THURSDAY, JULY 11, 1878

SCIENCE IN SCHOOLS

WE print with pleasure on another page a remarkable article from the *Times* of Monday. In itself the article may present nothing remarkable to the readers of NATURE, but as the deliberate utterance of the leading organ of opinion in this country, it marks a distinct stage of progress towards a more enlightened conception of what constitutes education. We hope that it is significant of the near approach of a radical change of the conception in this country of what subjects should be included in elementary education. We need not be surprised at the fate of Sir John Lubbock's Bill for the introduction of elementary science into schools, when such erroneous conceptions of what science is apparently exist in the mind of the Minister of Education in the House of Commons, Lord George Hamilton. The Vice-President of the Council has much to learn, when his idea of the Royal Society, one of the most venerable institutions in the country, is that of a kind of select Polytechnic, where "lectures" are delivered on "biology, chemistry, natural history, mechanics, astronomy, mathematics, and botany." But he is new to his work, and we must hope that the debate of Thursday last may lead him to obtain a more accurate conception of what is meant by elementary science.

Dr. Lyon Playfair, we believe, pointed out what is one of the great hindrances to the introduction of science into elementary schools; the mere name, "science," frightens ministers, inspectors, school-boards, and teachers; perhaps if the simpler phrase, "elementary knowledge," were used, the simple-minded individuals in whose hands are the training of our future citizens might find that they themselves had been compelled to become acquainted with it to their cost after they left school, and that it would have been much better for them had they had some little training in it before entering into the thick of the fight.

The most notable feature in the *Times* article, as well as in Thursday's debate, is the fact that it has at last dawned upon the leaders of opinion and the makers of our laws, that "education" and "instruction" are different things, and that a man may learn a great many "facts" at school, and have his education to begin when he leaves it. It is lamentable that we have to be continually reminded that we are the only one of the great European countries where this distinction is not recognised and practically carried out in education. Our whole system of education, hitherto, has been a mere cramming of the children's memories with words, words, words, to the weariness of children and teachers, and with results unsatisfactory to all concerned. As the *Times* puts it:—"To be taught something about gravitation, about atmospheric pressure, about the effects of temperature, and other simple matters of like kind, which would admit of experimental illustration, and which would call upon the learner to make statements in his own words instead of in those of somebody else, would be so many steps towards real mental development." Sir John Lubbock gave a most conclusive refutation of the idea that the teaching of science must be attended with hitherto unexperienced difficulties, and at the same time proved what a relief science-teaching would be to the ordinary dull routine of instruction, when he told the House that in the Scotch schools the authorities began to take alarm because science-teaching was found so comparatively easy and pleasant by the children. As to the argument that children who have been taught to know something about the objects and forces with which they every day come into contact contract a distaste for manual labour, we should have thought it had been long ago played out; it has almost as much force as the story told by another speaker of the boy who had been impudent to his master because the latter could not read his newspaper.

It is unnecessary for us to go again into the merits of the question which has been so often and so thoroughly discussed in these pages, especially as the *Times* has put it quite as forcibly as there is occasion for doing at present. It certainly seems sad, nationally suicidal, indeed, that a few more millions of those who will have the destinies of this country in their hands, are likely to be launched into active life, with all their education to acquire, ere legislation steps in to give us the advantages which nearly every other civilised nation gives to its children. Every day we hear of the ignorance of the working classes, every other month "congresses" are held to devise means to remedy the consequences of this ignorance—ignorance of the laws of health, ignorance of household economy, ignorance of the implements and objects of labour, ignorance of the laws of labour and production, ignorance of the nature of the commonest objects with which they come into contact every day, ignorance of almost everything which it would be useful and nationally beneficial for them to know—an ignorance, alas! more or less shared by the "curled darlings" of the nation. Yet while every day's paper shows how keen is the industrial competition with other nations, and how in one department after another we are being outstripped by the results of better—*i.e.*, more scientific—knowledge, the poor pittance of "elementary knowledge" asked for in Sir John Lubbock's Bill is refused by a minister whose own "education" leaves much to be desired. This state of things cannot long continue, and with such advocates for the children as the *Times* and Mr. Forster, we may hope that next time Sir John Lubbock brings forward his Bill it will meet with a happier fate.

THE JUBILEE OF UNIVERSITY COLLEGE

LORD GRANVILLE'S admirably reasoned and temperate speech at the jubilee of University College on Tuesday, reminds us how things move in this country. It records half a dozen great advances which are now accepted cordially and universally, with all of which University College is more or less identified, and in promoting which it has never failed to take a leading part.

To begin with, there is the absolute catholicity of its offer to the student—the invitation on its motto is *Cuncti adsint, meritæque expectent præmia palmæ.* When the University of London began in 1828, and when University College was incorporated in 1836, Oxford and Cambridge had not dreamt of throwing open their doors to dissenters. To-day the whole world so absolutely recognises the propriety of the step which University College then took, that it is difficult to give it enough credit for a courage which was then without precedent in England. Only the other day its invitation has been widened still farther. *Cuncti adsint* is to be understood as including *Cunctæ adsint*, and women as well as men will henceforth have unrestricted access to the classes in the faculties of arts, law, and science. Women are at least as much influenced in character by the kind of education which is given them as men are, and the action of University College guarantees that women—in London, at least—will have at their disposal the best education which England can offer.

The Chancellor of the University of London reminded us that the new demands of teachers of science have compelled institutions like University College to extend their buildings and to provide laboratory facilities in addition to the class-rooms and lectures of old days. University College is not alone in recognising this vital fact. King's College has thoroughly developed its practical teaching; the Scotch Universities have latterly been very much alive on the subject; Owens College, as becomes a new institution claiming to take rank with the most advanced teaching bodies of the day, has given exceptional prominence to laboratory work. But University College has not been unconscious of the movement, and she purposes, if possible, to outstrip her rivals.

The last movement, in which Lord Granville reminds us that her action has counted for a great deal, is that to extend the English definition of a university. She considers herself entitled to that appellation. "Now the term 'University,'" says Lord Granville, "has been differently understood by different persons and by different nations, and I think that the exact construction of it is very likely to be still more minutely debated in consequence of the able efforts of one of the most distinguished students of your college, now the most successful president of Owens College, whom we see among us, who has raised the question whether the number of universities ought not to be increased. In France 'university' means an aggregrate of all the schools and colleges of the kingdom. In Germany their famous universities are really professorial schools. Our two elder universities are really academical institutions—an aggregate of colleges. You know that the London University is not a teaching body at all, and that it is only an examining body, depending upon other sources, of which this college is the most prolific in giving us candidates for our examinations." The institution of University College has done much, the movement of Owens College has done more, to widen our ideas of what a University might do. There is no reason why we should be confined to the existing type of "academical institutions—an aggregate of colleges," supplemented by an examining body depending on other sources. We do not aim at French centralisation, but there is no reason why one or two universities on the German or the Scotch model should not be added to the very limited list of our English Universities. An amalgamation of University College and King's College into a teaching University of London would be a natural consequence of such a movement.

WINDMILLS AND WATERFALLS

OUR readers may remember the consternation caused some years ago by the publication of Prof. Jevons's work on our coal supplies, and the alarmed inference drawn from his calculations that the days of Britain's supremacy and prosperity were numbered. Certainly, if our prosperity is entirely dependent on our coal supplies, there can be no doubt that ere very long the beginning of the end will have arrived. Abundant as our coal supplies are their consumption at the rate of about 150 million tons annually cannot go on for ever; and while we may have the ships and the money too, it would be a serious thing for England if she had to look abroad for her greatest source of physical power. It is certainly at present difficult to see how the work of the world could be carried on if the supply of coal were completely exhausted; still if man were compelled to find a substitute or relapse into savagery or even perish altogether, we think the chances are he would be able in some way, without detriment to his progress, to adapt himself to his new circumstances. These ideas have been suggested by an interesting lecture, just published, recently delivered at Glasgow by Dr. C. W. Siemens, "On the Utilisation of Heat and other Natural Forces."

"The supremacy," he justly says, "which man enjoys over the animate and inanimate creation, and for which Divine Authority may be quoted, cannot be said to be the result of his superior muscular development, for amongst the members of the animal kingdom there are many which are his superiors in strength, agility, swiftness, and in natural aptitude to provide themselves against the vicissitudes of cold and hunger. The compensating advantage in our favour is the intelligence with which we are enabled to call forces of nature not our own into requisition to do our behests. It would not be too much to say that the power of man consists really in his ability to direct the forces of nature, and that the degree of civilisation to which he has attained is commensurate with his command of those forces."

Could any more forcible argument be urged in favour of the national advantages of scientific research, or of the yearly increasing importance of scientific knowledge in the every-day life of humanity?

Fortunately Dr. Siemens, in his lecture, gives us a pretty wide glimpse of hope that we need not despair because of the prospective exhaustion of the existing means of producing utilisable heat. Other methods, he suggests, might be found of bringing into action this greatest source of mechanical power, and that even now one of these methods might be so used that the exhaustion of our coal might be postponed for a considerably longer period than has been calculated. Dr. Siemens traces the progress of our knowledge of the real nature of heat and of the methods of ascertaining its mechanical equivalent. He shows how gradually we have learned to produce a greater and greater amount of mechanical effect from the consumption of a certain quantity of heat in the steam-engine, the blast-furnace, and other methods of utilising this source of power as derived from coal, and points out how, by means of electricity, this agent may be made to do a greater amount of work for us than ever. The wonderful results obtained from the Siemens' dynamo-electric machine are well known, and Dr. Siemens gives an example of the saving of power that might be effected by its use:—

"Let us suppose that at some central station 100 horse-power of steam or water power was employed to give motion to several dynamo-electric machines of the dimensions found most convenient in practice, and that by means of metallic conductors of suitable dimensions the electric current produced at the central station was conducted to a number of halls or factories requiring to be lighted, or to utilise mechanical power. If illumination were the only object in view, the total amount of light that could be thus produced would be equal to 125,000 candle-power. This would be equivalent to 6,250 Argand burners, each of 20 candle-power, at a consumption per burner of 6 cubic feet of gas per hour, or a total consumption of 37,500 cubic feet of gas to produce the same effect of light. This would require $3\frac{3}{4}$ tons of coal, and the electric light about as many hundredweights."

Now if the power to drive these machines could be obtained apart from coal the addition to our mechanical resources would be immense. While Dr. Siemens shows that the tides are a source of power that might be utilised directly or indirectly, he at the same time shows that the results would not be at all commensurate to the work expended. But the old sources of power, which have gradually given way before the universal introduction of steam—wind and falling water—might again be called into play, and with infinitely greater effect than ever. It is evident that within certain limits the rotatory motion required for the working of the dynamo-electric machine might be effected by means of the old-fashioned windmill, and to a much greater extent by means of falling water. Our readers may remember that Dr. Siemens, some months ago, in an address which he then gave, referred to the immense quantity of power which flowed ready made over the Falls of Niagara. In his Glasgow address he again referred to the subject, in order to show how this gigantic source of power might be utilised to produce action at a distance. "When," he says, "little more than a twelvemonth ago I visited the great Falls of Niagara, I was particularly struck with the extraordinary amount of force which is lost, as far as the useful purposes of man are concerned. 100,000,000 of tons of water fall there every hour from a vertical height of 150 feet, which represent an aggregate of 16,800,000 horse-power, producing as their effect no other result than to raise the temperature of the water at the foot of the fall

$$\frac{150}{772} = \frac{1^{\circ}}{5^{\circ}} \text{ Fahr.}$$

In order to reproduce the power of 16,800,000 horses, or, in other words, to pump back the water from below to above the fall, would require an annual expenditure of not less than 266,000,000 of tons of coal, calculated at an average consumption of 4 lbs. of coal per horse-power per hour: which amount is equivalent to the total coal consumption of the world. In stating these facts in my inaugural address on assuming the presidency of the Iron and Steel Institute, I ventured to express the opinion that in order to utilise natural forces of this description at distant towns and centres of industry the electric conductor might be resorted to. This view was at that time unsupported by experimental data such as I have been able since then to collect." Dr. Siemens then shows what has been done in conveying the electric light to a distance; and he points out that, "if mechanical force is required to be distributed, the arrangements are in every respect similar to those for the distribution of electric light; and it has been proved experimentally that the amount of power recovered at the distant station is nearly equal to half the power employed at the central station." Even as regards the consumption of coal, were that article used, Dr. Siemens shows that the magneto-electric machine is cheaper than the gas or steam-engine. But he rightly says:—"It would not be necessary to seek on the other side of the Atlantic for an application of this mode of transmitting the natural force of falling water, as there is perhaps no country where this force abounds to a greater extent than on the west coast of Scotland, with its elevated lands and heavy rainfalls. You have already conducted the water of one of your high-level lochs to Glasgow by means of a gigantic tube; and how much easier would it be to pass the water in its descent from elevated lands through turbines, and to transmit the vast amount of force that might thus be collected, by means of stout metallic conductors, to towns and villages for the supply of light and mechanical power!"

Dr. Siemens points out other directions in which the natural forces of the universe might be used for the purposes of man, without resorting, to such an extent as we do at present, to our coal supplies. While windmills are directly rather an uncertain source of power, still, he shows that a number of windmills, such as may be constantly seen working in Holland for the drainage of the land, might, for instance, be employed to raise water, by pumping, to an elevated lake or reservoir, whence the power could be drawn off by means of hydraulic motors when required, and might be conducted electrically to centres of habitation.

We ought to be grateful to Dr. Siemens for taking so much pains to lighten up the gloomy prospects which some pessimists have been presenting to us for some years past; and to those who may be cynical enough to reply that a return to the windmill and the water-wheel is simply a sign of the prophesied retrogression, we may fitly reply, in Dr. Siemens' own words:—

"It would be wrong to suppose that a resumption of the use of natural forces would throw us back to the time of the windmill and the primitive water-wheel which used to give motion to isolated establishments. We shall have learned to store, to transport, and to utilise these forces in a manner adapted to our superior requirements; and who knows whether the time may not come when our descendants in the third or fourth generation will look back upon the indiscrimate users of coal with something like the same feeling that we look upon the users of flint and bronze implements. Indeed, without waiting for the extinction of our coal-fields, it appears to me not improbable that natural forces will be resorted to simply on account of their comparative cheapness and convenience of application."

WEST YORKSHIRE

West Yorkshire: an Account of its Geology, Physical Geography, Climatology, and Botany. Part I.—Geology. By J. W. Davis, F.G.S., F.L.S. *Part II.—Physical Geography and Botanical Topography.* By J. W. Davis and F. Arnold Lees, F.L.S. With Maps and Plates. (L. Reeve and Co., 1878.)

THE merit of a work on local geology or natural history may be of two distinct kinds. The author may be an original investigator of a little-known area, and his book a positive addition to our knowledge; or the volume may be a tapestry, into which the scattered threads of information are worked by one who has the mastery of them all, and who presents us with the picture they have formed in his mind. It is to excellence of this latter kind the authors of "West Yorkshire" aspire. They have gathered from the contributions of all local observers, and have so assimilated the material with their own knowledge, as to render the substance of their book a useful outline of the geology and botany of the district they have chosen to illustrate. An area included within the region of Prof. Phillips's classical work on the mountain limestone districts of Yorkshire, and upon whose coal-bearing and associated strata so much good work has been done by the Government Survey, does not leave much room for novelty in its geology, though the botany, especially as treated in this book, is in rather a different case. The great merit of the work would therefore consist in the lucid and comprehensive manner in which it presents the scattered information to us as a whole. This, however, it scarcely possesses in as great a degree as most of the books of its class.

Examined in detail there are some points which call for remark. The introductory chapter is mostly occupied with a description of the boundary line of the riding—a most uninteresting subject—but it is enlivened by the accounts of the Pennine and Craven faults. The drawing of the latter, however, on the maps does not coincide with the description, and the former is scarcely indicated. This map —a most excellent one and derived from the best sources —unfortunately contains one or two other errors, viz., the Ingleton coal-field is wrongly coloured, and the words "upper Silurian" and "lower Silurian" are mismatched in the "references." In the next chapter the small Silurian area is well though shortly described, and we are then very admirably shown that the red conglomerates at the base of the mountain limestone in some places are the shore deposits of the early part of the latter epoch. The *pièce de résistance*, however, of this portion of the book is naturally the chapter which treats on the Carboniferous period, in which also are to be found the chief novelties due to the author. The lie and position of the great masses which form the backbone of the country are admirably given, and all the lately acquired information is incorporated. The lists of fossils, however, from the lower rocks, do not seem to have undergone much critical revision, and remarkably few additions seem to be recorded during the last thirty years. It is interesting to notice that, with respect to the lower coal measures, the author states his conviction that "the tendency of all the evidence in this part of the country is to show that the Gannister series and the Millstone grits form one natural division of the Carboniferous system," though he does not go so far as Prof. Hull in classifying them together. A valuable feature here is a set of comparative sections in different districts in which the locally-named coal beds are correlated, and which gives a very good idea of their changes. Some of the most interesting features of the Yorkshire coals, however, such as the convergence of many seams into the Beeston coal and the peculiar character of the Better bed coal, though mentioned, are scarcely made enough of, but the fossils associated with the latter have been very well worked at. The proof of the unconformity of the permian limestones and the true age of the picturesque Plimpton rocks, once associated with them, is admirably given, and then this part of the work concludes with an account of the superficial deposits, glacial striæ, and the Victoria Cave.

The second part, which, according to the preface, is only the introductory chapter to the complete flora of the Riding, to be produced in another volume, is more interestingly written. The area under consideration is divided into ten districts indicated on a map, and coinciding with the drainage areas. In each of these the relation of the flora to the general physical characters is pointed out, and lists of the most interesting plants found in selected and naturally separate localities are given, accompanied by remarks on the surrounding country. In each we are taken to the head sources of the river which runs through the district, and so pleasantly are we led along its banks that we seem to realise the several beauties of the neighbourhood while we learn their cause, and to collect all the interesting plants whose habitats are so graphically described. Great care seems to have been taken to exclude all doubtful statements, and to show the cause of the occurrence of particular sets of plants, where this is possible. It is therefore thoroughly reliable, and from the scattered nature of the little that had previously been done, contains more new matter than is to be found in the first part.

The book is accompanied by sixteen plates of geological woodcuts, which are rough, and add but little to its value. There are also five plates of coloured sections, mostly founded on those of the Survey.

We must certainly congratulate the authors on the completion of their task, which has been carried out in a creditable manner, and has resulted in a useful and instructive book.

OUR BOOK SHELF

Flowers. By J. E. Taylor. (Hardwicke and Bogue.)

THIS is a compilation in small octavo, illustrated with many familiar woodcuts and coloured plates. A feature is the index of 1,000 references. Very many of these, being only to the merest mention of names, might have been omitted in favour of a glossary of terms, and more especially a list of works of reference.

