, with marine remains, though very sparsely distributed; and these show that further subsidence or denudation in the north had opened a way for the arctic currents, killing out the warm-water animals of the Niobrara group, and filling up the Mediterranean of that period. Of the flora of these upper cretaceous periods, which must have been very long, we know nothing in the interior regions; but on the coast of British Columbia we have the remarkable cretaceous coal-field of Vancouver's Island, which holds the remains of plants of modern genera, and indeed of almost as modern aspect as those of the so-called miocene of Greenland. They indicate, however, a warmer climate as then prevalent on the Pacific coast, and in this respect correspond with a peculiar transition flora, intermediate between the cretaceous and eocene or earliest tertiary of the interior regions, and which is described by Lesquereux as the lower lignitic.

"Immediately above these upper cretaceous beds, we have the great lignite tertiary of the west—the Laramie group of recent American reports—abounding in fossil plants, at one time regarded as miocene, but now known to be lower eocene, though extending upward toward the miocene age.[5] These beds, with their characteristic plants, have been traced into the British territory north of the forty-ninth parallel, and it has been shown that their fossils are identical with those of the McKenzie River Valley, described by Heer as miocene, and probably also with those of Alaska, referred to the same age.[6] Now this truly eocene flora of the temperate and northern parts of America has so many species in common with that called miocene in Greenland, that its identity can scarcely be doubted. These facts have led to scepticism as to the miocene age of the upper plant-bearing beds of Greenland, and more especially Mr. J. Starkie Gardner has ably argued, from comparison with the eocene flora of England and other considerations, that they are really of that earlier date.[7]

"In looking at this question, we may fairly assume that no

[1] Lesquereux considers this flora to be eocene.

[2] "Fossil Plants of the Devonian and Upper Silurian Formations of Canada," Pp. 92, twenty plates. (Montreal, 1871.)

[1] Nordenskiöld, "Expedition to Greenland," *Geological Magazine*, 1872.

[2] Yet even here the Bald Cypress (*Taxodium distichum*), or a tree nearly allied to it, is found, though this species is now limited to the Southern States. Fielden and De Rance, *Journal* of Geological Society, 1878.

[3] Lesquereux. "Report on Cretaceous Flora."

[4] G. M. Dawson, "Report on Forty-ninth Parallel."

[5] Lesquereux's "Tertiary Flora"; White, On the "Laramie Group"; Stevenson, "Geological Relations of Lignitic Groups," Am. Phil. Soc., June, 1875.

[6] G. M. Dawson, "Report on the Geology of the Forty-ninth Parallel," where full details on these points may be found.

[7] *Nature*, vol. xviii. p. 124.

conceivable conditions of climate could permit the vegetation of the neighbourhood of Disco in Greenland to be identical with that of Colorado and Missouri, at a time when little difference of level existed in the two regions. Either the southern flora migrated north in consequence of a greater amelioration of climate, or the northern flora moved southward as the climate became colder. The same argument, as Gardner has ably shown, applies to the similarity of the tertiary plants of temperate Europe to those of Greenland. If Greenland required a temperature of about 50°, as Heer calculates, to maintain its 'miocene' flora, the temperature of England must have been at least 70°, and that of the South-western States still warmer."

The author then speculates upon the former migrations of plants, and although he does not assign, like Saporta, an unvarying north and south direction, he believes that in most instances these were the lines upon which they moved. He also places a cold period between the middle cretaceous (upper cretaceous of Atané, Heer) and the lower eocene (Greenland miocene, Heer), which had not been previously noticed.

We would here remark that there is, in like manner, evidence of a cool period at the base of the English eocene. Either one relatively cool period existed at the close of the upper cretaceous of America, and another at the base of the English eocene, or else too great an age is assigned to the American series. The latter supposition is supported by Lesquereux's researches. The beds showing the more temperate conditions on the two continents are either contemporaneous or else a geological interval exists between them. Much more evidence is required before the correlation of the American and European cretaceous and tertiary rocks can be finally determined, and it is satisfactory to know that Dr. Hayden is collecting evidence on the subject.

