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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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GOVERNMENT AID TO SCIENCE

IN our present issue will be found a letter from Mr. Wallace on Science Reform, a subject which we lately brought before our readers, and which is attracting, at last, the attention which its immense importance demands.

We have the greatest respect for Mr. Wallace, and therefore willingly give him the opportunity of stating his views, though we entirely dissent from them, and though we regret to see such a question as this dealt with in what we must describe as a narrow spirit calculated to win only popular approval. Mr. Wallace's letter opens with a denunciation of the Education movement as a madness of the public mind, and with an imputation upon the Science Reform movement as a scramble for the loaves and fishes. It is only consistent with such an exordium that the benefits of Science should be depreciated, and that its cultivation should be spoken of as a matter more of personal than of national concern.

"The broad principle I go upon," says Mr. Wallace, "is this—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not available for the benefit of all." And further on he writes: "I maintain that all schools of art, or of science, or for technical education, should be supported by the parties who are directly interested in them or benefited by them." We understand Mr. Wallace to mean by these and many similar passages, that the main result of cultivating Science is merely the gratification of those directly engaged in the pursuit, and that they who do not take this personal interest in it derive little or no benefit from it; and hence, that it would be unjust to tax the bulk of the community to enable a few individuals to indulge their philosophical tastes. If that is not the position which Mr. Wallace desires to take up, we must declare our inability to understand the letter before us; if the position be tenable, we need hardly say that no greater error can be committed than that of seeking aid to Science from the State.

But is it tenable for a moment? Is it really necessary to tell any educated man of the nineteenth century that science, art, literature, with one or two other matters, are simply civilisation; and that civilisation affects, not particular classes, but whole communities? To confine ourselves to our own province, Science, does Mr. Wallace really believe that the discoveries of chemists, naturalists, astronomers, and physicists do not directly benefit even the ignorant masses who cannot appreciate them? Does he know of a single class, we might say a single tax-paying being in England, who does not derive direct advantages from contrivances and processes which place at his disposal properties of matter and laws of nature unknown to uncivilised people? The material results of scientific labour, such as superior clothing and dwellings, more varied food, better medical and surgical appliances, sanitary improvements, easier locomotion, are accessible to all in proportion to their means, however ignorant they may be of the scientific principles to which they are indebted for them,—as accessible to them as to the very philosophers by whom those principles were discovered and applied. Where, then, is the injustice of taxing all classes, in proportion to their means of commanding the results of science, for advantages which, if not so taxed, they would obviously gain at the cost of others? We are surprised to find it necessary to insist on truths of so elementary a character.

Justice to the taxpayer may be a good electioneering cry, but in such a discussion as the present it will command no hearing. The question for us to consider is whether the taxpayer shall possess greater material advantages than those he now enjoys, and by what agency they may be most efficiently conferred on him: whether, as a nation, we shall strive for a still higher civilisation, and how it is to be attained: whether these objects will come to us unsought, or whether, as a nation, we must exert ourselves vigorously and systematically to gain them. The resulting benefit to the taxpayer will, we need not doubt, far exceed the price he pays for it.

At present, the British taxpayer contributes to the maintenance of a Royal Observatory, of a School of Mines, of a Museum of Natural History, of a Museum of Art, of an Ordnance Survey. The advocates of the *status quo* are bound to show, not merely that catalogues of stars, collections of minerals, animals, statues, mosaics and paintings, and elaborate maps of the kingdom are useful to the taxpayer, but that no other institutions can be added to these with advantage to him, and that those we have named have attained to absolute completeness and perfection, admitting of no further development or improvement. The existence of these institutions settles, once for all, the principle that it is just to tax the community for Science. If not, abolish them. But if taxation for these particular objects be just—which even Mr. Wallace does not deny—then the question whether there are not other objects that should be added to them is one that may fairly be asked.

The examination of this question involves the passing in review of all existing, and all possible, scientific institutions, in order to select those which are properly matters of national concern; the principle of selection being that the nation should charge itself with those only which have the two-fold character of general utility and of being beyond the means of individuals to maintain; it also involves the consideration of the mode in which the scientific affairs of the nation should be administered.