The principal aim throughout the book is to convey that all the many adaptations of flowers to secure fertilisation are due to a Divine Creator, and not thought out by the plants themselves. The theory of Natural Selection is hardly alluded to.

In glancing through the geological portion errors of fact, such as that palms are oolitic, are seen to be numerous. The confidence too with which the exact succession of dicotyledons in geological time is set out is not warranted by the present state of our knowledge. We read the oft-repeated theory, now stated as fact, that *Apetalæ* preceded *Polypetalæ*, and these *Gamopetalæ*. That this succession really took place, however probable in itself, is, it is well known, far from proved. The actual flowers discovered in the lowest eocene—almost the oldest dicotyledonous flowers known—are *Gamopetalous*, and have been referred to *Porana* and *Symplocos*. The abundance and differentiation of the *Papilionaceæ*, the *Cæsalpinaceæ*, and the *Mimosæ*, show how ancient are the *Polypetalæ*. Any preponderance we may fancy the wind-fertilised *Apetalæ* possess is due to the fact that most of them are forest trees, and it is the leaves of these which form the great mass of the known dicotyledonous floras. Were those divisions really produced in the sequence assigned them, the origin of all alike is far older than the eocene and at present unknown to us: so that even thus the writer of the book is in error.

A most unfortunate selection of illustrative genera of eocene plants has been made. Azaleas did not abound in the eocene, and have never even been met with in it. Neither did the cactus nor aroids, since they have been but recently noticed in the eocene, and then only in England. In like manner the "peculiar" feature attributed to the miocene, its gathering together in the same flora plants now only found at immense distances apart, is not a peculiarity of that formation, since it characterises eocene floras in at least an equal degree. Chapter IV., on the geographical distribution of flowers, deserves especial mention, but must be consulted itself should any one desire to learn (p. 80) how "the *Proteaceæ* became Australian, the magnolias and tulip-trees chiefly North American."

Looking at the more botanical part of the book, it is seen that the explanations of the modifications and appliances of flowers to insure fertilisation are in some cases not treated with the caution the subject requires. To select an instance: the theory that white flowers open more than any others at night, because they are the most visible to moths, seems probable at first sight; but the unscientific reader, to whom the work is addressed, wishing to see for himself, would reject it after his first walk down a hedgerow at eventide, when he found the dog-rose, the white convolvulus, and the daisy, all closed. Why, too, white flowers, if they rely upon their colour to attract, should be also the most powerfully scented, is not explained. It is likely that perfumes would be more necessary to the dark-coloured flowers which are open at night, unless we suppose, which from experience we of course should not, that only white flowers are fertilised by night-flying moths. Persons whose experience of flowers is confined to ordinary English gardens would remember the heliotrope, the mignonette, musk, yellow azalea, wall-flower, rose, coloured pink, hyacinth, violet, scented verbena, scented geraniums, as the most highly-perfumed plants, and would reasonably doubt that any exceptional attractions in this respect belong to white flowers. In comparison with perfume, the white colour may have little to do with it, but Mr. Taylor must have remarked that some law gives vastly superior brilliance to butterflies and day-flying moths and insects, and this law may also require that flowers which only open at night should, like insects which only fly at night, be white or comparatively very subdued in colour.

J. S. G.

Elements of Descriptive Geometry. By J. B. Millar, B.E. (Macmillan, 1878.)

THANKS to Messrs. Kempe, Hart, and other writers on Linkages, we are able "Curvo dignoscere rectum," and "Parallels design Sure as Demoivre" could. The title of the work before us shows that it is not concerned with such elementary details as those which most naturally find a place in works on practical geometry. Chasles in describing the aim of Monge's great discovery, says:—"La géométrie descriptive, en effet, qui n'est que la traduction graphique de la géométrie générale et rationnelle, servit de flambeau dans les recherches et dans l'appréciation des résultats de la géométrie analytique; et par la nature de ses opérations, qui ont pour but d'établir une correspondance complète et sûre entre des figures effectivement tracées sur un plan et des corps fictifs dans l'espace, elle familiarisa avec les formes de ces corps, les fit concevoir idéalement, avec exactitude et promptitude, et doubla de la sorte nos moyens d'investigation dans la science de l'étendue." Mr. Millar's book is a very serviceable exposition of the subject as thus described, and he has prefixed a short introduction on solid geometry. A good English text-book on this branch (solid geometry) is yet a desideratum. The plan on which the figures are arranged and drawn is, we think, likely to aid the student in his working out the propositions in the text.

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.]

Hughes's Microphone

MR. EDISON finds a resemblance between his carbon telephone and my microphone.

I can find none whatever; the microphone in its numerous forms that I have already made, and varied by many others since, is simply the embodiment of a discovery I have made, in which I consider the microphone as the first step to new and perhaps more wonderful applications.

I have proved that all bodies, solid, liquid, and gaseous, are in a state of molecular agitation when under the influence of sonorous vibrations, no matter if it is a piece of board, walls of a house, street, fields, or wood, sea or air, all are in this constant state of vibration, which simply becomes more evident as the sonorous vibrations are more powerful. This I have proved by the discovery that when two or more electrical conducting bodies are placed in contact under very slight constant pressure, resting on any body whatever, they will of themselves transform a constant electrical current into an undulatory current, representing in its exact form the vibrations of the matter on which it reposes; it requires no complicated arrangement and no special material, and to most experimenters the three simple iron nails that I have described form the best and most sensitive microphone. But these contact points would soon oxidise, so naturally I prefer some conducting material which will not oxidise.

Mr. Edison's carbon telephone represents the principle of the varying pressure of a diaphragm or its equivalent on a button of carbon varying the amount of electricity in accordance with this change of pressure; it represents no field of discovery, and its uses are restricted to telephony.

The three nails I have spoken of will not only do all, and that far better than Edison's carbon telephone in telephony, but have the power of taking up sounds inaudible to human ears, and rendering them audible, in fact a true microphone; besides it has the merit of demonstrating the molecular action, which is constantly occurring in all matter under the influence of sonorous vibrations.

Here we have certainly no resemblance in form, materials, or principles to Mr. Edison's telephone. The carbon telephone represents a special material in a special way to a special purpose.

The microphone demonstrates and represents the whole field of nature, the whole world of matter is suitable to act upon, and the whole of the electrical conducting materials are suitable to its demonstrations.

The one represents a patentable improvement, the other a discovery too great and of too wide bearing for any one to be justified in holding it by patent, and claiming as his own, that which belongs to the world's domain. D. E. HUGHES

London, July 2

Insects Corroborative of the Nativity of Certain Plants

WHETHER certain plants are, or are not, natives of Britain is a question that often exercises botanists, and any new evidence on the subject is always acceptable. It has recently occurred to me that a certain kind of evidence may be obtained by studying the insects attached to such plants. The question is one of interest not only to phyto- but also to zoo-geographers; for if the species of plant to which an insect is restricted is proved not to be indigenous then the insect cannot be indigenous either. If, on the other hand, the plant is only doubtfully an alien, and the insect is not one that might be easily introduced, then the probability is that the plant is a true native.

The plant that has suggested this idea to me is the wild or yellow balsam, *Impatiens noli-me-tangere*. This plant is reported from twenty-seven counties or vice-counties, but in most of these it seems to be admittedly an "introduction." Mr. H. C. Watson, the indefatigable author of the "Cybele Britannica," &c., seems to think that its claim to being indigenous is very slight, for he writes ("Topographical Botany," part 2, p. 607):—"If the *Noli-me-tangere* be really native here it must be so very locally: say, in North Wales and Westmoreland." Sir J. D. Hooker ("Student's Flora," first edition, p. 80) says, "Probably wild in North Wales, Lancashire, and Westmoreland;" Prof. Babington ("Manual," seventh edition, p. 72) does not mark it is an introduction, but Hooker and Arnott ("British Flora") regarded it with doubt; finally Hudson ("Flora Anglica," 1762, p. 332) thought it in his day truly wild in Westmoreland. It is evident, therefore, that the *Impatiens noli-me-tangere* is looked upon with suspicion by many of the present race of botanists, and probably rightly so in many of the "stations."

There are two species of Lepidoptera attached to this plant, and, I believe, restricted to it. One of these—*Lygris reticulata*—has been for a number of years known as a native of Westmoreland, where, on the banks of Windermere, it occurs very rarely. Its connection with the *Impatiens* in this country was not, however, known till very recently, when Mr. J. B. Hodgkinson, a well-known Yorkshire naturalist, traced it to its headquarters amongst the plant, where he also, still more recently, found the other Lepidopteron—*Penthina postremana*—which is attached to the balsam. Both of these insects are far from common (though *Lygris reticulata* is, like its food-plant, widely distributed—even as far as Siberia), and their occurrence in Westmoreland seems to me conclusive that the *Impatiens* is really indigenous there.

As apparently opposed to my theory, it must not be forgotten that there are several plants, certainly introduced into Britain, which have insects attached and restricted to them. Amongst others are the spruce-fir and the larch. On the spruce the following insects occur: *Eupithecia togata*, *Semasia nanana*, *Asthenia strobilella*, *Coccyx hercyniana*, &c., and on the larch *Eupithecia lariciata*, *Boarmia crepuscularia*, *Spilonota laricíana*, *Coleophora laricella*, &c. But it must be remembered that the spruce and larch are perennial trees (while the *Impatiens* is an annual plant), and that they are frequently imported in the form of young trees, or as undressed timber, and sent hither and thither all over the country. Hence the insects attached to them have many chances of being introduced, and of establishing themselves where the conditions are favourable.

It is possible that some of the insects I have last mentioned may have transferred themselves from the native coniferæ to the introduced ones, but I do not think this is likely. A few species live on the introduced as well as the native trees, as, for example, *Myelois abietella*, upon scots-fir and spruce, and the rare beetle *Dendrophagus crenatus*, upon scots-fir and larch, as I noticed when investigating the natural history of Aberdeenshire some years ago.

It is desirable that all the "stations" in which there is any doubt about the introduction of the *Impatiens* should be searched for the insects mentioned above, for it is not likely that they are confined to Westmoreland; and should they be found in any other locality, the probability is, it seems to me, that there the plant is really indigenous. F. BUCHANAN WHITE

Perth, July 5

Physical Science for Artists

SOME years ago, in Madeira, we had been watching a glorious sunset from the hills above Funchal; and, on turning to go eastward, we saw the sky before us suffused with a bright rosy tint, which ended abruptly beyond the Desertas, at some little distance above the horizon-line of the Atlantic.

At first it did not occur to us what was the cold blue-grey form that rose into the pink flush above, slowly losing its definition of outline as it gradually grew higher.

But this strange silhouette had so distinctly mountain outlines that, almost at once, we recognised the fact that we were looking at the shadow of Madeira cast by the setting sun on the mist.

This phenomenon may not be unusual, but I do not recollect having seen it described; and it is perhaps sufficiently different from the phenomena described by Prof. Brücke and Mr. F. Pollock to be worth recording. G. HUBBARD

Remarkable Form of Lightning

I AM able to confirm the fact that lightning occasionally takes the "punctuated" form described by Mr. Joule in NATURE, vol. xviii. p. 260. Some forty years ago, in a thunderstorm which I had the good fortune to witness at Ampton, in Suffolk, the lightning (with heavy rain) was almost incessant for half an hour or more, and about a quarter of the flashes (speaking from memory only) presented this unusual appearance. I have often looked out for it since, but only once with success, and then it only showed itself in a single flash out of many. On both occasions the "punctuated" flashes presented in general a curved or sinuous line without sharp angles; and two or three of them in the first-mentioned storm *appeared* to my eye as closed curves, one an almost perfect figure of 8; but their dazzling brightness made it impossible to speak to this with certainty.

London, July 8 E. J. LAWRENCE

Microscopy. The Immersion Paraboloid

THE immersion paraboloid illuminator exhibited at the recent *soirée* of the Royal Society as designed by me, proves to have been anticipated in principle and construction by Dr. John Barker, of Dublin, from whom a paper on the subject will be found in the *Proceedings* of the Royal Irish Academy for 1870.

An immersion paraboloid illuminator was also described by Mr. Wenham in the *Transactions* of the Royal Microscopical Society for 1856. My paper on the subject appeared in the *Monthly Microscopical Journal* for August, 1877, but that journal being defunct, I ask you to allow me to credit these gentlemen with a priority which, on perusing their papers, I find to be due to them. I ought to add that, until the construction by Messrs. Powell and Lealand of my illuminator, the device had never come into practical use, and that, so far as I can learn, no reference to it exists in any optician's catalogue or text-book on the microscope. JAMES EDMUNDS

8, Grafton Street, Piccadilly

Review of Henfrey's Botany

ALLOW me to correct an error which Mr. Bennett has made in his review of "Henfrey's Elementary Course of Botany" (NATURE, vol. xviii. p. 217). He adds a note as follows:—

"Evidently by an error of the press, the continued fraction of which the most common angles of divergence are successive convergents, is given as $\frac{1}{2}+\frac{1}{1}+\frac{1}{1}$, instead of $\frac{1}{2+\frac{1}{1+1}}$, &c., a correction needful to render the sentence intelligible to the student."

My note (p. 44) is as follows:—

"The mathematician will observe that these fractions are the successive convergents of the continued fraction $\frac{1}{2}+\frac{1}{1}+\frac{1}{1}$,&c."

I subjoined it for the sake of *mathematical* students only, who would know what Mr. Bennett does not seem to be aware of, that the method of writing the continued fraction I have adopted, is simply a convenient way of expressing it in one line; and it is *not* printed as he has misquoted it above.

GEORGE HENSLOW

6, Tichfield Terrace, Regent's Park, N.W.

[I am obliged to my friend Mr. Henslow for correcting my oversight in not accurately noting the form of his formula. The fact, however, that the sentence is, as, Mr. Henslow admits, put in a form which is adapted for "mathematical students only," in a work intended for beginners, seems to furnish a strong justification of the main point of my criticism.—A. W. B.]

Alumina

IT may interest your readers to know that pure alumina dissolved nearly to saturation before the blowpipe in an *acid* flux, such as a bead of phosphoric acid, invariably causes that to assume a pale but beautiful sky blue on cooling.

In an *alkaline* flux such as a bead of boric acid containing sufficient soda to dissolve it to saturation, alumina causes the bead to assume a pale red colour on cooling.

The greatest care has been taken to ascertain that the materials are absolutely free from any metallic or other oxide which might produce such colours, and the resulting beads have been shown to several gentlemen, as Messrs. Hunt and Roskell, Mr. Hutchings of Freiberg, and others.

Might not these facts then afford us some clue (so much wanted) to the cause of coloration in the sapphire and ruby?

London, July 1 W. A. ROSS

A Subject-Index to Scientific Periodical Literature

I HAVE been occupied for years in drawing up a classified index, not only to the titles of papers, but to what is still more wanted, to the facts contained in those papers. As yet I have met with scant encouragement.

A. RAMSAY

Kilmorey Lodge, 6, Kent Gardens, Ealing, W., July 8

CLUB-ROOT

ALL our readers who are agriculturists or practical gardeners will be familiar with the disease called in England "Club-root," or "Finger and Toes," or "Clubbing." It seems almost to confine its ravages to cruciferous plants, and often causes great destruction to large crops of turnips, cabbages, cauliflowers, not to mention what disappointments it may occasion to the growers of wallflowers, Brompton stocks, candytufts, and many other favourite flowers belonging to this large natural family. Not only is it well known, but it has often been written about, as the pages of our contemporary, the *Gardeners' Chronicle*, and most works on the cultivation of gardens, will abundantly prove.

The question of what did it consist of was often asked, and the answer was that it was caused by some insect or another, and some poor beetles and flies were signalled out as those which laid their eggs in the tissues of the young roots of the plants attacked, and, if we are not mistaken, this is the general belief to this present moment. The explanation never was, however, satisfactory. True, in the advanced stage of this disease insect larvæ were to be found in the club-like swellings of the roots; but in the very early stages no trace of larva or egg of any insect was to be seen, and yet the club-root disease was clearly there.

In the *Botanische Zeitung* for May 14, 1875, there appeared a short abstract of a paper read by M. Woronin, before the Botanical Section of the Natural History Society of St. Petersburg, on the 5th of March of the previous year, on the cause of this disease, and within the last few weeks we have received the full memoir, illustrated with upwards of fifty figures. This memoir is in Russian, but, thanks to a colleague (Prof. R. Atkinson), the writer has been able to glean a notion of its most interesting contents, in which he has been much assisted by the beautiful figures. The disease is known in Russia as "Kapustnaja Kila" (Kapusta = Cabbage, Kila = Hernia). About three years since it was so extremely prevalent that the vegetable crops about St. Petersburg failed, and the government ordered an investigation, from which much information was obtained as to the means adopted in different countries for its cure: such as sowing the ground, before planting the crop, with common salt, wood ashes, or, before all, soot. Every one knows, too, that in transplanting the young crucifers into their permanent beds that it is customary to pinch off the swollen portions, and then, if favourable weather followed, the newly-formed roots could well keep ahead of any fresh appearance of the disease. But M. Woronin went scientifically to work, and he was not long in discovering that the cause of the disease was a parasitic vegetable which seemed to have some affinities with the Myxomycetes on the one hand, and the Chytridiaceæ on the other, and the result of constant researches carried on through 1875, 1876, and last year, have resulted in nearly the whole life-history of this new plant being discovered. It is called *Plasmidiophora brassicæ*, and is decidedly very nearly allied to the Chytridia, but the new forms of this group daily coming to light, appear so different in their development, that much more must be known about them ere any satisfactory classification can be attempted. One most striking feature in the new plant is indicated by its generic name; this will be best understood by a short history of the plant's life. Take an old well-developed knob off a club-root, and examine the tissue; most of the parenchymatous cells will be found enlarged, their starchy contents gone, and they themselves gorged with a mass of spore-like bodies; by the ordinary disintegration of the cellular tissue these spores will get released, and after a lapse of six days, out of each spore will proceed the whole of the contents, which, colourless, but nucleated, will move about like so many minute amœba; these plasmodia will then attach themselves to the delicate root-hairs of the nearest young cruciferous seedling. One end of the plasmodium is attenuated like a cilium. The spores soon penetrate into the cells, where they will look just like Myxamœbæ. Filling the cells up with delicate plasmodic projections, they will next soon develop lots of spores, which will further contaminate the cellular tissue of the root, and in process of time the formation of the clubbing will be seen.