The lower eocene flora of Greenland "established itself in Greenland, and probably all around the arctic circle, in the warm period of the earliest eocene, and as the climate of the northern hemisphere became gradually reduced from that time to the end of the pliocene, it marched on over both continents to the southward, chased behind by the modern arctic flora, and eventually by the frost and snow of the glacial age. This history may admit of correction in details; but so far as present knowledge extends it is in the main not far from the truth."

Space does not permit us to reprint the pages devoted to the various theories that have been put forward to account for former vicissitudes of climate. While allowing due weight to Croll's ingenious and well known theories, and to the larger proportion in the past of carbonic dioxide, he nevertheless is convinced of the sufficiency of the Lyellian theory of former altered distribution of land and water to account for all the facts hitherto observed.

The author conceives, however, that in some recent publications the Lyellian theory has been misconceived, but this is not exactly the case. What he here terms the Lyellian theory was really shared by many contemporary writers on physical geography, and is, that when land surfaces are aggregated round the equator and the polar oceans are wide and open, a hot period results, and that the reverse distribution induces cold, thus giving to land the heating power. The more recent theory is a modification of this, requiring masses of water, warmed under the equator, to circulate, unchilled by polar currents, and the polar oceans to be dry or else more or less closed in by land. This view he adopts.

"If North Greenland were submerged, and low land reaching to the south terminated at Disco, and if from any cause either the cold currents of Baffin's Bay were arrested, or additional warm water thrown into the North Atlantic by the Gulf Stream, there is nothing to prevent a mean temperature of 45° Fahrenheit from prevailing at Disco; and the estimate ordinarily formed of the requirements of its extinct floras is 50°,[1] which is probably above rather than below the actual temperature required."

Professor Dawson believes that to whatever causes the cold periods may be traced, they drove the warm temperate flora to the south, unless protected in insular spots by warm currents, and that on the return of warmth the plants would return northward.

"If, however, our modern flora is thus one that has returned from the south, this would account for its poverty in species as compared with those of the early tertiary. Groups of plants descending from the north have been rich and varied. Returning from the south they are like the shattered remains of a beaten army. This at least has been the case with such retreating floras as those of the lower carboniferous, the permian, and the Jurassic, and possibly that of the lower eocene of Europe."

The great stretch north and south of the American continent favoured these migrations, and "is also connected with the interesting fact that, when new floras are entering from the arctic regions, they appear earlier in America than in Europe; and that in times when old floras are retreating from the south, old genera and species linger longer in America. Thus, in the Devonian and cretaceous new forms of those periods appear in America long before they are recognized in Europe, and in the modern epoch forms that would be regarded in Europe as miocene still exist. Much confusion in reasoning as to the geological ages of the fossil floras has arisen from want of attention to this circumstance."

[1] Heer. See also papers by Professor Haughton and by Gardner in *Nature* for 1878.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

IN reply to a question in the House of Lords the other day the Duke of Richmond and Gordon stated that it was only in 1875 that it was decided to add agriculture to the syllabus of the Science and Art Department. At the first examination in May, 1876, there were only 150 candidates. By the following year 72 classes had been established, and the number of candidates rose to 800. In 1878 the classes had increased to 91, and the candidates for examination to 1,265, and this year the number of classes had reached 147; the number of persons under instruction was 2,839, of whom 2,193 came up for examination. Prof. Tanner reported that the results of the examination were very satisfactory. Fifty selected teachers, it was stated, had been brought up to London to undergo a course of training at the expense of the department.

THE two silver medals which are annually given by the Royal Geographical Society to those candidates whom the examiners deem to be most proficient in geography at the Cambridge Local Examinations have this year been awarded as follows:—Physical Geography, J. R. Davis; Political Geography, Miss Helen Jones. This, we believe, is the first occasion on which a medal has been awarded to a lady.

THE professors of the Paris Museum of Natural History having to present to the Minister of Public Instruction the names of two candidates for the lectureship of Comparative Anatomy, vacated by the death of M. Paul Gervais, have selected M. Georges Pouchet for their first candidate, and M. Jourdain for the second. The appointment of the former is quite certain.