A recent article in the *Pall Mall Gazette* powerfully exposes the failure of local, as contrasted with central, administration. The principles so ably contended for by our contemporary are perfectly applicable to the business of science. The time indeed is gone by for declamation against centralisation. The bugbear of the past has become the necessity of the present. Armies, fleets, railroads, telegraphs, commerce, literature, enterprise in every form, even well-ordered private households, as pointed out in the article to which we refer, are all examples of centralisation—and the tendency is daily to add to the catalogue. It might have been better that each man should suffice for himself, but as a matter of fact he does not. He relies on co-operation for the attainment of objects which he cannot compass alone, and however small the number who so unite for a common purpose, one usually directs the operations. What is true of individuals is true of a nation. Nothing that concerns the well-being of the community can be, or is, left to the

chance efforts of individuals; an organisation is formed with a directing, a centralised authority, to which the whole body defer.

This is now wanted in England for Science, which cannot be cultivated without system, nor can it be governed without system. In a former number of this journal an article from the pen of Prof. Roscoe gave an interesting picture of the scientific organisation of Germany, which may be taken as typical of the Continent. Their arrangements, which carry Government intervention to a point not as yet contemplated by anyone in England, so far from having the deadening effect imputed to Government aid, has produced in large numbers men of the highest attainments and the largest and most original views, and is developing a continuity of results of the greatest practical and theoretical value. The physical education and intelligence of the people is confessedly ahead of that which the same classes in England can boast. The arts in which we once justly claimed pre-eminence are in many instances now more advanced with them than with us mainly because the principles on which they depend are, more assiduously studied, and the artisans by whom they are practised more thoroughly instructed by them than by ourselves. Many branches of trade in England already painfully attest their superiority. As a matter of fact, individual enterprise, which it is so easy glibly to pronounce the incarnation of vigour, has not borne the fruit at home which Government support, with its supposed emasculating tendency, has yielded abroad.

Are we, then, to fall back in the race of nations, to see our trade and our manufactures dwindle away, and our naval and military systems take second rank, because there is an apparent noble independence in the attempt to do single-handed what single hands are proved incapable of doing? We assert that, other things being as nearly equal as variations in religion, customs, and form of government will admit, the degree of cultivation of Science by nations will ultimately determine their places in the human family. No nation on earth has a greater abundance of natural resources and of accumulated wealth than we; no people have higher gifts or nobler aspirations; none need less fear despotic interference from its Government; no nation, therefore, is better qualified to carry out a system which has proved so successful in less-favoured countries.

The question that presses for decision is, What shall we call on the Government to contribute to scientific advancement, and in what manner shall the scientific administration of the future be constituted? The present Government is ready, we doubt not, to perform its part, if only the necessity be shown by competent testimony to exist. It is the duty of men of science, who alone can speak on the subject with authority, to give this testimony, and to help the Legislature to place on a footing worthy of a great nation a department of its duties which has hitherto been, to a most injurious extent, overlooked.

THE THAMES SUBWAY

SEVERAL attempts have been made to pass under the Thames. The chalk and alluvial deposits of the valley at Gravesend would even now offer formidable, if not insurmountable, difficulties to the attempt, once made, to tunnel through strata with water sources so unmanageable. The Thames bed at Limehouse had hidden dangers, which, however, did not succeed in stopping the bold attempt, made some forty years since, to pass beneath the river—an attempt carried in fact to a successful issue in spite of innumerable difficulties, but at an overwhelming expense. The skill and ingenuity displayed were equal to the occasion, but the object attained was not commensurate with the magnitude of the work, and for years it served rather as a warning than an example to be followed.