Sometimes the ripe spores are spherical, sometimes they are twin-like, or lenticular. If cabbage or turnip seeds be sown in a watch-glass and supplied with distilled water, and shortly after the first appearance of germination, a number of spores of *Plasmidiophora brassicæ* be added to the water, these will be found to at first float freely in the water, but sooner or later will sink and attach themselves to the delicate root-hairs of the little seedlings, and in this way their whole history, so far as now known, may with facility be traced. It seems noteworthy that the whole mass breaks into spores all at once, as in Chytridium proper. There would seem to be as yet no conjugation detected, and the plasmodia would appear as if they absolutely engulfed the starch granules on which they feed.

It must be a matter of regret that this memoir is written in a language known unfortunately to so few scientific botanists. If the learned author knew only Russian it would be absurd and unreasonable to record this regret, but to one knowing French and German, as M. Woronin does, it would have been no trouble to have increased a hundredfold the grateful readers of this important memoir.

E. PERCEVAL WRIGHT

SCIENCE IN SCHOOLS

THE following article on Sir John Lubbock's Bill on the introduction of science in elementary schools appears in Monday's *Times*:—

The rejection of Sir John Lubbock's motion for the addition of elementary science, or, rather, as the matter was more happily put by Dr. Lyon Playfair in the course of the debate, of elementary knowledge of common things, to the subjects for which grants are given under the education code, although an inevitable and foregone conclusion, is not on that account the less to be deplored. As happens in many similar cases, the argument was all on the side of the minority, and Lord G. Hamilton, in opposing the suggestion on the part of the Privy Council, was only able to say that its adoption would, perhaps, entail some temporary uncertainty about the subjects in which inspectors would be required to examine and children to pass. If schools existed for the convenience of inspectors, or even in order that children might not be troubled by uncertainties, the objection would have been a valid one; but upon any other supposition it seems to tell against, rather than in favour of, the contention which it was intended to support. The nation is spending large and rapidly increasing sums of money upon schools, and it will every year become a matter of greater urgency that these sums should not be misapplied, either by the omission from the code of subjects which would be useful or by the inclusion of others which have no apparent tendency to promote the attainment of the ends to which education is supposed to be directed. These ends, in the case of a peasant child, are presumably to render him a more useful and a better conducted member of society than he would become by the unaided light of nature; and it is obvious that the means to their attainment are twofold—first, to cultivate the intelligence in such a way as to facilitate the acquirement and the application of knowledge; and, secondly, to impart the knowledge which has to be applied. Until a comparatively recent time, however, the imparting of knowledge was considered to be the sole purpose of education and to be in itself the best means of mental training; so that educationists occupied themselves more about the seed than about the soil, and were chiefly concerned to teach those things which they thought it most important that a child should know. The instruction given to the poor for many years was almost limited to reading, writing, arithmetic, and elementary religious instruction, while that imparted to the rich was laid upon the same foundation, and was only carried further because the pupils had more time at their disposal. In the employment of this time the instructors could only teach what they knew; the most famous public schools and the two great Universities restricted themselves to giving their pupils some knowledge of classics and mathematics.

As soon as physiologists had discovered that all the faculties of the intellect, however originating or upon whatever exercised, were functions of a material organism or brain, absolutely dependent upon its integrity for their manifestation, and upon its growth and development for their improvement, it became apparent that the true office of the teacher of the future would be to seek to learn the conditions by which the growth and the operations of the brain were controlled, in order that he might be able to modify these conditions in a favourable manner. The abstraction of the "mind" was so far set aside as to make it certain that this mind could only act through a nervous structure, and that the structure was subject to various influences for good or evil. It became known that a brain cannot arrive at healthy maturity excepting by the assistance of a sufficient supply of healthy blood—that is to say, of good food and pure air. It also became known that the power of a brain will ultimately depend very much upon the way in which it is habitually exercised, and that the practice of schools in this respect left a great deal to be desired. A large amount of costly and pretentious teaching fails dismally for no other reason than because it is not directed by any knowledge of the mode of action of the organ to which the teacher endeavours to appeal; and mental growth in many instances occurs in spite of teaching rather than on account of it. Education, which might once have been defined as an endeavour to expand the intellect by the introduction of mechanically compressed facts, should now be defined as an endeavour favourably to influence a vital process; and, when so regarded, its direction should manifestly fall somewhat into the hands of those by whom the nature of vital processes has been most completely studied. In other words, it becomes neither more nor less than a branch of applied physiology; and physiologists tell us with regard to it that the common processes of teaching are open to the grave objection that they constantly appeal to the lower centres of nervous function, which govern the memory of and the reaction upon sensations, rather than to those higher ones which are the organs of ratiocination and of volition. Hence a great deal which passes for education is really a degradation of the human brain to efforts below its natural capacities. This applies especially to book work, in which the memory of sounds in given sequences is often the sole demand of the teacher, and in which the pupil, instead of knowing the meaning of the sounds, often does not know what "meaning" means. As soon as the sequence of the sounds is forgotten nothing remains, and we are then confronted by a question which was once proposed in an inspectorial report:—"To what purpose in after-life is a boy taught if the intervention of a school vacation is to be a sufficient excuse for entirely forgetting his instruction?"

In order to avoid such faulty teaching, few agencies are more valuable than what are technically called "object" lessons, in which the faculties of the pupils are exercised about things instead of about words; and the suggestion of Sir John Lubbock would lead to object lessons of a very useful character. To be taught something about gravitation, about atmospheric pressure, about the effects of temperature, and other simple matters of like kind, which would admit of experimental illustration, and which would call upon the learner to make statements in his own words instead of in those of somebody else, would be so many steps towards real mental development. At the end of a vacation, even if the facts of any particular occurrence had become somewhat mixed, the pupils would nevertheless preserve an increased capacity for acquiring new facts, and would probably retain these for a longer period; and such are precisely the changes which it should be the province of education to bring about. We would even go further than Sir John Lubbock, and in elementary schools would give an important place to the art of drawing, which teaches accurate observation of the forms of things. The efforts of a wise teacher should always be guided with reference to the position and surroundings of a child at home, and should seek to supplement the deficiencies of home training and example. Among the wealthier classes the floating information of the family circle often, though by no means always, both excites and gratifies a curiosity about natural phenomena; but among the poor this stimulus to mental growth is almost, if not entirely, wanting. An explanation of the physical causes of common events, such, for instance, as the rising of water in a pump, would usually be a revelation to the pupils of a Board School, and would start them upon a track which could hardly fail to render them more skilful workers in any department of industry, and which might even lead some of them to fortune. A wise and benevolent squire set on foot many years ago a school for the children of his labourers, in which drawing and the elements of natural science were carefully taught; and the result was that the children educated there, instead of remaining at the plough's tail, passed, in an astonishingly large number of cases, into positions of responsibility and profit. On every ground, therefore, we hope that Sir John Lubbock's proposal will at no distant time be adopted by Parliament; but in the meanwhile there is a still more important department of teaching which is wholly neglected, and concerning which the deficiencies of home instruction are at least equally manifest. We refer to a proper knowledge of the influence of conduct upon life. It should be the duty of every schoolmaster to try and make his pupils understand how production—that is to say, industry—leads to wealth, and how destruction—that is to say, idleness—leads to poverty. The reason why confidence in others is necessary to all enterprise, and the reason why honesty, in the largest sense of the word, is the only root of confidence, should in like manner be enforced by precept and illustrated by example; and such teaching, if it could only be made general, would do more to heal the breach between capital and labour than all the panaceas of all the politicians who have ever sought to figure as the "friends of the working man."

OUR ASTRONOMICAL COLUMN

TEMPEL'S COMET, 1873, II.—Up to the time of writing it would appear that this comet has escaped detection. Even if there be no great error in the calculated position, its faintness must render discovery difficult in the summer skies, but it may be hoped nevertheless that a vigorous effort will be made in the next period of absence of moonlight to recover the comet, as in the event of want of success in the present year, it will be probably lost, or in the same case as the short-period comet of De Vico of 1844, which, being missed at the second return in 1855, has not been again observed. M. Schulhof has communicated to the French Academy a further ephemeris of Tempel's comet, from which are extracted the places subjoined:—

At Paris midnight.	R.A. h. m.	N.P.D. ° ′	At Paris midnight.	R.A. h. m.	N.P.D. ° ′
July 13 ...	15 31·6 ...	93 18	July 29 ...	15 47·6 ...	100 8
,, 17 ...	15 34·4 ...	94 55	Aug. 2 ...	15 53·8 ...	101 57
,, 21 ...	15 38·0 ...	96 36	,, 6 ...	16 0·8 ...	103 46
,, 25 ...	15 42·4 ...	98 21	,, 10 ...	16 8·6 ...	105 36

During this interval the comet's theoretical intensity of light will be only three times that it possessed at the date of the last observation in 1873, when it was the faintest object that could be observed in a dark field with a 7-inch refractor. A few days' difference in the date of perihelion passage, which is probable enough, changes the geocentric path materially, so that the search must be extended to some distance on each side of the calculated place for the day of observation.

In its present orbit the comet cannot approach the planet Jupiter within 0·62, and with M. Schulhof's period of revolution it is easy to see that there will be no near approximation of the two bodies during the next twenty years—in such case the perihelion passages must always occur at a season of the year when observations of the comet would be barely, if at all, practicable. Hence an additional reason for a very close search in the present summer.

THE "TEMPORARY STARS" OF KEPLER AND ANTHELM.—The objects observed by Kepler in 1604 and by Anthelm in 1670, which Sir John Herschel was wont to describe as "temporary stars," but which there is, nevertheless, reason to believe to be still visible as telescopic stars, will not escape the attention of observers who are interested in the variables, at this season. As mentioned some time since in this column, Prof. Winnecke remarked, in 1875, a star of the twelfth magnitude on his scale, which is very near the calculated place of Kepler's famous star, and to the place of a star entered upon Chacornac's Chart, No. 52, as a *tenth* magnitude. We are able to state that no star was discernible in this position with 7-inches aperture on several occasions in 1872-74. The position of Winnecke's star for 1855·0 is in R.A. 17h. 21m. 49·3s., N.P.D. 111° 19′·3; it therefore precedes No. 16,872 of Oeltzen's Argelander by 33s. and is north of it 2′: Argelander's star is of 8·9m. and the best reference point in examination of the neighbourhood. For 1870·0 we have:—

	R.A. h. m. s.	N.P.D. ° ′	
Kepler's star 1604...	17 22 51...	111 22·0	Schönfeld's reduction from observations of Fabricius.
Chacornac's star 10m.	...17 22 43...	111 22·5	Read off from his chart, therefore only approximate.
Winnecke's star 12m.	...17 22 43...	111 20·8	Observed at Strasburg.
Argelander's star 8·9m.	...17 23 16...	111 22·8	

There is also a star of about 12m. in R.A. 17h. 22m. 57s., N.P.D. 111° 24′·4, and therefore as near to the calculated position of Kepler's star as Winnecke's object, which has not shown any variation during several years. The difference of magnitude noted by Chacornac and Winnecke rather points to their star as the one to be closely watched.

The place of the star discovered by Anthelm in 1670 has been calculated from the observations of Picard and Hevelius by Prof. Schönfeld, and from those of Picard only (as given in the *Histoire Céleste* of Lemonnier) by Mr. Hind, their results differing only 2s. in R.A., and 0′·4 in N.P.D. The telescopic star 11·12m., which is now visible almost in the same position, was meridionally observed at Greenwich in 1872, the result for 1880·0 being R.A. 19h. 42m. 45·1s., N.P.D. 62° 58′ 32″. Variation extending to more than one magnitude has been remarked in this object, during the last twenty-five years, thus, with the near coincidence of position affording strong indication that it may eventually prove to be the star which suddenly brightened up in 1670. A star of similar magnitude follows it 12·5s., about 3′ to the north, and another follows at 22·5s., about 2′ northerly. In the years 1872-74 the presumed star of Anthelm was judged to be at times sensibly equal to the first of these stars following it, at others decidedly fainter—even at the first glance.

JEREMIAH SHAKERLEY.—The transit of Mercury on November 2, 1651, it will be remembered, was predicted by Jeremiah Shakerley, a young devotee of astronomy, who, finding by the tables in his hands, apparently founded upon the observations of Horrox, that it would not be visible here, undertook the, at that period, great voyage to India for the purpose of witnessing the phenomenon, which he observed at Surat. Vincent Wing mentions this circumstance in his *Astronomia Britannica*, where the following passage occurs:—"Hanc conjunctionem prædixit idem D. Shakerlœus in *Colloquio* seu *Disceptatione, De Mercurio in Sole Videndo*, et postea ipse transmigrans in *Indiam*, conjunctionem hanc insignem ibi videbat, eamque amicis in *Anglia* communicavit, ut patet ex Literis ad *Christophorum Townlœum, Henricum Osbornum, Londinensem*, aliosque missis."

No work of Shakerley's exists in the libraries of the British Museum, the Royal Observatory, or the Royal Astronomical Society. His *Tabulæ Britannicæ* are in the possession of the Royal Society, and we believe are also found in the Cambridge University Library. The immediate object of this note is to inquire if any reader of NATURE has met with the other works of Shakerley mentioned by Lalande in his *Bibliographie*, or with a publication in which the transit of Mercury in 1651 was predicted.

THE GENESIS OF LIMBS

WHY are our limbs so much alike and yet so different? What do our limbs stand for as compared with the bodies of other animals? Whence have limbs such as ours arisen? What *is* a limb?

The word *limb* is the Anglo-Saxon word *lim*, most probably connected with the Latin *limbus*—the border,

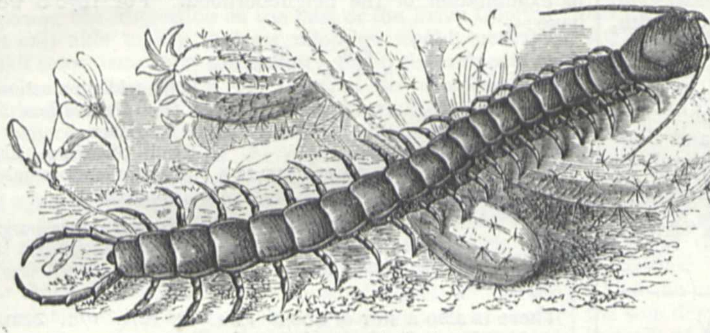

FIG. 1.—A Centipede.

outer edge, or extremity of anything, and thence applied to any attached, projecting, or out-lying portion.

But there are projecting portions of animal bodies essentially like our own body which are not called limbs, *e.g.*, the dorsal and anal fins of fishes, while yet that name is freely bestowed upon structures which have no relation to our limbs save a relation of analogy from similarity of use, as, *e.g.*, the legs of insects or the arms of star-fishes. Insects

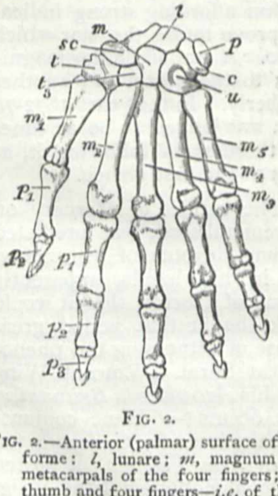

FIG. 2.

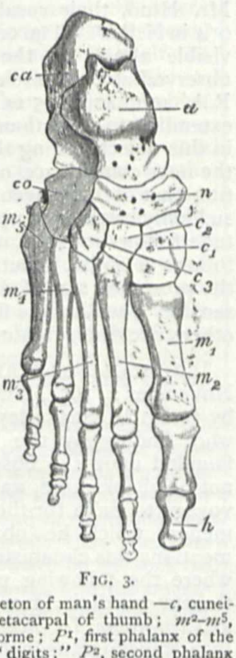

FIG. 3.

FIG. 2.—Anterior (palmar) surface of the skeleton of man's hand —*c*, cuneiforme; *l*, lunare; *m*, magnum; m¹, metacarpal of thumb; *m²–m⁵*, metacarpals of the four fingers; *p*, pisiforme; *P¹*, first phalanx of the thumb and four fingers—*i.e.* of the five "digits;" *P²*, second phalanx of the five digits; *P3*, third, or ungual phalanx; *sc*, scaphoides; *t*, trapezium; *tz*, trapezoides; *u*, unciforme.

FIG. 3.—Dorsum, or upper surface, of skeleton of right foot.—*a*, astragalus; *c¹*, ento-cuneiforme; *c²*, meso-cuneiforme; *c3*, ecto-cuneiforme; *ca*, calcaneum; *co*, cuboides; *h*, distal phalanx of hallux; *m¹*, metatarsal of hallux; *m²–m5*, metatarsals of the four outer toes; *n*, naviculare.

and their allies present certain resemblances and differences carried to a higher degree than in us, and which may be here adverted to. The difference in shape between the limbs of the right and left sides in us is minute and accidental. Our *bilateral* symmetry is complete, but in many crustaceans the shapes of the right and left great claws differ to a large extent. The resemblance between the thoracic and pelvic limbs in us is great, but the resemblance between the successive legs of many arthropods is much greater, especially in the class of centipedes, where the successive segments of the body, with their appendages, exhibit *serial* symmetry carried to the highest degree. The amount of likeness, as regards *serial symmetry*, which exists between our pairs of limbs is less than exists in many back-boned creatures, while at the same time there are a great many others in which it is not carried nearly so far as it is in ourselves. These varying degrees of serial symmetry are such that upon the theory of evolution we must suppose that if this serial symmetry originally existed, it must have been lost and reacquired perhaps several times to produce what we see before us in the existing creation.

Thus if we compare with the structure of the human hand and foot the same parts in apes, we find that in them the toes (or digits of the foot), instead of being short like ours, are long and mobile like our fingers, while the great toe (or hallux) is set out at an angle from the others, to which it is powerfully opposable. At the same time the main points of structure of the ape's foot remain like our own, and thus while it is morphologically a foot, it is functionally more or less of a hand. Here, therefore, serial symmetry is already more complete than in us.

If we descend to hoofed beasts, *e.g*, the hog, the giraffe, or the horse, we find the number of digits equally and simultaneously reduced in both the fore and the hind limb, and while in the two former creatures the third and fourth digits of each extremity are increased in size at the expense of the others, in the horse there is but one digit so increased—the animal walking upon but four digits, which answer respectively to our two middle fingers and our two middle toes.

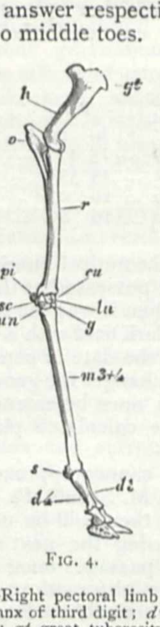

FIG. 4.

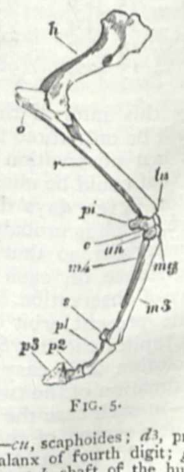

FIG. 5.