THE number of students at the German Universities during the winter semester 1878-9 was 18,770. Berlin stands at the top of the list with 3,213, while Rostock had only 161.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 19.—"Relations between the Atomic Weights and certain Physical Properties (Melting and Boiling Points and Heats of Formation) of Elements and Compounds." By Thomas Carnelly, D.Sc., Assistant Lecturer on Chemistry in Owens College, Manchester. Communicated by Prof. H. E. Roscoe, F.R.S.

Anthropological Institute, June 24.—Mr. John Evans, F.R.S., vice-president, in the chair.—The election of the following new Members was announced:—Mr. F. Du Cane Godman, F.L.S., F.Z.S., and Mr. Percy Cotterill Wheeler, Bengal Civil Service.—Prof. W. H. Flower, F.R.S., read a paper on the osteology of the natives of the Andaman Islands. There are few people whose physical characters offer a more interesting subject for investigation to the anthropologist than the native inhabitants of the Andaman Islands. Purity of type, due to freedom from mixture with other races for an extremely long period, owing to their isolated position and their inveterate hostility to all intruders on their shores, and exemplified in the uniformity of their physical characters, is to be found among them, perhaps in a more complete degree than in any other group of mankind. The type, moreover, is an extremely peculiar one, presenting a combination of characters not found in any race of which we have at present materials for a satisfactory comparison. It is, indeed, probable that the more or less mixed and now scattered fragments of Negrito population, found in the interior of various islands of the Indo-Malayan Archipelago, and even upon some parts of the mainland of Asia, may have been derived from the same stock, but the special interest of the Andamanese consists in the fact that they alone of the diminutive black, woolly-haired people, occupy the whole of the small islands, on which their ancestors have dwelt from time immemorial, or rather did so occupy them until the coming upon them of the English in 1857. The materials upon which the observations contained in the memoir are based, are far more complete than any which have hitherto been brought together, consisting of nineteen skeletons and nearly thirty skulls. The skeletons indicate an average height of 4 feet 9 inches in the males, and 4 feet 6 inches in the females, thus showing that they belong to some of the smallest of known races. The skulls all belong to what is known as the brachycephalic or round-headed type, having an average cephalic index (or proportion of breadth to length) of 82. The forehead is broad and flat, without any projection over the orbits. The nose is narrow and the jaws less prominent than in the other black races. The proportionate length of the various bones of the limbs differ greatly from the European standard, but resemble those of the negro. With the Australian the Andamanese have very little affinity, the smooth hair of the former entirely separating them, independently of cranial characters, as dolichocephaly (or long-headedness) strongly pronounced brow ridges, low orbital index, wide nasal aperture, great prognathism, &c. It is to the other woolly-haired races that we must naturally turn in endeavouring to find their nearest relatives. The Papuans and inhabitants of the Melanesian Islands differ from them greatly in their principal cranial characters, especially in the great height and narrowness of the skull. The Tasmanians had wider heads, but their facial characters were more like those of the Australians, and therefore widely different from the Andamanese. The African negroes, again, are almost all dolichocephalic, and as a general rule are extremely prognathous, and strongly platyrhine or broad-nosed. Many of them, however, have the smooth brow and round orbits seen in the Andamanese, and not generally met with in the true oceanic negroes. The natives of the Andaman Islands, with whom may probably be associated the less known Aetas of the Philippines, the Semangs of the Malay Peninsula, thus constitute a race apart, to which the name Negrito may properly be applied. At first sight, they appear in their craniological characters to present little affinity to either of the other woolly-haired races, but it is probable that they represent a small or infantile type of the same primary group, as nearly all the characters by which they differ from the other negroes—the smaller size, smoother, and more globular heads, absence of supraorbital prominences, rounder orbits, and less projecting jaws, are those which we find in the younger individuals of a species, as compared with the older, or in the smaller species of a natural group as compared with the larger. It is very possible, but this is purely hypothetical, that the Andamanese, whose geographical position is almost midway between either extremes of the range of the woolly-haired races, may be the unchanged or little-modified representatives of a primitive type, from which the African negroes on the one hand, and the Oceanic negroes on the other, have taken their origin, and hence everything connected with their history or structure becomes of the greatest interest to the anthropologists.—The following papers were also read:—On palæolithic implements from the Valley of the Brent, by Mr. Worthington G. Smith; and Portstewart and other flint factories of the north of Ireland, by W. J. Knowles.

Physical Society, June 21.—An extra meeting of this Society was held on the above date at Cooper's Hill Indian Engineering College, on the invitation of Col. Chesney, R.E., Lord Rosse occupying the chair.—Prof. Unwin, of the College, read a paper on experiments relating to the friction of fluids on solid surfaces against which they rub. It has long been known that a board dragged through water suffers a resistance varying in some way as the square of the velocity; that a stream takes a uniform motion at such a velocity that the component of the weight of the water down its inclined bed is balanced by the frictional drag on the bottom. The fluid in the neighbourhood of the stream is known not to move as a solid mass, the centre moving faster than the sides, and the different fluid layers rub against each other. The adhesion of the fluid to the solid against which it moves also gives rise to a sliding or rubbing action. Our knowledge of the subject has hitherto been gained from observations on pipes, streams, and from the experiments of the late Mr. Froude with a plank of wood drawn through the water of a canal. It is desirable to have a set of laboratory experiments, however, in which the conditions can be varied more than can be done by such methods, and for this purpose the author had designed a special apparatus. In Mr. Froude's experiments there was a practically unlimited mass of water and a definitely limited extent of solid surface, and his results are not free from certain anomalies. The author thought it might be instructive to try the other case of a limited mass of water and a virtually unlimited surface. A disk in rotation gives such a surface. In some respects a cylinder would (as suggested by Prof. Ayrton) be the simplest to treat theoretically, but there are experimental difficulties in its way. The apparatus of the author consists of a metal disk rotated on a vertical axis in a vessel of water, and the problem is to determine its resistance to rotation, since this will be equivalent to the water-friction upon it. Within the outer vessel is placed a thin copper chamber, the diameter of which is unalterable, but the depth is variable at pleasure. The disk is placed concentrically inside this chamber, where there are two cheese-shaped masses of water, one above and one below the disk, which are dragged into rotation next the disk, and retarded next the sides of the pan. The couple required to rotate the disks is equal to the couple exerted by the disk or the fluid when the motion is uniform; hence the tendency of the chamber to rotate is measured, by suspending the latter from three wires in a manner similar to the bifilar suspension of magnets. An index marks whether it rotates or not on a graduated scale; and a weight suspended by a cord measures the force required to keep the index at zero. Let M be the moment of the frictional resistance of the disk, N the number of revolutions per second. Then $M = C N^x$, where C and X are constants. The author has obtained a number of results which are, however, not yet ready for publication. He mentioned, however, that a rough cast-iron disk has a frictional resistance almost exactly as the square of the velocity, whereas a turned brass disk gave a value of x decidedly less than 2. The resistance is a little greater when the mass of water is larger. These results were calculated for a speed of 10 feet per second. The author hopes to try the effect of temperature, &c., on fluid friction and viscous as well as thin fluids. Prof. Unwin also exhibited a piece of apparatus with which he hopes to study the stress of rivetted plates under shear, by means of elastic substances such as caoutchouc. He purposes to stretch the caoutchouc and photograph the appearance of stress rivetted lines upon it.—Lieut. G. S. Clark, R.E., explained the process invented by Prof. McLeod and himself for determining the absolute pitch of tuning-forks. Unlike other methods this is an optical one, and consists in arranging the tuning-fork to vibrate in front of a rotating drum whose periphery is marked with dots or fine lines at equal intervals. A microscope was arranged to comprise in its field of view the edge of the fork and several of the intervals on the drum, so that when the drum was rotated at a rate which made the speed of an interval equal to the period of the fork, a set of prominences or waves, in width equal to an interval, were visible; the body of the wave being caused by the advance and recession of the fork in its vibration. The rotation of the drum was regulated by an air-regulator devised by Prof. Unwin, the observer himself