FIG. 4.—Right pectoral limb of a Giraffe.—*cu*, scaphoides; *d3*, proximal phalanx of third digit; *d⁴*, proximal phalanx of fourth digit; *g*, magnum; *gt*, great tuberosity of the humerus; *h*, shaft of the humerus; *lu*, lunare; *m3+4*, united metatarsals of third and fourth digits; *o*, olecranon; *pi*, pisiforme; *r*, radius; *sc*, cuneiforme; *un*, unciforme.

FIG. 5.—Right pectoral limb of Horse.—*c*, cuneiforme; *h*, humerus; *lu*, lunare; *m³*, metacarpal of the third digit—the only one fully developed; *m⁴*, rudimentary fourth metacarpal; *mg*, magnum; *pi*, pisiforme; *p¹*, proximal phalanx; *p²*, middle phalanx; *p3*, third or ungual phalanx; *s*, sesamoid; *un*, unciforme.

It is, then, quite a mistake to regard the ox's hoof as answering, morphologically, to the horse's hoof "cloven;" each single hoof of the horse answers only to the inner division of each double hoof of the ox or giraffe. Now in all these creatures we find a still further increase in serial symmetry as compared with the apes and man.

If, however, we turn to such an animal as the mole we find a much decreased degree of such symmetry, the fore-limb being of enormous strength, with its bones shortened and broadened out, while the hind-limb is slender and deli-

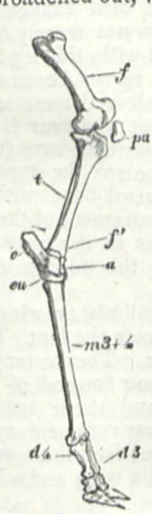

FIG. 6.

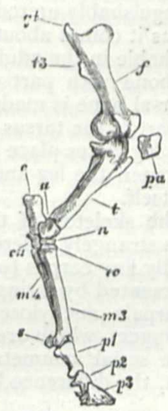

FIG. 7.

FIG. 6.—Right pelvic limb of Giraffe.—*a*, astragalus; *c*, calcaneum; *cu*, cuboides; *d* 3, proximal phalanx of third digit; d^4, proximal phalanx of fourth digit; *f*, femur; *f'*, rudiments of fibula (the line is not continued far enough—the rudimentary fibula is a small ossicle reposing on the upper surface of the calcaneum, as shown in the figure); m^{3+4}, metatarsals of digits 3 and 4 united into one "cannon-bone"; *pa*, patella; *t*, tibia.

FIG. 7.—Skeleton of right pelvic limb of Horse.—*a*, astragalus; *c*, calcaneum; *cu*, cuboides; *ec*, ecto-cuneiforme; *f*, femur; *gt*, great trochanter; *m*3, metatarsal of third digit; m^4, rudimentary fourth metatarsal; *n*, naviculare; *pa*, patella; p^1, p^2, and p^3, first, second, and third phalanges of the third and only digit; *s*, sesamoid; *t*, tibia; *t*3, third trochanter.

cate. The mole works underground with such exceeding rapidity that it has been said to fly beneath the soil, but in the beast which really does fly—the bat—serial sym-

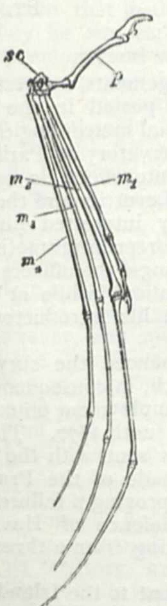

FIG. 8.—Hand of Bat (*Pteropus*).—m^1–m^4, metacarpals of the four fingers; *p*, pollex, with a very short metacarpal; *sc*, scaphoides.

metry is still less developed. The framework of the bat's wing consists of the very same bones which exist in the human arm and hand, only exceedingly elongated and slender. The four fingers—wonderfully drawn out—are connected together (and to the body and legs) by a delicate web of skin. The foot is a striking contrast to the enormously enlarged hand, being small in size with short toes. And yet, though serial symmetry is thus disguised in the bat, it nevertheless shows itself in other ways more or less noteworthy. The outer bone of the fore-arm—the *ulna*, is incompletely developed, and the corresponding bone of the leg—the fibula, is also incompletely developed. But much more than this, in some bats we find outside the

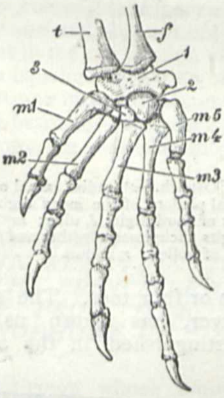

FIG. 9.—Left foot of a Monitor Lizard (*Varanus*).—*f*, fibula; m^1–m^5, the five metatarsals, m^1 being that of the hallux; *t*, tibia; 1, astragalo-calcaneum; 2, cuboides; 3, ecto-cuneiforme.

elbow-joint a distinct and separate little bone which quite answers to the knee-pan (or *patella*) of the leg—a most exceptional case of serial homology.

The creatures just referred to are all mammals, but birds and reptiles present us with some instructive examples both of serial homology and discrepancy. In ourselves and in all beasts, the motion of the foot upon the leg takes place between the long bones of the latter (tibia and fibula) and the tarsus. In the crocodile, or

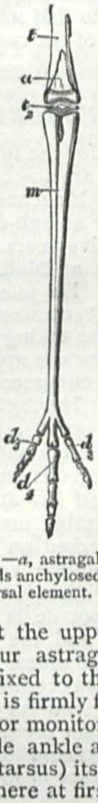

FIG. 11.—Right foot of Emeu.—*a*, astragalus; d_2–d_4, second, third, and fourth digits; *m*, metatarsals anchylosed together except at their distal ends; *t*, tibia; t_2, distal tarsal element.

monitor, it is not so, but the upper part of the ankle, or tarsus (answering to our astragalus and os calcis), is firmly and immovably fixed to the leg bones, while the lower part of the tarsus is firmly fixed to the metatarsals. Thus in the crocodile, or monitor, motion does not take place between the whole ankle and the leg, but in the middle of the ankle (or tarsus) itself.

In the leg of a bird there at first sight seems to be no tarsus at all, nor any bones which we can with certainty call "metatarsal." We have only one single long bone, at the lower end of which are three or four articular surfaces for the three or four toes. The study of the very young bird, however, has shown us that though no tarsus can be distinguished in the adult, yet such a part does exist for a certain brief period of the bird's life and then disappears.

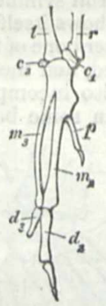

FIG. 10.—Right hand of Ostrich.—c^1, radial carpal ossicle; c^2, ulnar carpal ossicle; d^2, proximal phalanx of the index digit which has three phalanges; $d3$, phalanx of third digit; *l*, ulna; m^2 and $m3$, metacarpals of second and third digits anchylosed together and with that of the pollex; *p*, proximal phalanx of pollex; *r*, radius.

In its fate we have an interesting resemblance to the condition which we have already found existing in the crocodile, and which condition the bird exaggerates. The upper part of the tarsus becomes not merely firmly fixed to, but indistinguishably united with, the leg-bone, or tibia, while the lower part of the tarsus becomes as indistinguishably united with the coalesced metatarsals, and thus it comes about that no tarsus whatever is distinguishable in the adult. The apparent leg-bone (tibia) is leg-bone with part of the tarsus also; the apparent metatarsal bone is made up of metatarsal bones with the other part of the tarsus also. The movement of the foot on the leg takes place in the bird (as in the crocodile), not between the leg and ankle, but in the middle of the ankle itself.

In the skeleton of the bird's fore-limb, or wing, the hand is strangely different in aspect from the foot. There is hardly any carpus (or wrist) visible. The metacarpus is represented by a single complex bone formed of three metacarpals anchylosed together, and there are only three fingers, which are all more or less rudimentary.

Here serial symmetry is more disguised than ever in the bat, the difference between a bird's wing and a bird's

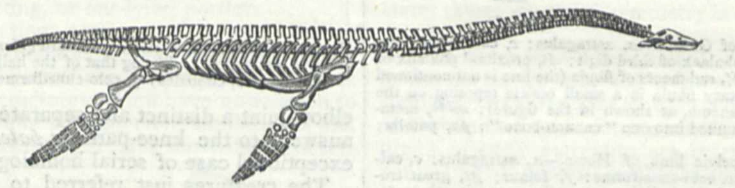

FIG. 13.—Skeleton of a Plesiosaurus.

leg being so great. And yet even here we meet with a curious example of the tendency to vary similarly which exists in serially homologous parts; for in the bird's carpus there is a similar arrangement, though less thoroughly carried out, to that which exists in the bird's tarsus. The distal part of the carpus coalesces altogether with the metacarpus (as the distal part of the tarsus does with the metacarpus), but the proximal part remains distinct in the form of two separate carpal bones.

(*To be continued*)

ST. GEORGE MIVART

THE OBSERVATORY OF PARIS

ARRANGEMENTS for the future management of the Observatory at Paris are now complete. Contre-Amiral (until recently Captain) Mouchez is appointed director, with M. Maurice Lœwy as sub-director—these appointments taking effect for five years.

M. Mouchez was born at Madrid in 1821, but is the son of French parents. He joined the Naval School at Brest in 1837, and in 1839 commenced his nautical career in the *Fortune*, which was taking part in the blockade of Buenos Ayres. In 1840 he was appointed to the *Favorite*, which proceeded on a circumnavigating expedition extending over five years. Having shown an early aptitude for astronomical observations, he was intrusted with them. On this voyage he became aware of the imperfect determination of the latitudes and longitudes of some of the sea-ports visited, and his attention was directed to the construction of portable instruments for improving them. In 1850 he embarked on board the *Capricieuse*, also destined for a scientific voyage round the world, which, like that of the *Favorite*, occupied five years. He was charged by the Dépôt de la Marine with the survey of the Rio de la Plata and the Brazils, a survey which extended over about 3,000 miles.

In 1860 M. Mouchez was commissioned by the French Government to visit England, for the purpose of reporting upon the system of weather predictions organised by the late Admiral Fitzroy, Leverrier at the time contemplating the establishment in France of his own system of storm-warnings. M. Mouchez, who was enthusiastic in favour of the Fitzroy arrangements, suggested that the *Dépêche anglaise* should be posted in the French ports, and recommended a special meteorological organisation independent of the Observatory at Paris. The proposition, which was carried into effect, is said to have created differences between Leverrier and the Minister of Marine. M. Mouchez greatly interested himself from an early period in his naval career in promoting astronomical and physical studies amongst the officers of the Government marine, and observations while at sea. His views are noticed by Arago in his introductory work for scientific travellers.

In 1867 he commenced the survey of the coast of Algeria, a work which, in consequence of repeated interruptions from his employment on other urgent missions, was not completed until 1877. Thus in 1870, Contre-Amiral Mouchez was sent with the French fleet to the Baltic for the blockade of the Prussian coasts, but the attempted blockade proving a failure, he was recalled and charged with the defence of Havre, which place he succeeded in preserving from a threatened hostile occupation.

In 1874 he was sent to the Island of St. Paul for the observation of the transit of Venus, and next to that of M. Janssen his mission may be considered the most successful. At his suggestion the French Government established, in 1875, an observatory at Montsouris, where naval officers are practised in making astronomical observations, as also intending travellers, on the recommendation of the Société de Geographie. He is a member of the Academy of Sciences in the section of Astronomy, and of the Bureau des Longitudes, and was for some time a member of the Council of the Observatory. It is understood that M. Bardoux suggested the adoption of the system in operation at the United States Naval Observatory at Washington, and to model the great Paris Observatory after that institution; and as stated above, the appointment of Admiral Mouchez as director, and M. Lœwy as sub-director, are at present intended to be limited to five years, with the same restriction as to future nominations.

M. Maurice Lœwy, who was born at Pesth in 1834, commenced his astronomical career at the Imperial Observatory of Vienna, under the late Prof. Carl von Littrow, on whose recommendation he was transferred to the Observatory of Paris by Leverrier, in 1860. At Vienna he was much occupied with the calculation of the orbits of comets, including the great comet of Donati in 1858, for which body he was one of the first to establish elliptical elements. He succeeded Laugier, as one of the astronomers of the Bureau des Longitudes in 1872, and since 1874 has been charged with the preparation of the *Connaissance des Temps*, the French national ephemeris, and the *Annuaire*, works which have greatly benefited by his energetic superintendence. Under Delaunay's rule, M. Lœwy occupied the position of sub-director of the Observatory of Paris, charging himself with the meridian observations.

The installation of Admiral Mouchez took place on Saturday by the Council of the Observatory, of which M. Dumas is president.

PROF. W. M. GABB

We greatly regret to hear of the death from consumption, on May 30, at his residence in Philadelphia, of Prof. William M. Gabb, who for many years has occupied a very prominent place among American naturalists.

He was born on January 20, 1839, in Philadelphia, and was educated at its High School, being one of the many graduates of whom that institution had reason to be proud. As a boy he was especially interested in mineralogy and palæontology, and at an early age was so fortunate as to secure an engagement with Prof. James Hall, where he had ample opportunity of indulging his tastes. Returning to Philadelphia, he became a member of the Academy of Natural Sciences, and soon commenced the critical study of the fossil invertebrates of the United States, especially those of the cretaceous formation.

In 1860 he entered the service of the Geological Survey of California, under Prof. J. D. Whitney, but returned to the East in 1868, and undertook the geological survey of their lands for the Santo Domingo Land and Mining Company, which, however, was made to cover a considerable portion of the Dominican Republic, and to which he subsequently made several successive visits for the purpose of continuing his work.

During his connection with the Geological Survey of California he made an extended exploration of the peninsula of Lower California, collecting much important geological and biological material.

In 1873 he became connected with the Costa Rican Government, undertaking a general geological and topographical survey of its territory, and combined with it very extensive researches into its natural history and ethnology, sending his collections to the National Museum in Washington. This labour occupied him for about three years. The results of his work have been given to the public in various forms. A full account of the topography, with an elaborate map, appeared in Petermann's *Mittheilungen*, and a paper on the ethnology of the native tribes, published by the American Philosophical Society, is one of standard value.

In the autumn of 1876 he revisited San Domingo, returning to the United States in March last. For many years he has been threatened with pulmonary disease, the extension of which has been checked by his abode in subtropical regions. The unfavourable symptoms, however, increased of late, and he succumbed shortly after his return to Philadelphia.

Dr. Gabb left an extensive manuscript on the geology and palæontology of Costa Rica, which will be published ere long under competent supervision, thus closing a career of energy and activity, not only in the prosecution of researches, but in the elaboration of their results, which has been seldom equalled by a man of his age. It is very rare, indeed, that one man has accomplished so much in so many distinct branches—in geology, geography, palæontology, ethnology, &c.—as the subject of our present notice.

ON THE ANATOMY OF THE ORGAN OF HEARING IN RELATION TO THE DISCOVERY OF THE PRINCIPLE OF THE MICROPHONE OF PROF. D. E. HUGHES, AND THE MAGNOPHONE OF MR. W. L. SCOTT, A.S.T.E.[1]

The two gentlemen whose names appear in the heading of this paper seem to have arrived at the same important result, viz., the extraordinary effect of mobile particles in transmitting sound under certain conditions, by quite independent research. In perusing the interesting accounts of the *microphone* in several scientific journals, but especially an article in the *Electrician* for May 25, in which number also will be found Mr. Scott's statement of the principle, it occurred to me that the transmitting power of the *otoconia* and *otoliths* in the ears of animals bore very pertinently upon this question. We find *otoconia*, or numerous minute particles in all the *Vertebrata*, with perhaps the exception of the bony fishes which have single concretions, or the union of many in one. *Otoconia* are also found in the *Tetrabranchiate Cephalopoda* (*Nautilus*, Fig. 1), the whole of the *Pteropoda*, in the *Pulmonifera inoperculata*, or rather the bisexual *Pulmonifera* (snails and slugs, Fig. 3), there being an operculum in *Amphibola*. On the other hand, in the *Dibranchiate Cephalopoda* (*Sepia*, Fig. 2), all the *Heteropoda* (Fig. 5) and the *unisexual operculate Pulmonifera* (Fig. 4) the ear-sacs contain single *otoliths*.

It will be thus seen that the nature of the auditory concretions is by no means an unimportant element in the classification of animals.[2] Prof. Huxley alludes to the genus *Polyophthalmus*, an Annelidan with eyes in every segment, as a remarkable fact, but this is excelled by his notice of otoliths in the tail of *Mysis flexuosa*,[3] a little pelagic crustacean which I have often had the opportunity of examining.

Every physiologist is aware that there are structural particulars in the ears of *Vertebrata* which show clearly that nature's philosophy is of a more profound character than that to which man has hitherto attained. Indeed if we study the simplest ears in creation, those, for example, of the common *Snail* and of the *Periwinkle*, a most interesting problem is presented to us to solve, namely, the precise function of the numerous otoconia in one case, and of the single otoliths in the other. It is commonly granted that these concretions augment the sonorous undulations by resonance, a view which is borne out by several considerations. If we take two stones and strike them together under water, the head also being immersed, the collision will produce a very loud and peculiar sound, but in order to make the minute otoconia impress one another

[1] By John Denis Macdonald, M.D., F.R.S., Dep. Ins. Gen. R.N., &c.
[2] See a paper by the author in the *Linnean Transactions* for 1860, in which a classification of the Gasteropoda has been attempted.
[3] See *Ann. and Mag. of Nat. Hist.* for May, 1851.

with the rhythmical flow of the undulations of sound, they must be poised off from the walls of the auditory sac. And this is effected, in some instances, by little tubercles on the inner surface as in the *cuttle fish* or as in the *Heteropod*, as shown in Fig. 5 (*h*), the auditory organ of *Cerophora*, in which also large vibratile cilia effect a continual rotatory motion of the spherical otolith. In other cases when otoconia are present, a fine ciliated lining not only prevents the contact of these minute particles with the walls of the sac, but keeps them in constant motion, jostling one another in a remarkable manner. Now when acoustic waves are passing over the auditory organ, it is easy to perceive how their impulses may be imparted to the otoconia, and thereby communicated with augmented effect to the auditory centre.