quickening or slowing the drum so as to keep the prominences steady. The time was beat by an electric clock designed by Prof. McLeod. An aniline glass pen was used to mark the beginning and end of the period of observation on the drum. A counter was also employed to give the number of revolutions. The pen and counter were actuated by electricity through the medium of a key. In these experiments a König fork giving 256 vibrations per second correct at 16°·1 C., was tested, and found to give 256·2966 vibrations per second. Frequent bowing did not alter the phase. Fixing the fork rigidly, as in a vice, did so. The temperature coefficient for König's forks (·00011 for each degree Centigrade) was confirmed by these experiments. Forks of different octaves were compared; audible beats could be counted, and modifications of Lesage's figures seen. This optical method is preferable to audible ones, because of its independence of the ear and the fact that nothing is attached to the fork itself. Prof. Guthrie inquired if the periods of the forks had been found to alter through use or magnetisation. The author said that he had not yet tested these points. Prof. McLeod instanced an old König fork which was correct at 16°·1 C., requiring now a temperature of 25° C. to make it so. Lord Rosse suggested the use of the regulators employed with equatorial clocks to keep the rotation of the drum steady. Capt. Abney inquired if a difference of vibration had been detected between the beginning and end of a series of observations. None had been certainly observed.—Prof. Macleod then described an electric clock used in the foregoing experiments. The zinc and steel compensating pendulum moved by its own gravity, but at each beat made and broke a battery circuit by means of two bent springs, one on either side. The current passing through an electro-magnet, detained a bent lever until the pendulum swung to the other contact. By this contrivance time was marked. Prof. Macleod found that platinum contacts frequently stuck together in these experiments; but this defect had been cured by the use of a liquid shunt of dilute sulphuric acid, which destroyed the extra current. This remedy had been suggested to him by Lord Rayleigh. Prof. Macleod demonstrated the complete success of this device, which acts as well as a condenser shunt. He had also observed a curious effect with these liquid shunts, which as yet he could not explain. Two shunts having the same acid in both were employed, one shunting the extra current from four Daniell cells, and one that from two Daniell cells. The first showed evolution of H and O gas, the platinum electrodes being unaffected. The second showed no evolution of gas, but one platinum plate was dissolved away and deposited in a black powder on the other. He also exhibited a new cell formed of zinc and mercury plates, with zincic-iodide solution and mercurous chloride salt. Red iodide of mercury is formed at the negative electrode. The E M F is $\frac{7}{10}$ths of a Daniell cell, but the internal resistance very low and the cell very constant; while there is no local action. Prof. Guthrie suggested that the extra current was really a succession of sparks; the platinum might be carried bodily over from one electrode to the other. Mr. F. H. Varley stated that Mr. F. Higgins had observed a similar effect with carbon electrodes in a voltameter, one carbon falling away into a fine powder, and due perhaps to the disintegrating action of liberated gases. He had also himself seen a platinum wire in contact with a carbon one eaten thin and drawn into very fine silky pens, while the carbon was stained blue, although the current passing was of low tension. Mr. Chandler Roberts suggested that perhaps a hydride of platinum was formed in the case mentioned by Prof. Macleod. Prof. Guthrie suggested experiments with fluorescent liquid shunts in the dark.—Mr. J. W. Clark then described some experiments on the surface tension of sulphurous anhydride, sealed in a capillary tube within a second tube, containing the same substance. He found that at low temperatures the level of the liquid is lower in the narrow than in the wide tube. As the temperature rises the meniscus in the narrow tube descends till about 156° Fahr.; it is level with that of the wider tube, both surfaces being slightly concave. Above this temperature the surfaces become plane, then convex, the level in the wide tube becoming higher than that in the narrow one. These experiments are being continued, and Mr. Clark's other results will be communicated to the Society later on.—Prof. Guthrie proposed a vote of thanks to Col. Chesney.

PARIS

Academy of Sciences, June 30.—M. Daubrée in the chair.—The following papers were read:—On the chemical constitution of alkaline amalgams, by M. Berthelot. He shows that the relative affinities of the two alkaline metals for oxygen are inverted in their amalgams. This explains the singular anomaly discovered by MM. Kraut and Topp, viz., the displacement of potassium in dissolved potash by amalgamated sodium, producing the crystallised amalgam $Hg_{24}K$. The displacement is the necessary consequence of the greater loss of energy undergone by the potassium in the formation of the amalgam.—On a peculiarity of an experiment of Gay Lussac and Thenard, by M. Debray. The experiment is that in which hydrated potash or soda in vapour are passed over an excess of well cleaned iron in a highly heated gun-barrel. Hydrogen and vapour of potassium or sodium are liberated, the oxygen being fixed in part of the iron. Gay Lussac and Thenard noticed, without explaining, that the fixation was chiefly on the metal in the part exterior to the furnace, and therefore less hot. This M. Debray attributes to the presence of vapour of the metal and of hydrogen remaining in the apparatus. From experiments by M. Sainte-Claire Deville, it may be deduced that if a mass of iron incompletely oxidised, and having its different parts at variable temperatures, be in a more or less dense atmosphere of hydrogen, the oxygen will quit the hotter parts where it was originally fixed, and go to the cooler. M. Debray illustrates the phenomena by an experiment.—Spectral examination of ytterbine, by M. Lecoq de Boisbaudran. He gives the approximate position and form of the bands, grouped chiefly between the solar lines D and F, of which the spectrum is composed.—M. Dausse was elected Correspondent in Mechanics in room of the late General Didion.—On atmospheric waves, by M. Bouquet de la Grye. This relates to the results of some 15,000 observations of barometric height, and direction and velocity of the winds, at Brest. The numbers given as showing the maximum influence of solar and lunar action prove the greatness of this action and the impossibility of making serious predictions of weather before the atmospheric laws dependent thereon have been studied.—On the nature of the soil of the Isthmus of Gabes and the Chotts, by M. Roudaire. He gives a summary of his observations (some of which have been formerly referred to). His collections contain about 300 plant species and 120 animal, several new; he has also some 500 geological specimens, results of twenty-two borings, daily observations of atmospheric pressure, temperature, hygrometry, the wind, &c.—On Stokes's law; reply to M. Becquerel, by M. Lamansky.—On the dissociation of sulphydrate of ammonium, by MM. Engel and Moitessier. They prove that sulphuretted hydrogen and ammonia do not combine in equal volumes at 50°, and that the supposed vapour of sulphydrate of ammonium is merely a mixture of two gases.—Action of phtalic anhydride on naphtaline in presence of chloride of aluminium, by MM. Ador and Crafts.—On the ashes and lava of the recent eruption of Etna, by M. Cossa. The very fine blackish-grey ash is formed of fragments of crystals of triclinic felspar, augite, small grains of magnetite, and a large number of variously coloured splinters of glass. The lava is formed in great part of large crystals of triclinic felspar disseminated porphyrically in a microcrystalline magma, formed of small crystals of the same felspar, augite, magnetite, and a little greyish vitreous matter. The phenomena (in M. Cossa's opinion) tell against the hypothesis of pre-existence in the solid state of the crystalline elements in lava vomited by volcanoes.—New researches on development of the embryonal sac in angiospermous phanerogams, by M. Vesque.—On a new substance of the epidermis, and on the process of keratinisation of the epidermic coat, by M. Ranvier. The new substance, found in the form of drops in cells of the epidermis, and rapidly colourable red with carmine, he calls *eleidine*; it plays an important *rôle* in keratinisation of the epidermis.—On the structure of broad ligaments, by M. Guérin.—On the state of glandular cells of the submaxillary after prolonged excitation of the chorda tympani, by MM. Arloing and Renaut. He concludes that these cells have a proper individuality, and are not embryonal forms of muciparous cells.—Forage in shocks of sheaves, by M. Duplessis. Green forage may be transformed into hay, in rainy weather, by arranging in shocks, and this transformation takes place more surely and economically than by the old method in the same circumstances.—On the ancient roads of the Sahara, by M. Berlioux. Some old inscriptions have been discovered by the German expedition in the Libyan Desert, on the route the author had indicated as probably a Roman road at one time.

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