Whatever may be the intrinsic nature of nervous force it exhibits unmistakable polar properties which would

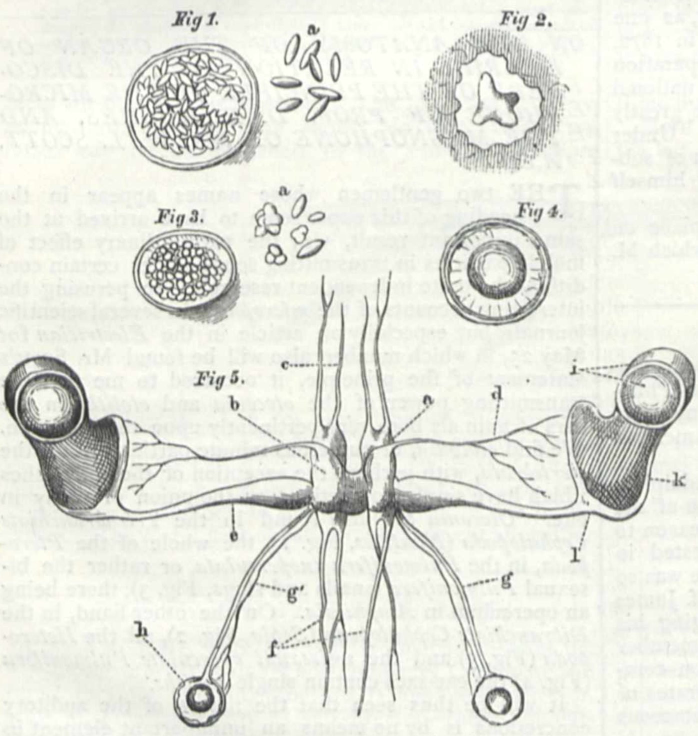

FIG. 1.—Auditory sac of *Nautilus*. *a*, otoconial particles, elliptical.
FIG. 2.—Section of auditory cavity of *Sepia*, with a somewhat cruciform otolith.
FIG. 3.—Auditory sac of *Limax atelis*, &c. *a*, otoconial particles, some of them compound, others of variable size.
FIG. 4.—Auditory sac of *Litorina*, *Geomelania*, or *Cyclostoma*.
FIG. 5.—Cerebroid ganglia and organs of vision and hearing in *Cerophora*. *a*, upper cerebroids; *b*, lower cerebroids; *c*, buccal nerves; *d*, motor nerve of the eye; *e*, optic nerves; *f*, trunks communicating with the pedal ganglia; *g*, pedicle of the auditory sac; *g'*, nerve distributed to the auditory sac; *h*, auditory sac with contained otolith; *i*, meniscus, and lens of the eye; *k*, body of the eye; *l*, retina.

thus place it in the category of the electric force, though no one now would attempt to reason out the identity of the two. It is, however, a new idea that nervous force in the *function of audition* plays an analogous part to the *electric force* in the case of the *microphone*. Moreover, if we look to the anatomy of the ear, we see that provision for a complete circuit is made. Take, for example, the auditory sac (*h*), pedicle (*g*), and nerve (*g'*) of *Cerophora* (Fig. 5). Nothing would appear to be wanting if we admit the nervous centre to be the equivalent of the battery, From all this it would seem to be a rational hypothesis that nervous force in traversing the circuit just indicated under the influence of sonorous undulations is actually transmitted from particle to particle of *otoconia*, or through the revolving *otolith*, as the case may be. But while the *microphone*, or the principle involved in it, affords us some additional light in relation to the physiology of hearing, the study of the anatomy of the ear might give electricians some valuable hints as to the construction of transmitting apparatus. One of Prof. Hughes' transmitters so exactly resembles the natural arrangement of the parts in the middle ear of the higher animals, that some few remarks on this subject may not be out of place here. Many years ago (1847-48) I noticed that a small piece of steel casually lying in the box of a square pianoforte reproduced, with great fidelity, any note, or number of notes, touched on the instrument, by the impact of its own weight meeting the vibrations of the sound-board beneath. Here was, in effect, the basis of the *telephone*, and I would indeed have anticipated the wisdom of the age had I known how to call in the aid of electricity in the simple way that this has been done by Prof. Bell. The fact, however, was made the subject of a paper published in the *Medical Gazette*, in which the *Membrana tympani* and the *Malleus* were compared with the sound-board and steel rod in the case referred to. Moreover, the inference was drawn that while the membrane communicates its vibrations to the ossicles, or small bones, it also causes the *malleus* to percuss the face of the *incus* responsively to the rapid and varied impressions made upon it, a view which borrows additional weight from the fact that in the frog articulation is still persistent where, from the absence of muscles for adjustment it might be considered to be quite unnecessary.

It should also be remembered the handle of the *malleus* extends like a radius from the centre to the circumference of the drum membrane, so as thus to include, without impeding, its three vibrating segments. The centre gives the *key-note* the circumference the *fifth*, and the intervening region the *third*. Only add to this the aural lens or lenticles, the *otoliths*, or the *otoconia*, with the light which the *microphone* has cast upon their function, and we are enabled to form a better conception of the physiology of hearing than has hitherto been possible. The accentuations, piano, forte, &c., in musical pieces, are marked with extreme accuracy, and should the parts of the music be deranged by a defect in time, an uneasy jog will be produced in the auditory apparatus, hence the antipathy of the mind to any erratic deviation in this respect. It is very remarkable that the *malleus* and *incus* (the hammer and the anvil) should correspond not only in figure, but also in function, to the objects from which their respective names are derived, for as we have already seen, the uses of the hammer and anvil, as employed in mechanics, are literally fulfilled by the *malleus* and *incus* answering very important ends in the faculty of audition. By the action of one upon the other, sounds are not only correctly transmitted to the auditory centre, but an accurate register of time, grace, and style, is effected in the manner above explained. Thus the physical organisation itself may be shown to be the natural preceptor of the mind.[1]

[1] Dr. F. de Chaumont writes as follows:—

Since Dr. Macdonald's paper was forwarded to you the appearance of Mr. Blyth's has added still stronger confirmation to the analogy between the microphone and the auditory apparatus of the mollusca, &c. One point in particular is the necessity of moisture of some kind or other, as a medium between the conducting particles, shown by the fact that even the watery vapour from the breath of the experimenter produced a sensible increase in the strength of the sounds elicited; and further, that the addition of simple water to the cinders was productive of still more striking effects. All this bears out the view taken by Dr. Macdonald that we have in the *otoconia*, *endolymph* and *vestibule* of the ear the most complete type of a microphone.

It would be well to try the free suspension of good conducting particles in a non-conducting fluid medium, sufficiently limpid to offer the least possible impediment to their movement.

The oscillation of the transmitter as a whole by mechanical means ought also to be tried in order to imitate the effect of vibratile cilia in the case of the auditory vestibule of animals.

F. DE CHAUMONT

Army Medical School, Netley, June 20

WORK AND PROGRESS OF THE IMPERIAL GEOLOGICAL INSTITUTE OF VIENNA[1]

I. *THE Staff* has its full complement. M. D. Stur has been appointed sub-director, Dr. O. Lenz has returned from Africa with much information on the West Coast. M. Pilide, volunteer since 1875, has been appointed official geologist in Roumania. Two volunteers have joined, and there are four students in the museum and laboratory.

II. *The Building* has been considerably altered and enlarged, giving more space for laboratory, library, and museum.

III. *The Survey Operations* have been directed to (1) *the Special Map of the Empire*. Section 1. MM. Stache and Teller surveying the Central Alps south and east from the Cividale massif, the Oetzthal massif, &c. 2. MM. von Mojsisovics, Vacek, and Bittner—the Cima d'Asta, Sette Communi, and eastward to the Venetian plain, the Tertiaries of the Vicentin, and down to the valley of the Adige. 3. MM. Paul, Tietze, and Lenz, East Galicia and part of N.E. Hungary.

(2). *Local Surveys, &c.*, D. Stur—Review of Sternberg's and Corda's collections of Carboniferous Plants in the Prague Museum; Coal-bed of Upper Silesia; Fossil Plants of Lunz in Upper Austria. Stache—Palæozoic Schists of the Semmering on the Styrio-Austrian frontier. Von Mojsisovics—Trias in Upper Austria and Carinthia. Wolf—Railway Line in Upper Austria. Paul and Fr. Ritter von Hauer—Coal-beds of Aspang and Kladno. Bittner—Geological Map of the Archduke Leopold's Estates South of Vienna.

(3). *With Government Aid*, R. Hoernes—Devonian Strata near Gratz, Styria. Koch—Rhæticon and Selvettra group.

(4). *The Bohemian Commission.*—Krejci and Helmhacker—The Silurians of Central Bohemia. Laube—The Erzgebirg between Bohemia and Saxony. Fritsch—Palæozoic Saurians and Crustacea of Beraun. Nowak—Cypris-shales with Insects. Boritzky—Porphyries.

5. *Hungarian Geological Survey.*—Banat and South and West Hungary, surveyed by MM. Hofmann, Roth, Matiasovics, Boeckh, and Hantken.

IV. Rearrangement of and additions to, the *Museum*. Forty-one donors. Above 1,000 specimens, presented by Fr. Karrer, illustrative of the geology and fossils of the region traversed by the Francis-Joseph Aqueduct from the slopes of the Schneeberg to Vienna.

V. *Library.*—1. *Books:* Increase of 270 works in 281 volumes or parts; Periodicals, 422 volumes. Total at the close of 1877, 8,346 work in 22,496 volumes or parts; 766 Periodicals and Transactions in 13,261 volumes or parts. Various new Exchanges. 2. *Maps:* Arrangement completed. Total at the close of 1877, 933 in 3,825 sheets, besides the original maps by the Institute, and the special general maps of the Austro-Hungarian Empire reduced from them.

VI. *Laboratory.*—Newly established in a fresh locality. Enlargement of collection of artificial crystals, by Karl Ritter von Hauer. Analysis of eruptive rocks of the Ortler mountain-group, by M. John. Analyses of fossil fuel, ores, building-materials, &c.

VII. *Publications.*—1. The Transactions, vol. vii. part IV., and vols. viii. and ix., with fifty-four maps, sections, and plates, comprising Vacek's paper on the Mastodons of Austria; F. Karrer's Geology of the Francis-Joseph Aqueduct; and Stur's description of the Culm-flora. 2. The Annals: Ten contributors. 3. The Mineralogical Communications; Twenty-two contributors. These papers will for the future be published by themselves. 4. The Proceedings: Twenty-six contributors. 5. Other publications: MM. von Hauer and Neumayr's Guide for the Meeting of the German Geologists; M. Stache's Geological Map of the Maritime region of Austria; Fr. von Hauer's "Geology," second edition.

[1] From Fr. Ritter von Hauer's Annual Report, January 8, 1878.

METEOROLOGICAL NOTES

DR. OTTO KRÜMMEL publishes a paper in the current number of the journal of the *Gesellschaft für Erdkunde* of Berlin, on the distribution of the rainfall of Europe, illustrated by a well-executed map of seven colours, which show the regions where the annual rainfall does not exceed 9·8 inches (25 ctm.), is from 9·8 to 15·7 inches, from 15 7 to 21·7 inches, &c., the deepest tint covering all those regions where the rainfall exceeds 39·4 inches (100 ctm.). The map exhibits in a striking manner the small rainfall in the east and the heavy rainfall in the west; the markedly reduced rainfall of such mountain-sheltered plains as those which surround Paris, Clermont, Mannheim, Prague, Pressburg, and the great plain of Hungary; the large rainfall of the slopes of the Caucasus, which stands out in strong contrast with that of the arid regions all round; and the exceptional rainfall of Spain, which presents on the map a picturesque patchwork of all the seven colours representative of the wettest down to the driest regions portrayed on the map. The most important feature, however, is the partition of Europe into two divisions, by a waved line lying about the forty-third degree of latitude, the southern division being characterised by a rainless or all but rainless summer, and the northern by rain all the year round, where an absolutely rainless month is of rare occurrence. Slight exception may be taken to the rainfall set down for Iceland, Holland, and portions of the east of Scotland and west of Norway, as being a little too large, but on the whole the map is an admirable piece of work.

DR. HORNSTEIN, of Prague Observatory, has discussed the observations of the wind made there from 1849 with a Kreil's anemometer, and the results, which have been communicated to the Vienna Academy, disclose periodicities of velocity and direction generally accordant with Wolf's relative numbers of the sun-spots and with the well-known secular variation of the aurora. The mean annual velocity increases from the period of minimum to that of maximum sun-spots, and thence decreases with the diminution of the sun-spots to the minimum; and from the period of maximum to that of minimum sun-spots, the mean annual direction of the wind changes from a westward to a more southerly direction, while the change is in the opposite direction from the minimum to the maximum sun-spot period.

MR. BLANFORD, the Government Meteorologist for India, published quite recently a forecast of the weather of the monsoon season now set in. Reasoning from the unusually persistent high pressure then prevailing over Northern India, the singular absence of abnormal variations of pressure over the same region, and the heavy rainfall during the cold weather, he thinks it probable that the monsoon current will be below its average strength, that the rainfall will be more equally distributed than last year, and that the monsoon will commence later than usual in Upper India.

ON the occasion of the commemoration of the 400th anniversary of the founding of Upsal University in September last, the Swedish Government published an Atlas of fifty-one maps which had been prepared by Prof. Hildebrandsson to show the direction of the upper currents of the atmosphere during 1875 and 1876. About the same time the Meteorological Society (London) published thirty weather maps for March, 1876, prepared by Mr. Clement Ley, in illustration also of the upper currents. As regards the broad results arrived at, both authors are substantially agreed, the results being that while the surface winds blow inwards upon cyclonic areas of low pressure and outward from anticyclones, the upper currents blow away from cyclonic and inwards upon anticyclonic areas. The most striking part of Mr. Ley's paper is the diagram in which he has summarised with no small amount of skill the facts of his cirrus-cloud observations. The point in the diagram is this: if the upper currents there depicted are to be regarded as tolerably close approximations to the movements of the cirrus-clouds of a cyclone, it follows that the region of the cirrus occupies a much higher level over the front portion of cyclone than it does over its rear—notably than over the north-west quadrant—a point of prime importance in relation to the theory of storms.

THE energetic way in which the Missouri (U.S.) weather service is being conducted may be judged of from the fact of the Report of the weather of May having reached us by post on June 24. This Report gives a statement of the rainfall for the month at from sixty to seventy stations, a map showing the distribution of the rainfall over the State for May, and a rapid sketch of the chief features of the weather. The rainfall was greatest in the central-southern districts, amounting to 8·00 inches at Bolivar, and least in the north-east, where at Canton it was only 1·77 inch. The increased efficiency of the system is well shown by the fulness with which the great storm of the 17-18th with its accompanying thunder and lightning and locally-developed whirlwinds has been accurately observed over Missouri, of which Director Nipher promises a full report. A separate sheet accompanies the Report, with all the instances of heavy rainfalls which have occurred during the past thirty years. Of these the most noteworthy as regards rate of fall was a downpour of 5·05 inches in an hour and-a-quarter on August 15, 1848. The heaviest continuous fall was 7·83 inches during thirty hours on June 18-20, 1859.

WE learn from the Mauritius Meteorological Report for 1876 that the rainfall of the whole island during that year was 12·63 inches less than the average, and that daily observations are now received from Seychelles, Rodrigues, and others of the neighbouring groups of islands. Valuable tables appear in the Report, showing the monthly means of pressure, temperature, and humidity from 1853 to 1874; but the noteworthy feature of the year's observations are the mean hourly values of the velocity and direction of the wind now published for the first time. These exhibit a well-marked daily period in the direction from E. 22° 15′ S., the most southerly point at 4 A.M., to E. 7° 0′ S. at 1 P.M., and thence back to E. 22° 15′ S. at 4 A.M., the daily variation thus being 15° 15′. Equally marked is the diurnal variation in the velocity, the minimum 9·7 miles per hour occurring from 2 to 3 A.M., and the maximum 18·5 miles per hour from 1 to 2 P.M. Hence, as regards this part of the south-east trades, the influence of the sun during the day is to double the velocity of the wind and to impress upon it a more truly easterly direction.

IN an eighth contribution to meteorology Prof. Loomis deals with the origin and development of storms, in which he shows that the great American storms are not confined in their origin to any particular locality, half of them originating on or close to the Rocky Mountains, and more than two-thirds north of 36° N. lat. The first stage in their development is the formation of an area several hundred miles in diameter, over which the barometer differs little from 30·000 inches, with areas of high barometer on the east and west sides, often another to the north, and occasionally a fourth to southward. The mean height of these different high areas examined was 30·310 inches on the west and 30·420 on the east side, that on the east side being thus the greater; and the distance of each from the central area of nearly uniform pressure which they surround is generally about 1,000 miles. A system of winds towards an intermediate or central point then sets in, resulting in a diminished pressure over the central area. The author supposes that the inflowing air escapes by an ascending current, carrying with it a large amount of vapour which as it is cooled is condensed into cloud and rain, and that the heat thus liberated further expands the air, thereby increasing the force of the inward movement of the wind. Rain is thus one of the conditions which increase the force of a storm. Prof. Loomis finds that an area of low barometer of considerable size may be formed and continue for several days with little or no rain, but in such cases the pressure did not fall so low as 29·250 inches. No storm of great violence has yet been found unaccompanied by a considerable fall of rain or snow. The general inward movement of the air towards a central area begins before any considerable precipitation of rain or snow has taken place. The easterly course of storms is considered to be occasioned by the general circulation of the atmosphere in that direction, and by the upward motion of the air taking place principally on the east side of the low centre as indicated by the position of the rain-areas. By this upward motion the air which presses in upon the east side of the low centre is prevented from restoring the equilibrium of pressure upon that side, and thus the low centre is steadily transferred toward the east, or the storm travels eastward. On the other hand, when the fall of rain or snow on the west side of the low centre is copious, widespread, and continued, the easterly progress of the storm is retarded, or arrested, or in some cases even retrogrades to westward, of which the storms of March 9-14, 1874, and January 1-18, 1875, were examples.

DR. WOJEIKOF sends to the Paris Exhibition new isobaric charts of the globe for January and July, which are rectifications of Buchan's isobaric charts, published in 1869, made by charting the large amount of fresh and fuller meteorological information collected since that time. Lake Baikal has recently been levelled, and its true height now ascertained to be 1,539 feet above the sea, instead of 1,342 feet, as given by Kropotkine. Correcting the barometrical observations for this height the mean pressure of this region in January is 30·630 inches, which is the maximum mean pressure for the globe at this season, and consequently 0·200 inch greater than was given in Buchan's chart. This extraordinarily high pressure in Eastern Siberia, which is 1·300 inch higher than that of Iceland at this season, is attributed by Dr. Wojeikof to the clear dry atmosphere of Siberia, and intense cold of the valleys and the high mountain barrier, which shuts off all communication, as regards the lower atmosphere, with the Pacific, where pressure in winter is low. A point of some interest brought out in the chart for July is the existence of two centres of low pressure controlling the wind systems of the Asiatic continent, the one being the Punjab and adjacent parts of Beloochistan, and the other the region around Lob-Nor. Dr. Wojeikof introduces an important feature into his charts in *not* tracing the isobaric lines over those portions of the globe which are at least 1,800 metres (5,906 feet) above the sea, some mountain-groups only being excepted. In this way the great plateau of Tibet, with its ramifications, is omitted, it being evident, for instance, that the winds of the Gangetic plains cannot be influenced by any differences that may obtain between the sea-level pressure there and that of the plains of Siberia, owing to the high, broad plateau of Tibet interposed between.

GEOGRAPHICAL NOTES

IN the course of the address which he recently delivered before the Geographical Society upon the subject of his travels on the western frontier of China, Capt. W. J. Gill, R.E., gave an interesting account of his experiences on the borders of Thibet. He entered that land of mystery at Ta-chien-lu, whence the road at once ascends to the great plateau through a valley amongst granite rocks, capped at the summit with bare crags of limestone. Standing on the summit of the pass, by which the great upland country was reached, the traveller saw stretched below a fine valley closed in on both sides by gently sloping round-topped hills, covered with splendid grass. The road to Lithang was a succession of mountainous valleys, huge pine forests, and open glades. Capt. Gill found Lithang a cheerless place, some 12,500 feet above the sea-level. The natives told him that Ta-so, the last mountain-pass before reaching Bathang, was a very bad "medicine-mountain," the inconvenience caused by the rarefaction of the air at these great altitudes being attributed by them to subtle exhalations. On the road thither Capt. Gill passed the magnificent mountain Nen-Da, 22,000 feet high, and near the top of Ta-so he entered a little circular basin, surrounded on all sides but one by ragged precipices, with a pond of clear water at the bottom. On crossing the crest of the pass, he entered a large basin two miles in diameter, where a wild and savage scene presented itself to his sight: great masses of bare rock rising all round, torn into every conceivable shape by the rigour of the climate. The bottom of the basin was covered with the *débris* that had fallen from them, and some small pools of water in the hollows formed the sources of the stream, which eventually became a roaring torrent among the pine forests in the valleys below. Bathang, Capt. Gill found, had been recently rebuilt, after its destruction, a few years ago, in a frightful series of earthquakes, which, lasting for several weeks, devastated the whole neighbourhood. The town, he says, is chiefly remarkable for its immorality and its lamasery. Besides his description of the country Capt. Gill gave some interesting information respecting the habits of the Thibetans, contrasting them with those of the Chinese. Owing to their originally nomad mode of living they have no idea of inn accommodation, and the owner of a good house even will, as often as not, be found sleeping on the flat roof, whilst the hardy people in winter can sleep with their clothes half off and their bare shoulders in the snow; tables, chairs, and bedsteads are unknown in their houses. Thibet is a land flowing with milk and butter, the enormous quantity of the latter consumed by a Thibetan being very startling—butter in his oatmeal porridge, and huge lumps of butter in his tea. As a rule he does not drink much milk, which is mostly made into butter, but he is fond of sour cream, curds, and cheese; and this brings a Thibetan bill of fare to an end.

NEWS from Samarcand recently received gives some interesting descriptions of the district of Karatejin, which formerly belonged to Khokand but was afterwards ceded to Bokhara by the Russian Government. Karatejin, with the smaller districts of Dorwas, Wachia, and Shugnan, as well as the largest portion of Kojistan, are situated in the immediate neighbourhood of the plateau of Pamir. Karatejin in winter is completely isolated, and only during the summer months is accessible from the neighbouring districts. The manners and customs of its inhabitants are yet in the most primitive state. They have no idea of measures or weights, have neither markets, booths, caravans, nor indeed any institutions of public life. Theft is a thing unknown amongst them. Their occupation consists mainly in tending cattle, besides a little agriculture; everything is general property, as it were. If any family is short of provisions it is a matter of course that the next neighbour gives them what they may want.

THE *Pandora*, which is to be sent out by the *New York Herald* to the North Pole, has been re-christened at Havre the *Jeannette*. She leaves this week for San Francisco to complete her outfit, and starts next June for Behring's Straits. News has been received from Washington that there is no probability that funds will be appropriated this year for the intended Polar Colony of Capt. Howgate. No tidings have arrived yet from Capt. Tyson's preliminary expedition.

A CORRESPONDENT of the Hong Kong *Daily Press*, writing from Labuan, gives some interesting particulars respecting a scheme which, if carried out, may contribute much to the development of the resources of Borneo. An American company was formed for this purpose some time back, and obtained large concessions from the Sultan; but the policy of the United States government being to discourage in every way the extension of American commerce abroad, and the expenditure of any capital in foreign countries by its citizens, it has been deemed expedient to transfer the rights thus acquired to British merchants, and to leave to them the task of developing the enormous riches which now lie dormant in this beautiful island. For this purpose the steamer *America*, with representatives of both parties, went to Brunei, and the circumstances of the case having been explained to the Sultan, he not only consented to the transfer, but added to the former grants that of Gaya Island and the mainland opposite, including the magnificent harbour known as Gaya Bay, an enormous sheet of water said to be capable of sheltering the united fleets of the world. By this addition to the former grant the territory conceded now extends in an unbroken line from Kinarn's Bay, on the west coast, across the island to Sibuco, on the southern edge of St. Lucia Bay, on the east coast. This matter having been arranged, the *America* proceeded northwards, and, entering Maludu Bay, passed through the Malwalla channel to Sandakan. The approaches to this channel are very imperfectly surveyed, and abound with coral reefs and shoals not marked on the charts. From Sandakan the steamer went on to Sulu, and anchored in Membong Bay, about fifty miles south of the petty fort of Bhanuar, which has been held by Spain for the last two years. The Sultan of Sulu, when visited, expressed his hearty concurrence in any scheme which would tend to open up and civilise the rich and splendid provinces on the mainland now lying waste, and he at once confirmed the grants made by the Sultan of Borneo. Returning to Sandakan, the party proceeded up the Kina Batangan River in a steam launch, penetrating nearly two hundred miles into the interior, where no European vessel had ever been before, and then, having taken formal possession of their property at Sandakan, proceeded on their voyage to Labuan.

THE Rev. W. G. Lawes, the well-known New Guinea traveller and missionary, has communicated to the *Colonies* an interesting account of a visit which he paid, towards the close of last year, to the previously unknown village of Kalo, on the western bank of the Uanekela (or Kemp-Welch) River, which empties into Hood Bay, New Guinea, not far from Kerefunu. Mr. Lawes says that the village is laid out in streets and squares, all of which are kept scrupulously clean, being swept every day by the women. He induced one of the chiefs to accompany him some three miles up the river, which he found takes a sharp curve a little way above Kalo, and becomes narrower, but after about a mile it widens out again into a fine broad stream. It is said to be navigable for a long distance, and, according to native accounts, runs to Manumanu, in Redscar Bay. On the Kalo side of the river groves of cocoa-nut trees abound, and betel-palms are also plentiful, while on the east bank numerous and extensive plantations of bananas and sugar-cane were seen. Mr. Lawes states that the villages round and near Hood Bay are inhabited by a fine race of men, who are industrious and kindly-disposed, though at first shy and suspicious. They have a warlike character, but their hostility to each other would probably be soon removed if more constant intercourse were established among them. Cocoa-nuts are at present the only article of any commercial value which the natives possess, and it is probable that some day large quantities of *copra* will be exported from this part of New Guinea; no doubt, too, the country has other resources which are as yet undeveloped.

NOTES

IN reference to our article (vol. xviii. p. 235) referring to the very unsatisfactory manner in which the publications of the Geological Survey are produced and distributed, we have received several communications professing to indicate the causes to which this unfortunate condition of affairs is to be attributed, and suggesting means by which it can be remedied. It would scarcely be within our province—even f it were in our power—to point out the particular departments or the individual officials with whom the responsibility for bringing about this almost perfect deadlock rests. We do, however, feel ourselves called upon to give expression to that dissatisfaction which is so widely felt in scientific circles, both in England and abroad, at the slowness with which the survey is carried on, the dilatoriness with which its results are published, the exorbitant prices charged for the maps and memoirs, and the parsimonious manner in which they are distributed. And in doing so we are acting no less in the interest of the overworked and often underpaid officers of the survey, whose efforts are frequently wasted, and whose patient labours fail to obtain proper recognition, through the neglect of the publishing department in making known the results of their work.

As an instructive comment on the above, we may state that we have just received a magnificent series of maps illustrating the geology of Wisconsin and Colorado, along with a thick descriptive volume relating to the former state, full of beautiful chromo-lithographic illustrations of the peculiar geological phenomena to be found in the state. In execution and scientific accuracy these maps are equal to anything of the kind we have seen produced in Europe, and their liberal distribution by the Central and State Governments ought to make our own Government ashamed of its "penny-wise and pound-foolish" parsimony. The Colorado maps are issued, under the care of Dr. Hayden, by the Department of the Interior, while the Wisconsin volume and maps have the names of Messrs. Chamberlin, Irving, and Strong attached to them.

DR. JANSSEN has succeeded M. Puiseux in the astronomical section of the French Bureau des Longitudes, thus leaving vacant the post of geographer to the Bureau.

AT its session of July 1, the French Academy of Sciences elected Prof. C. Friedel to the vacancy in the chemical section resulting from the death of V. Regnault in January last. His chief competitors were MM. Cloez and Schutzenberger. Prof. Friedel occupies the chair of mineralogy at the École des Mines. His time is devoted, however, chiefly to chemical research, and he is at the present day the most prominent representative of the modern school of French chemists, who have grown up under the eye of Prof. Wurtz. His activity as an investigator began in 1856, and since that time he has chronicled a large number of valuable results won in various departments, but more especially in organic chemistry. His name is associated chiefly with extensive and elaborate researches on acetones, and on silico-organic compounds, and with the remarkable series of syntheses in the aromatic series by means of aluminium chloride, which for some time past he has been carrying out in company with Prof. Crofts, of Boston. Although his hair is streaked with grey, Prof. Friedel possesses a vivacity, energy, and devotion to his science, unexcelled by any of the younger chemists of the day, and promising a long-continued activity in the future.

AMONG recent deaths abroad we notice those of Prof. J. L. Chateau, of Ivry-sur-Seine, Prof. Labat of Bordeaux, and Prof. Ehrmann, formerly Dean of the Medical Faculty of Strasburg, who was aged eighty-six at the time of his death.

PROF. VIRCHOW is following up the cranial investigations which led him to assign a Turkish rather than a Slavic origin to the Bulgarian race. For this purpose he has recently received fifteen Bulgarian skulls from the battle-field of Kadiköi, which have been carefully prepared by the red-cross surgeons.

PROF. VIRCHOW has decided to resign his seat in the German Parliament. He takes this step solely because his parliamentary duties interfere with his scientific labours; and, while he may be a good enough politician, he thinks himself a better *savant*.

WE briefly alluded recently to the annual session of the Vienna Academy of Sciences. At this session Baron von Rokitansky was re-elected president for the coming year, and the Crown Prince Rudolph of Austria was named honorary member. The class for mathematics and natural sciences has lost by death during the past year among its regular members K. v. Littrow, and among the corresponding members, the astronomer, Santini, of Padua, and the physicists Weber and von Mayer. These vacancies were filled by the election of Prof. E. Weiss of Vienna to Littrow's chair, and by the election to corresponding members of the zoologist, Prof. v. Brauer, of Vienna, the physicists, Prof. G. T. Fechner, of Leipzig, Sir William Thomson, of Glasgow, and Prof. J. Schwann, of Lüttich. The triennial prize for the most fruitful contribution to physics was assigned to Capt. A. von Obermayer, for his researches on the influence of temperature on the friction coefficients of gases. Prizes for the discovery of comets have likewise been assigned to MM. Winnecke, of Strassburg, Coggia, of Marseilles, Tempel of Florence, and Swift, of Rochester, New York. The Academy has appointed during the past year a standing committee for ethnographical researches in Austria. Prof. Doelter, of Graz, who was recently sent by the Academy to make a study of the extinct volcano, Monte Ferru, on the island of Sardinia, has recently submitted to the academy a detailed report of his investigations. The analyses of the lavas would tend to place them among the more modern eruptive formations. Monte Ferru exhibits a variety in the character of its lava deposits rarely found among volcanoes thus far examined. The chief species described are normal phonolite, trachytic phonolite, sanidine-plagioclase trachyte, sanidine-augite trachyte, felspar with and without olivine, leucite-basalt, trachyte,-tufa, rhyolite and hornblende-andesite.

ARRANGEMENTS are being made in Paris for an interesting sequel in 1879 to the present exhibition, which shall be entitled "Exposition des Sciences appliquées à l'Industrie." It will occupy the old Palais de l'Industrie. Assurances of co-operation on the part of leading scientific and industrial personages have been so numerous, that the success of the undertaking is already well guaranteed. The programme defining the aims and limits of the exhibition will appear at an early date.

THE *Medical Times and Gazette* regrets to learn that Dr. Burdon Sanderson has resigned his post as Professor at the Brown Institution. The work he has done in this position has been of a kind that is above praise. It has been mainly directed to the investigation of the phenomena of contagion, and, coupled with that of Dr. Klein, also connected with the Brown Institution, has done much to instruct us in the structure, functions, and characteristics of the lymphatic system—to mention only one series of researches. We sincerely hope that the post will be filled by one who will continue and expand the work already commenced in this invaluable Institution.

THE new historical museum of Frankfort-on-the-Main was opened on June 14. The new museum now contains all the objects of antiquity and art which were hitherto distributed in various public buildings of the old city. Several local scientific societies have presented the whole of their collections to the new establishment.

THE foundation stone of the Chadwick Natural History Museum was laid last week. The building is to be in the public park, Bolton. At present the town, although the third in importance in Lancashire, does not possess a museum.

A LETTER from the Préfet de la Seine has been sent to M. Mascart, the Director of the French Central Meteorological Bureau requesting that arrangements be made to post the weather warnings at the Bourse, Pont St. Eustache, and Halles Centrales, three places where monumental barometers have been placed at the expense of the municipal exchequer. It is curious that Paris does not yet receive a single warning although warnings are sent daily to 1,500 parishes, most of them of the smallest description.

THE first number of *L'Electricité*, a French semi-monthly periodical, has been issued.

A GENERAL meeting of the Mineralogical Society of Great Britain and Ireland was held at 116, Victoria Street, S.W., on Thursday, July 5, R. H. Scott, F.R.S., in the chair. Prof. Harkness read a paper on "Cotterite," a new variety of quartz from Ireland. A paper by Prof. Heddle, of St. Andrews, on "A New Manganesian Garnet from several Localities in Scotland," was read by the Secretary. The Secretary also read papers on "Youngite," and on "The Artificial Production of Psilomelane," communicated by Mr. J. B. Hannay, of Owens College, Manchester; and on "Penwithite, a New Cornish Hydrous Manganesic Silicate from Cornwall," analysed and described by himself. The annual meeting was fixed for Wednesday, August 14, at 2.30 P.M., to be held at Dublin.

BESIDES those whose names we gave last week, Mr. A. Cowper Ranyard, Mr. F. C. Penrose, and Mr. Giles Loder have also sailed for America, to observe the eclipse of the sun on the 29th inst.

WE have received the July number of the *Pantiles Papers*, a monthly literary magazine and review published at Tunbridge Wells. We are glad to see that the journal pays some attention to science.

TWO aeronautical ascents have been made from the Paris Cour des Tuileries in balloons of 450 cubic metres filled with hydrogen gas; the first took place on June 30 by MM. Gaston Tissandier and Jules Godard, and the second on July 7 by MM. de Fonvielle and Albert Tissandier. Both balloons were guided by a N.W. wind. On July 7 the balloon travelled at a regular rate of nine metres per second. Some interesting observations were made. It was noticed that cumuli have a height sometimes twice as great as their horizontal dimensions. The summit was observed to reach an altitude of 3,500 metres when the base was floating at an altitude of 800 metres. These clouds play the part of humid conductors connecting inferior with superior strata, and their dissolution in the form of rain is connected with electric phenomena.

MR. BRYCE M. WRIGHT has reprinted in a separate form from the *Journal de Conchyliologie* his "Description of the New Genus *Delphinulopsis*, and of the New Species *Delphinulopsis lesourdi*."

THE Paris Jardin d'Acclimatation has just made a most extensive and valuable acquisition of animals from Nubia. It includes fourteen giraffes, seven elephants, ten lions, two young hippopotami, seventy dog-faced baboons, and a number of antelopes, panthers, birds, &c. Herr Reiche, of Hanover, who captured these animals on the banks of the White Nile, receives for them the sum of 10,000*l*.

THE ancient records of the monastery of Fulda, and other German cloisters, which have been recently published among the *Monumenta Germaniæ*, give detailed accounts of a visitation of grasshoppers in the year 873, surpassing in point of destructiveness even those prevalent of late years in America. The grasshoppers appear to have come from the East, and, after having devastated nearly the whole of France, perished in the Atlantic. They are described as having hidden the sun, and having been able to eat everything green on a hundred acres in the course of an hour. Spanish monastic archives relate likewise the appearance of grasshoppers in 873, which appears to be the first record of an invasion by these insects in Europe.

WE are asked to state, on behalf of the Sunday Society, that, through the praiseworthy liberality of Sir Coutts Lindsay, the proprietor and director of the Grosvenor Gallery, New Bond Street, the Summer Exhibition at this institution will be open on the three following Sunday afternoons, between the hours of two and six:—On Sunday, July 14, the gallery will be opened free to the subscribers and members of the Sunday Society, and on July 21 and August 3 to the public, by tickets, which will be issued by the Sunday Society. These will be forwarded by post on receipt of stamped envelope. All applications to be by letter to the Honorary Secretary, 19, Charing Cross.

WE give the following extract from a letter sent us by Mr. R. Chartres on recurring decimals of the form—

$$\dot{\cdot}abc\,..\,ka_1b_1c_1\,..\,\dot{k}_1,\ \text{where } a + a_1 = 9 = b + b_1 = \&c.$$

$$\tfrac{1}{19} = \dot{\cdot}05263157894736842\dot{1}.$$

Here we observe a remarkable connection between the figures. Beginning with the last figure 1 we notice that each figure is double of the one to the right of it, one being carried when the double is over ten. Thus the eighteen recurring figures can be written down in a moment. Similarly the twenty-eight recurring figures of $\frac{1}{29}$ can be written down at once by multiplying by 3, thus:—

$$\tfrac{1}{29} = \dot{\cdot}034482758620689655172413793\dot{1}.$$

$$\text{Generally, } \frac{1}{nr-1} \text{ (where } r = 10\text{)}$$

$$= -1 + \frac{nr}{nr-1} = -1 + \frac{1}{1 - \frac{1}{nr}}$$

= Sum of the terms after the first of a geometric series *ad infinitum* whose first term is unity and common ratio $\frac{1}{nr}$.

Now, to divide a decimal by nr is simply to divide by n, and remove the figures one place to the right; and since the last recurring figure will be unity, we can get the whole period by beginning with 1, multiplying by n, and placing it to the left.

M. BOREL, the French Minister of War, has prepared a decree, which has been signed by the President of the Republic, for establishing in the army a high school of war. Besides tactics and special lectures on military topics, pupils will be taught geodesy, topography, geography, and telegraphy. They will be taken from among officers who have been commissioned for some length of time.

ARTICLE No. V. of the third volume of "Hermathena" is an exceedingly able and interesting sketch of "Greek Geometry from Thales to Euclid," by Dr. G. J. Allman. At the outset it is stated that the present century is "characterised by the importance which is attached to historical researches, and by a widely-diffused taste for the philosophy of history." In mathematics Dr. Allman points to such works as Bretschneider's "Die Geometrie und die Geometer von Euklides"; Hankel's "Zur Geschichte der Mathematik in Alterthum und Mittel-Alter" (we are glad to find that our author's opinion of this work harmonises with the judgment we ventured to pass upon it in these columns); to Hoefer's "Histoire des Mathématiques" (1874), and to some others with which we are not acquainted. Dr. Allman opens his remarks with stating that "in studying the development of Greek science, two periods must be carefully distinguished. The founders of Greek philosophy—Thales and Pythagoras—were also the founders of Greek science, and from the time of Thales to that of Euclid and the foundation of the museum of Alexandria, the development of science was, for the most part, the work of the Greek *philosophers*. With the foundation of the school of Alexandria, a second period commences; and henceforth, until the end of the scientific evolution of Greece, the cultivation of science was separated from that of philosophy, and pursued for its own sake." In the course of forty-seven pages the investigation of what discoveries and advances are due to each geometer is most carefully and discriminatingly done, and the reader is put in full possession of the several authorities, and is thus in a position to try the correctness of Dr. Allman's deductions. We shall look forward to the continuation of the present paper which the writer promises.

AT a recent meeeing of the Birmingham Microscopical and Natural History Society, Mr. A. W. Wills exhibited the curious rotifer *Melicerta pilula* (figured by Mr. Charles Cubitt in the *Monthly Microscopical Journal* of July, 1872), which coats its tube with a wall of pellets consisting of *its own excremental pilules*. Mr. Wills gave an interesting description of the rotifer, and of his experiments with it. One of the specimens he exhibited had commenced the wall of its tube with the natural pellets, and had finished it first with blue pellets, and lastly with scarlet, according as he had fed it with indigo and carmine. After the meeting Mr. Wills gave the remainder of his specimens to Mr. Bolton for distribution among his correspondents.

IT is stated on the authority of a native Japanese paper, that the Hakubutsu Kioku (Exposition Bureau) of the Home Department proposes to erect a permanent exhibition building at Uyano, on the site of the National Exhibition held last year. It will cover about 700 tsuba of ground, and the frontage is to be 360 feet by 75 feet. On its completion it is intended to close the exhibition at Yamashita.

DR. MANZONI, of Bologna, has recently established the identity of the marl deposits of Upper Austria with those of the Renodale near Bologna, and describes eight varieties of echinoderms common to the two formations. Of these one still exists, and another is likewise found in chalk deposits.

THE philosophical faculty of Göttingen has offered two prizes of 1,700 and 680 marks for the best works on the causes affecting the changes in chemical composition of plants of the same species, such as climate, soil, fertilisation, &c. They must include a critical review of all facts hitherto gathered on this subject, and suggestions as to the best methods for completing our knowledge in this department, accompanied by the results of independent research in the directions indicated. Competitors must forward their work before August 31, 1880, and the decision will be announced March 11, 1881. They can make use of Latin, German, French, or English.

W. LANGE has sought to answer the question whether the silicium present in the sap of plants is in the form of silico-organic compounds, or not, and finds (*Ber. d. deutsch. chem. Gesell.*, vol. ii.) that it exists exclusively as a hydrate of silicic acid in very dilute solution.

FURTHER RESEARCHES ON THE SCINTILLATION OF STARS

THE results at which M. Ch. Montigny had arrived with regard to the influence of the atmosphere upon the scintillation of stars (see NATURE, vol. xiv. p. 562) have since been thoroughly confirmed by his further researches on this subject. The series of observations now comprises no less than 447 evenings, and the predominant influence of rain upon the intensity of scintillation may now be recognised as proved beyond doubt. We may here remind our readers that the intensity of scintillation is measured by the number of changes of colour which the star shows in the scintillometer during one second, and that M. Montigny has first proved that approaching moist weather increases this intensity. The frequent occurrence of wet days in the year from August, 1876, to August, 1877, has increased the average intensity from 71 to 76; but the following very dry autumn of 1877 brought down the average to 68 for that season.

M. Montigny has also given continual attention to the relation between the scintillation and the nature of the spectrum of any particular star. He has, as before, classified the 41 stars observed according to the three types of Father Secchi (of which type I. comprises the stars with four lines in the spectrum, type II. those with a number of fine lines or indistinct bands, and type III. those with broad bands and black lines), and for each type the new average intensity of scintillation is now given, each star in these comparative researches being reduced to an altitude of 60°. It appears now that the average for the first type has remained exactly the same as found before, while those for the other two types have changed but very little, although the number of observations has now risen from 611 to 3,025. These slight changes arise, doubtless, from the circumstance that the recent observations extend to 108 stars instead of 41. All these observations confirm, in the most definite manner, that fact which has already resulted from the first observations, and which M. Montigny expresses as follows:—"The stars possessing spectra with dark bands and black lines scintillate less than those with fine and numerous spectral lines, and considerably less than those possessing spectra with but a few principal lines."

Reserving the special data regarding the scintillation-intensities and the details of the stellar spectra for a further communication, M. Montigny now publishes a series of results respecting the colours of stars, which are of extreme interest.

The colours which the stars show in the scintillometer change in frequency from one type to another, and even between stars of the same type. For the same star the colours in their particular shades, in their frequency, and in their brightness, are further affected by temperature, the degree of atmospherical moisture, and the altitude of the star above the horizon. On the same evening, and under the most favourable atmospherical conditions, the number of colours and their brightness decrease steadily as the star rises in the east, and at a certain altitude they are no longer seen. In the west the reverse takes place, *i.e.*, the number of colours and their brightness increase the lower the star sinks, down to a certain altitude above the horizon, which changes according to the clearness of the atmosphere. If the star rises or sets, the limit at which the colours cease to be distinct is all the lower, both in the east and in the west, the finer and warmer the weather happens to be at the time. If the star has passed beyond this limit in rising or has not reached it in setting, it shows only a circle of a constant colour in the scintillometer, *i.e.*, of the colour peculiar to the star, and thus this apparatus offers an excellent means for determining the colours of stars.

The colours observed in scintillation are: red, orange, yellow, green, bluish green, blue, and violet. The difference in these colours is characteristic for the different star types, if we neglect the influence of the star's altitude and the condition of the atmosphere. Thus the red, which is the most constant colour for the three types, generally approaches the shade between the lines B and C of the solar spectrum in stars of the two first types, while stars of the third type give either a very dark red, or a bright cherry red, or very deep pink. The blue in stars of the first type is bright, and resembles steel blue in shade, while the blue in stars of the third type often shows a very dark shade, so dark sometimes that it becomes difficult to recognise it. When the weather was rainy the blue seemed generally to predominate amongst the other colours in all stars. Pure green was not so frequent than the other colours. Violet was also very rare amongst all the stars, but particularly amongst those of type III.; if this colour was visible in stars of the other two types, they were always near the horizon. Yellow was rarely absent; yellow of greater or lesser brightness predominated completely in a large number of stars when they were high above the horizon and had ceased to scintillate. Orange is very frequent amongst the colours of the stars of the third type, while they scintillate.

If we reflect upon this short sketch of the changes of colour of scintillating stars, we see at once how complicated this phenomenon is, and that, in order to obtain data of tolerable certainty, at least two series of observations must be made, one in dry and the other in rainy weather; and further, that the influence of the star's altitude must be determined, which can be done by dividing the observations into separate zones of five degrees each.

With regard to the colours of scintillating stars Arago has expressed the opinion that the colour observed at any special moment is the complementary colour to those rays of the light peculiar to the scintillating star which at that moment are absent in the eye or in the telescope. M. Montigny agrees with this view and confirms it by an observation which he made when, on some evening specially favourable for observation, he inserted a prism just when the circle produced in the scintillometer by the light of the star Capella was very sharp and showed bright colours; he then found the two arcs of the circle divided into different colours, and this could not have been the case if the colours seen without the prism had actually been present. M. Montigny, however, intends further to examine this question by means of the spectroscope.

Arago also raised the well-known question whether the scintillation of stars is the same for two observers stationed at different places. M. Montigny replies to this question in the negative, and this was Arago's opinion also; he found the colours of a star to be different for those rays which are differently refracted by the two halves of the object-glass. In the same sense M. Donders has noticed that the scintillation does not always show the same peculiarities for each eye of the same observer. Another circumstance may be cited here as another proof, viz., that a double star, both components of which are of the same colour, such as Castor and its companion, which are both white, does not always show the same colours in the scintillometer at the same angles of position. Although the angle separating these two stars amounts to but five seconds of arc, it yet suffices to produce different colours. This shows how greatly the appearance of stars in the scintillometer is affected by the smallest differences in the conditions under which they are observed, since two separate pencils of rays of the same colour travelling side by side and at the same moment may yet be changed to different colours on their passage through the atmosphere.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

The subject of the use and abuse of examinations is beginning to be agitated in Austria. Within a few weeks past, two students, one at Pest and the second at Graz, have committed suicide after failing to pass examinations for the doctor's degree. The latter of the two had completed a lengthy course of study, and was an assistant of recognised ability in the university.

During the past few years the educational institutions of Rome have been entirely reorganised. The university, as constituted at present, is without a theological faculty. It numbers sixty-four professors, twelve in the legal faculty, twenty-four in the medical, sixteen in the scientific, and twelve in the philological-philosophical. Nearly all the conveniences of a well-appointed university are now enjoyed by the students: a botanical garden, laboratories for physics, chemistry, and physiology; the new observatory on the Capitoline, with special institutes for geology, mineralogy, mathematical physics, pharmacy, comparative zoology and anatomy, pathological anatomy, and six clinics. During the past month the Minister of Education has issued a decree for the foundation of a school of archæology, which shall be amply equipped, and meet a want long felt in this centre of archæological investigation.

SOCIETIES AND ACADEMIES

London

Royal Society, May 23.—"Experimental Results relating to the Rhythmical and Excitatory Motions of the Ventricle of the Heart of the Frog, and of the Electrical Phenomena which accompany them," by J. Burdon Sanderson, M.D., F.R.S., and F. J. M. Page, B.Sc., F.C.S.

This paper, although of some length, is a condensed statement of experimental results, so that it scarcely admits of being abstracted. These relate, as stated in the first paragraph, to (1) the order and duration of the rhythmical and excitatory motions of the heart of the frog, (2) the normal electrical condition of the surface of the heart and the influence thereon of mechanical, chemical and thermal injuries, and (3) the characters of the normal and of the excitatory electrical variations, and the modifications of those characters which are induced by injuries of the surface, and under the temporary influence of radiant heat. As we have not space to reproduce the whole, we will confine ourselves chiefly to the very interesting experiments contained in the two last sections.

The authors begin this part of the subject with the statement that they have confirmed, by repeated experiment, the observations made by Engelmann in 1873, that all parts of the surface of the "resting" heart are equipotential, and that the electrical inequalities which are usually found whenever the surface of the organ is investigated, when in this condition, owe their existence to slight injuries; they then proceed to discuss the conditions which lead to the existence of electrical differences. These are (1) permanent injury of the surface, however superficial and slight in extent, and (2) the temporary influence of radiant heat. As regards permanent injury, their observations are substantially in accordance with the conclusions of Hermann as regards other excitable and contractile tissues, viz., that the death of a part renders it *negative* to all living parts of the same organ. Substituting for the word death (which, in order to express the whole truth, must be understood to include every degree of local lesion, however limited in extent or slight in degree) the expression "permanent injury," this proposition becomes adequate for its purpose.

The authors further find that the influence of radiant heat produces a modification of the electrical condition of a part, of which the sign is opposed to that of the electrical change produced by injury. They were led to this result by the consideration that if arrest of the chemical changes which constitute the life of a part renders it negative, it is probable that a momentary intensification of these changes will render it positive.

The fundamental experiment by which both facts are established is as follows:—Two points on the surface of the heart, which may be as near to each other as two millims., are connected with a galvanoscopic circuit, and found to be equipotential. A loop of platinum wire, heated by a current, is brought into the neighbourhood of one of them for one second. After an interval of about a second the warmed surface becomes positive: in a few moments this effect subsides. If, then, the hot wire is brought nearer so as to scorch the surface, however slightly, and then removed, the opposite effect—that of permanent injury—manifests itself. The same spot, which was before positive, now becomes negative in a very much greater degree; for whereas the temporary "positivity" scarcely exceeds 1-2,000th Daniell, the "difference" of potential produced by injury may amount to 3-100ths Daniell. On the physiological meaning of these effects the authors do not enter. An indication of their bearing is, however, given by the observation in the next section, which relates to the so-called variation of the heart. By variation is meant the electrical disturbance which accompanies, or rather precedes, each contraction of the ventricle. The fact that such a disturbance exists has been known for several years. It has also been recognised that it precedes the visible change of form by which the systole discloses itself. The authors now show that the disturbance consists of two phases having opposite signs—that in the first phase, which is of short duration, parts near the apex become positive to parts further from it; that in the second phase the opposite condition is observed; further, that the first phase is entirely over before the ventricle begins its contraction, whereas the second phase corresponds in duration with the period during which the ventricle is doing the greatest amount of mechanical work, and ceases at the moment of decline of the muscular contraction of the ventricle. These time relations of the two phases suggest the inference that in all probability the first phase corresponds with that of the negative variation of ordinary muscle, with which it agrees in sign, and that the second phase is more immediately associated with the muscular contraction. That this is so appears to be shown by the observation that if any two points of the rhythmically pulsating heart a and b, of which a is nearest to the apex, are investigated by suitable means during the period of systole, it is found that the variation observed (in which, so long as the surface is in its normal state, *a* becomes negative to *b* in the second phase) is modified by momentarily warming (in the manner already described) as follows:—When *b* is warmed *a* still becomes negative in the second phase; but the extent of the deflection is four or five times as great as before. When *a* is warmed, instead of becoming negative in the second phase, it becomes positive; in other words, the second phase is reversed. Permanent injury (as *e.g.*, by the closer approach of the hot platinum wire) produces similar results, with this difference: that whereas the modifications produced by radiation are transitory, and in fact pass off in a few seconds, those caused by injury are of much longer duration. All these facts seem to show that there is an intimate relation between the second phase and the act of contraction. The nature of this relation is matter for further investigation.

Linnean Society, June 20.—Prof. Allman, F.R.S., president, in the chair.—Mr. W. Catell was elected a Fellow of the Society.—Dr. J. Gwyn Jeffreys exhibited and made remarks on specimens of a new species of *Virgularia*, dredged by himself and the Rev. A. M. Norman in the Osterfjord, Norway, and which Dr. Danielssen will further describe.—Some gourds, probably the fruits of *Lagenaria vulgaris*, from Pekin, were shown by Mr. J. R. Jackson, of Kew. These, which were quite ornamental in form, had had their figure given them while in the living state by their being inserted into moulds, thus growing to the pattern desired.—A notice of some shells dredged by Capt. St. John, R.N., in the Korean Strait, was read by Dr. J. Gwyn Jeffreys. Of fourteen species enumerated six are now, for the first time, found living in the North Pacific as well as the Atlantic. *Nucinella ovalis* and *Kellia pumila*, supposed extinct, are thus shown recently living in the Korean region. Six other species are already known as inhabiting both oceans. No less than nine of the fourteen species are Coralline Crag fossils. The author finds this collection supporting his formerly expressed view, that mollusca common to the North Atlantic and North Pacific oceans may have originated in high northern latitudes, and have found their way to Japan on the one side and Europe on the other by means of the bifurcation of the great Arctic current.—Chas. B. Clarke read a paper on two kinds of dimorphism in the Rubiaceæ. The group in question is well known to be largely dimorphic, the variations chiefly consisting in the length of the style and stamens. The author now records dimorphism as follows:—1. Where the point of insertion of the stamens is altered, being situate in one form high above the middle of the corolla tube, and in another form at the base of the corolla tube—that is, subepigynous instead of epicorolline. 2. Where there are two kinds of fruit, viz. (*a*) a large fruit corresponding to a sessile flower, &c., and (*b*) a small fruit corresponding to a peduncled flower.—The Secretary read, for Capt. W. P. Armit, some notes on the presence of *Tachyglossus* (= Echidna) and *Ornithorhynchus* in North and North-East Queensland. It is shown that the Echidna occurs at Bellenden Plains, 18° S. lat., which habitat appears to be the most northern limit yet recorded in the Australian continent. The Ornithorhynchus is also met with 150 miles west of Georgetown and on the Leichardt River, about 18° S. lat.—Some remarks on the Echidna skull accompanying the above paper were made by Dr. J. Murie. Its comparison showed that, in all particulars, it agreed with that of the common *E. hystix*, and that supposed to be specifically distinct, to wit, the *E. setosa*. The New Guinea Echidna (*Acanthoglossus Bruijnii*) presents marked characteristic differences from both.—Prof. Oliver communicated a paper by Mr. N. E. Brown on the stapeliæ of Thunberg's herbarium and descriptions of new genera. Of eleven species of stapelia of Thunberg's determination, five only properly belong to the genus as now understood, and six belong to five different genera, two of which (*Trichocaulon* and *Diplocyatha*) are now characterised for the first time. *Sarcocodon speciosum* from the Somali land, and *Huerniopsis decipiens* from South Africa, are curious plants, the genera and species receiving a formal description.—The abstract of a paper on the shell of the bryzoa, by Mr. Arthur W. Waters, was taken as read.—The main points of observations on the white whale (*Beluga leucas*) exhibited at the Westminster Aquarium, were given orally by Dr. J. Murie. These notes chiefly related to the times and manner of breathing, certain outward peculiarities, visual organs and movements of body and tail in progression round the tank, along with other physiological topics. Respiration in and out of the water is not identical as to times and manner. A fungus (*Saprolegnia ferax*, Smith), that lately known as the "salmon disease," grew in abundance on the body of the whale, and no doubt acted prejudicially to the animal's health.

Mathematical Society, June 13.—Prof. H. J. S. Smith, F.R.S., vice-president, in the chair.—Mr. T. R. Terry was admitted into the Society, and Mr. J. D. H. Dickson was proposed for election.—Dr. Hirst, F.R.S., communicated a paper by M. Halphen, on the characteristics of systems of conics.—Mr. J. J. Walker read a paper on a method in the analysis of plane curves. This last paper was the development of a method of treating the intersections of a transversal with a plane curve which occurred to the author some years since; it contained, *inter alia*, a discussion, by the use of the method, of the problem of the inflexion-tangential curve for the quartic, with the determination of the co-ordinates of the tangential point in terms of the co-ordinates of the corresponding point of inflexion.—Mr. Tucker (hon. sec.) communicated the following papers:—On the calculus of equivalent statements, II., Mr. Hugh McColl; On the flexure of spaces, Mr. C. J. Monro; On the decomposition of certain numbers into sums of two square integers by continued fractions, Mr. S. Roberts, F.R.S.; On a new method of finding differential insolvents of algebraical equations, Mr. R. Rawson.—Questions were asked by Prof. Cayley, F.R.S. ("Has a solution been given of the statement that in colouring a map of a country, divided into counties, only four distinct colours are required, so that no two adjacent counties should be painted in the same colour?"); by Mr. Merrifield, F.R.S., on the uniform distribution of points in space; by Mr. Tucker, in connection with the announcement made in NATURE (vol. xvii. p. 104) of a second exception to Fermat's statement that all numbers of the form $2^m + 1$ are primes. The two exceptions now known are for $m = 5, 12$, in which cases $5 . 2^7 + 1$, $7 . 2^{14} + 1$ are factors respectively. Mr. Tucker suggested that $9 . 2^{21} + 1$, $11 . 2^{28} + 1$, &c., might be factors when $m = 19, 26$, &c.

Physical Society, June 8.—Prof. W. G. Adams, president, in the chair.—The following candidate was elected a Member of the Society:—Mr. R. H. Solly.—The Secretary read a paper by Prof. Hughes on the physical action of the microphone.—Sir John Conroy, Bart., M.A., read a paper on the light reflected by potassium permanganate. After referring to the results obtained by Haidinger and Stokes, and more recently by Wiedemann, he proceeded to describe his own experiments, which have been made by means of a very complete Babinet's goniometer provided with a vertical as well as a horizontal stage, so that the reflecting surface could be placed directly over the axis of the instrument. Sunlight, unpolarised or polarised in any plane by a Nicol, was used, and the moving arm of the instrument carried a direct-vision spectroscope with a "bright-spot" micrometer and a reflecting prism for bringing a second spectrum into the field. The colour of a surface, obtained by rubbing the crushed permanganate into a surface of ground glass with an agate burnisher, was found to vary with the nature of the light and its angle of incidence, and it further varied as the surface was immersed in benzene, bisulphide, or tetrachloride of carbon. With light polarised perpendicular to the plane of incidence, the dark bands in the reflected spectrum are far more distinct than when unpolarised or polarised perpendicularly to that plane. In the first of these three cases four bands are observed at angles less than 40°, and the blue end of the spectrum is very weak; as the angle of incidence increases the intensity of the blue rays diminishes: the dark bands gradually shift towards the blue end of the spectrum, and at about 60° a new band appears near D. With a still greater angle more of the blue rays are reflected and the bands fade away, those in the more refrangible part disappearing first. This displacement amounts approximately to 0·006 tenth-metre.—Prof. S. P. Thompson exhibited and described a cheap and efficient form of optical bench. Two straight oak bars, about two metres in length, are clamped together, as in a lathe-bed, and a number of slides carrying various appliances slide easily without shake, and can be fixed in any position by wedges. The several frames carrying the diffraction grating or edges, the eye-piece (with an engraved glass micrometer), &c., are so made, in wood, as to be capable of adjustment in any plane; and the instrument can also be employed for making photometric or other measurements. The mean of two determinations for the wave-length of certain red light gave 0·000629 as compared with Fresnel's figure, 0·000640, while the total cost did not exceed 3*l*.—The Secretary then read a paper by Prof. Ayrton, of the Imperial College of Tokio, Japan, on the electrical properties of beeswax and lead chloride. The index of refraction of the former substance increases in passing from the liquid to the solid state, and it therefore seems important, in connection with the electro-magnetic theory of light, to carefully measure the specific inductive capacity of a condenser made of wax, as it is cooled through its solidifying point. The rise in capacity, as the temperature falls from 80° C. to 60° C., is very striking, and the entire change was found to be in exact agreement with the changes known to occur in the index of refraction for light. An elaborate series of experiments was made, which sufficed to show that the results obtained were not due to any change in the distance apart of the plates (of copper) between which the wax was placed, caused by any shrinkage of this wax on solidifying. In consequence of a remark of M. Buff that lead chloride behaves as a metal, Prof. Ayrton has studied it as a dielectric, and he found a diminution of resistance by electrification; but as this result was not confirmed on subsequent experiment, the question was more fully investigated, when he found that, with an electromotive force under 1·75 volts, there is an increase in resistance, and above that amount there is a regular or irregular diminution. This limiting force is about that required to decompose water, and he concludes that the results obtained must be due to the damp contained in the lead chloride.

Entomological Society, June 5.—H. W. Bates, F.L.S., F.Z.S., president, in the chair.—Mr. J. A. Finzi exhibited a remarkable hermaphrodite specimen of *Anthocaris cardamines*. —Mr. Rutherford exhibited a series of large cocoons from Mount Camaroons, formed by the larvæ of a species of Bombyx allied to *Anapha panda*, Bdv. These cocoons varied in diameter from four to seven inches, and each one contained from 130 to 150 smaller cocoons, all of which were tenanted by a larva or chrysalis in various stages of development. It would appear that *Anapha panda*, like some other species of *Bombycidæ* is social, and that the larvæ unite to form an aggregate cocoon of sufficient strength to withstand the attack of enemies and probably extreme changes of temperature.—Mr. Rutherford also exhibited a specimen of a *Papilio* as a case of so-called "hermaphroditism", with asymmetrical markings on the wings which approached respectively *Papilio cynorta* and *Papilio Boisduvalianus*, thus creating an impression that those two forms were but the sexes of one species. These specimens were from the collection of Mr. F. J. Horniman.—Mr. Meldola exhibited photographs of two species of tropical orthoptera sent to Mr. Darwin by Dr. Zacharias as an illustration of protective resemblance in the very perfect leaf-like appearance of the fore-wings; and some small beetles of the genus *Spermophagus* and their cocoons, which had been found in a packet of seeds of *Cassio neglecta*, sent from Brazil by Dr. Fritz Müller to Mr. Darwin. The full-grown larvæ had emerged from the seeds, leaving the latter in a damaged condition, and had spun the small cocoons from which the beetles had issued, the insects having reached this country alive. Mr. Meldola also exhibited the proboscis of a sphinx moth caught by the narrow tube-like nectary of a pale yellow *Hedychium*, which had likewise been received from Dr. Fritz Müller, who states that sphinges are frequently found caught in this manner.—Sir Sydney Saunders communicated notes by Mi. M. Lichtenstein, on new ideas as to the life-cycle of aphidians, giving the results of considerable breeding experiments.—The Secretary read a paper from Dr. Fritz Müller entitled "Notes on Brazilian Entomology," in which the author gave the results of his observations on the odours emitted by butterflies and moths, as well as facts bearing on various other subjects more or less connected with the theory of evolution. In reference to this paper the wings of *Antirrhœa archœa* from Brazil, and of *Mycalesis drusia* from the Nicobars were exhibited, in illustration of the author's theory of "scent-fans."—The following papers were also communicated: "On some longicorn Coleoptera from the Hawaiian Islands," by Dr. Sharp. "On the Larvæ of the Tenthredinidæ, with Special Reference to Protective Resemblance," by Mr. Peter Cameron; and "On *Macropsebium coterelli*, and other New Species of Coleoptera from Lake Nyassa," by Mr. H. W. Bates. The author exhibited the remarkable longicorn beetle above designated, which possessed some prominent characters of the Prionidæ.

Royal Microscopical Society, June 5, 1878.—H. J. Slack, president, in the chair.—Major O'Hara and Dr. J. Edmunds were elected Fellows of the Society.—A paper by Prof. Keith, on the results of a computation relating to Tolles' ⅙-objective, was read by the Secretary.—Prof. Stokes read a paper on the question of a theoretical limit to the apertures of microscopical objectives, in which he showed that, theoretically, a pencil of rays from a radiant in glass (or under equivalent conditions) of 180° could be refracted by a single refraction at a spherical surface, so as to present to the second lens a pencil of about 81° free from spherical aberration; and, while not asserting the possibility of utilising the whole of the pencil of 180° in glass, he thought a very large part of it might be available in a practical construction—a far larger part than can be used with dry lenses. The subject was further discussed by Messrs. Ingpen, Stephenson, and Mayall.—The other papers were on the measurement of the diameter of the flagella of *Bacterium termo*, by the Rev. W. H. Dallinger; on the framework of the mastax of *Melicerta ringens*, by Mr. F. A. Bedwell; a translation by Mr. Kitton of a paper by M. Petit on some new genera and species of diatoms; and a note by Mr. J. H. Stephenson on the effect produced on *Pleurosigma angulatum* by stopping out the central dioptric pencil. Mr. Stephenson exhibited, after the meeting, *Pleurosigma angulatum*, with his new oil-immersion lens, under the conditions explained in his paper; and Mr. Mayall demonstrated the aperture of Tolles' ⅙-objective, by Abbe's apertometer, to be largely in excess of the maximum possible for dry lenses. Some extremely good slides of the mastax of *Melicerta* and *Conochilus*, mounted by Lord S. G. Osborne, which had been sent by Mr. Bedwell, were also exhibited.

Meteorological Society, June 19.—Mr. C. Greaves, F.G.S., president, in the chair.—J. C. Philips and W. S. Rawson were elected Fellows.—The following papers were then read:—The climate of Lundy Island, by A. J. H. Crespi, B.A., F.M.S. Lundy Island, from its geographical position, might be expected to have a mild, damp climate, with cool summers and warm winters, and a small diurnal range of temperature, and so, no doubt, it has, although certain local circumstances in addition to its peculiar configuration make the climate remarkably inclement, windy, and unpleasant. The island runs nearly due north and south, having an extreme length of four miles and a breadth of from 200 yards to 1,600 or 1,800; there is a nearly flat table-land or "top" running due north and south, having an altitude of 450 feet; shelter there is none, every current of wind sweeps the whole table-land. From the edge of this table-land the ground slopes away to the sea; sometimes the descent of the side-land is extremely abrupt, at other spots more gradual, while the side-lands are deeply cut by caves, precipices, small bays, and glens. All around the island the water is deep a few hundred yards off, while the currents are formidable, and tremendous seas break upon the rocks almost every day in the year. The *one* drawback of the place is the wind, so furious and continuous are the blasts first from one quarter, then from another, for days and even weeks. When gales occur, as they generally do at short intervals, the force of the wind becomes incredible: walls are torn down, gates and doors wrenched out of their fastenings, and the few buildings which can be blown down are more or less injured. Fogs are remarkable for their frequency and density, and are nearly always drenching. The rainfall is nearly 50 inches per annum. February and March are said to be the coldest months and August the hottest; the mean temperature of the year is about 50° or 51°.—On the auroral or magnetic cirrus, by the Rev. S. Barber, F.M.S.—Contributions to the meteorology of Natal, by Dr. R. J. Mann, F.R.A.S. This paper is a discussion of the observations taken at Maritzburg (2095 feet above sea-level) during the six years 1860-65; from it we learn that the summer of Natal is a season of copious rain and the winter a season of relative dryness; also that the former is a time of abundant and frequent cloud, and the latter a time of preponderant sunshine. The summer is consequently cooler in a material degree than it would otherwise be, on account of the frequent prevalence of cloud and the abundance of the rainfall; and the winter has its temperature materially raised from the constant occurrence of clear skies and bright sunshine. The mean annual rainfall was 31·13 inches, of which amount nearly 28 inches came down during the six summer months (October to March), and scarcely more than 2 inches during the four midwinter months (May to August). Thunderstorms are of frequent occurrence, the average exceeding seven per month from October to March. The thermometer rarely rises above 85° in the shade even in the summer months, unless a hot wind is blowing; it then mounts to somewhere between 85° and 97° according to the strength of the sirocco. The degree of humidity indicated by the dry and wet bulb thermometers when a hot wind is blowing varies from 25° to 52° of moisture. The highest temperature recorded during the six years was 97°·6, the lowest 29°, and the mean 63°·3.—Note on the mean relative humidity at the Royal Observatory, Greenwich, by W. Ellis, F.R.A.S. In this paper the author gives the mean relative humidity in each month of the year at 9 A.M. and 9 P.M., and the mean of the twenty-four hourly values, derived from the photographic records of the dry and wet bulb thermometers for the twenty years 1849-1868. The 9 A.M. value is smaller than the mean in summer and larger in winter; and the 9 P.M. value is larger than the mean throughout the year, but most in summer. The mean monthly values change little from April to August, and from October to February; and there is a great decrease between February and April, and a corresponding great increase between August and October. The mean for the year is 80·7.—On a method of sometimes determining the amount of the diurnal variation of the barometer on any particular day, by the Hon. R. Abercromby, F.M.S.—On the relative duration of sunshine at the Royal Observatory, Greenwich, and at the Kew Observatory, during the year 1877, by G. M. Whipple, B.Sc., F.R.A.S. The author having instituted a comparison of the amount of sunshine recorded at these two observatories, finds that the totals show that for the whole year the excess in the number of hours the sun shone at Kew over the number at Greenwich, amounted to 171. This difference is no doubt due to the direction of the wind, for Greenwich lying to the south-east of the chief part of London, and having also large manufacturing establishments on its northern side, is greatly shaded by cloud, probably in a great measure due to smoke, when the wind blows from W., N.W., or N., while at Kew, which is situated to the west of London, and is remote from factories and shipping, enjoys a larger percentage of sunshine with these winds. With winds from the N.E., S., and S.W., Kew has but slight advantage over Greenwich. With E. and S.W. winds the London smoke is driven over Kew, and its presence in reducing the transparency of the air is evident in the diminished amount of sun recorded, the quantities being only 81 and 65 per cent. of those registered at Greenwich.—Account of the atmospheric disturbance which took place in lat. 21° N., and long. 25° W., on January 27-28, 1877, by J. H. Cardew.—Notes on some remarkable cloud formations accompanying sudden and frequent changes of temperature and wind, by Capt. W. Watson, F.M.S.

VIENNA

Imperial Academy of Sciences, February 28.—The following, among other papers, were read:—On some sensations in the region of visual nerves, by M. Brücke.—On the galvanic polarisation of platinum in water, by M. Exner.

PARIS

Academy of Sciences, July 1.—M. Fizeau in the chair.—The following among other papers were read:—On sulphuric saponification, by M. Fremy. He expresses his satisfaction because this process, *without distillation* (which discoloured the fatty acids), is now become an industrial operation, as the Exhibition proves.—On a system of telephone without electromagnetic organs, based on the principle of the microphone, by M. du Moncel. A reference to recent results by Blyth, Hughes, &c., in this direction. He thinks some of the sounds heard in telephones connected with telegraph lines may arise from friction of the lines on their supports.—On diphtheria in the East and especially in Persia, by M. Tholozan. There is no record or tradition of croup, scarlatina, or diphtheritic or gangrenous angina in Persia previous to 1869. In that year and the next a small epidemic of scarlatina appeared. In 1874 an epidemic of diphtheria broke out in the south of Persia and spread towards the north and west. Particulars are given.—M. Friedel was elected member in the section of chemistry in room of the late M. Regnault.—Thermal researches on the chromates, by M. Morges. The electrolytic decomposition of the chromates is not comparable to that of the alkaline sulphates. The heat confined does not exceed 12,500 calories. The chromates are rather comparable (thermally) to the carbonates.—*Trombe* of May 15, 1878, in the department of Vienne, by M. De Touchimbert. This appears to have been very violent, uprooting strong trees, damaging houses, lifting railway carriages, and throwing persons down. Its course (about forty kiloms.) was from S.S.W. to N.N.E. and E. Its width was 1,000 to 1,200 m.; velocity about 44 m. per second; pressure about 220 kilog. per square metre.—On the deformations of the disc of Mercury during its transit, by M. Lamez. Calculation shows that an advance of 8 sec. on the theoretical instant of contact may have been produced by the ellipticity; and an advance was observed.—On a single liquid pile depolarised by the action of atmospheric air, by M. Pulvermacher. The exciting liquid, (dilute sulphuric acid, caustic potash, or sal ammoniac) is placed in a porous cylindrical vessel. The positive metal is a rod of amalgamated zinc placed in this vessel, and the negative consists of long bell-springs of fine wire (silver or platinum) coiled round the cylinder, their coils sufficiently apart to avoid capillary action. The wire is thus in contact at a great many points with the liquid which transudes the porous vessel, and the external air has a continual oxidising action on these numerous small surfaces of tangence, thus effecting depolarisation.—On a new mode of formation of glycolate of ethyl, by MM. Norton and Tchermak. This is by action of glycolide on ethylic alcohol.—On the action of chlor-hydrates of amines on glycerine, by M. Persoz. On heating, *e.g.*, glycerine with chlorhydrate of aniline, one easily obtains phenylised derivatives of glyceramine along with secondary products.—On anærobiosis of micro-organisms, by M. Gunning. With the aid of ferrocyanide of ferrosum, which he found an extremely sensitive reagent for oxygen, he had shown that the apparatus and media commonly used for culture of micro-organisms cannot be freed from oxygen by the methods recommended for this purpose. In a memoir to the Amsterdam Academy, he gives arguments for attributing the cessation of putrefaction solely to the death of the bacteria, caused by absence of free oxygen. M. Pasteur considers that putrefaction is sometimes stopped because the small organisms have passed into the state of germs.—On the "piedra," a new species of parasitic affection of hair, by M. Desenne. This consists of hard nodosities (visible to the naked eye) at regular intervals on the hair. It is met with in the province of La Cauca, Columbia. It is cured by greasing the head well, and is not contagious.—On the explanation of the effects of irrigations practised in the south of France, by M. Barral. These are important, not only on account of the matters brought by the water, and the satisfaction of the need of moisture, but on account of the reactions they favour in the layer of earth necessarily moistened, aërated, and put in contact with mineral or organic compounds.—Letter from Prof. Du Bois Reymond presenting two new volumes of his researches on the physics of the muscles and the nerves. They contain memoirs published since 1855.—A memoir by Prof. Villari was presented, on emissive power and the different kinds of heat which some bodies emit at 100°.

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