A better geological knowledge of the Thames valley has, however, been gradually acquired during the last half-century; and it has become evident that while some parts of the valley present the greatest difficulties to the execution of any such work as a tunnel under the river, other parts present conditions singularly favourable for such works. It is found that the chalk *e*, Fig. 2, which disappears at Croydon and reappears at Watford, passes under London at a depth of from 200 to 300 feet; that next over the chalk come beds of sand, shingle, and clay, from 80 to 100 feet thick taken together, *c* and *d*; next above these is a single massive formation of clay, in round numbers from 100 to 200 feet thick under London, and acquiring a still greater thickness—as much as 450 feet—at places not far distant. This clay is so compact and tenacious, that, except in a few places, it is perfectly impervious to water. The various railways in the neighbourhood of London, as at Primrose Hill, Copenhagen Fields, Norwood, and elsewhere, show how readily tunnels can be made through it. It has also been ascertained that this clay, known to geologists as the London Clay, though thin and uncertain at Limehouse, dips westward from that place and gradually acquires a greater thickness, until at London Bridge it forms a mass 129 feet thick. It therefore became evident that while, at and below Limehouse, any tunnel passing under the Thames would have to pass through the soft and permeable beds of sand and shingle lying between the London Clay and the chalk—beds charged with water—forming in fact originally the great water-bearing beds under the London Clay at London, and therefore almost impassable to any tunnel under the Thames; above Limehouse, and thence to London Bridge, the gradually increasing mass of London Clay presents ground more and more favourable for the execution of such a work. If a place could be found where, on the one hand, without going to too great a depth, the alluvial beds on the surface and any accidents in the Thames bed itself, and on the other hand the beds of sands and shingle below the London Clay, could be avoided, while at the same time the intermediate London Clay was thick enough to allow of the passage of a tunnel and for a sufficient thickness of roof and floor, it was clear that at such a place the conditions for the construction of a tunnel would be as favourable as could be desired.

The first to apply this knowledge was Mr. P. H. Barlow, C.E., F.R.S., who fixed upon a spot intermediate between London Bridge and Limehouse (where the thickness of London Clay must be about 80 ft.), and at a sufficient distance below London Bridge to render an underground passage of the Thames a work of great public utility. A space of vacant ground near the western entrance to the Tower was obtained from the Crown; and on the Middlesex side a small wharf offered sufficient width for the tunnel to

pass under, and be carried to the shaft in Vine Street. Allowing for any likely greater depth of a former channel, or for any effect the river might have had on the clay, Mr. Barlow considered he would be safe in allowing a minimum thickness of 20ft. of London Clay to exist between the river and the top of the tunnel—a conjecture, the correctness of which has been fully proved in the execution of the tunnel; for not the slightest percolation of water from the river was detected during any part of the work. It is a question, in fact, whether a less depth might not have sufficed. Greater difficulties were apprehended in the making of the two shafts, as the gravel on either side of the river was known to be charged with water—that on the Middlesex side especially. On the north side of the river the ground rises at Tower Hill, and thence towards the City, to a height of about 40ft. above Thames high-water mark; and the London Clay is capped by a thick bed of gravel, the spring at the base of which supplies so many of the City pumps. This gravel, however, does not slope down to the river, but is cut off at the sloping ground. When the shaft on the north side came to

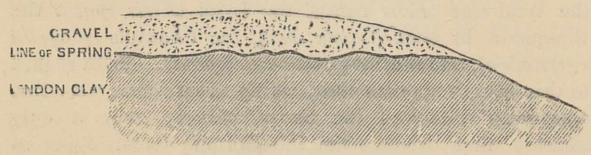


FIG. 1

be made, it was found, after passing this 14ft. of made ground, that the site of it was exactly on this intermediate hill of clay, and that the gravel which thinned out only a few feet higher had therefore been escaped. The shaft consequently was carried without difficulty through the 14 feet of made ground and 44 feet of London Clay to a depth of 58 feet. On the south side, the gravel, alluvial, and made soils, *a*, were found to be 35 feet thick, and charged with water, which rose and fell with the tide (highest just before low water) in the river, to the extent of 3 feet. By the use of iron-tubing, a passage through has been effected, although with more difficulty, and the shaft carried to a depth of 17 feet in the clay *b*, or a total depth of 52 feet. Between these two points Mr. Barlow laid the tunnel at a slight curve, so as to have a depth in the centre 18 feet greater than at the ends. The shafts have a diameter of 10 feet at top and 8½ feet at bottom. The tunnel is 7 feet in diameter, and is formed by cast-iron tubing in lengths of 1½ feet each, each ring being composed of thin segments with a key piece. An iron shield, devised by Mr. Barlow, was pushed on in advance of the work, and the tubes fixed in as soon as the requisite length of excavation had been completed, and the small space left between the clay and tube filled in at once by concrete. The work was carried on day and night, and advanced without interruption. No subsidence occurred in any part, and a regular and steady progress of 9 feet daily was made. Mr. Barlow, junior, is the engineer of the work, and Mr. Greathead the contractor; and the whole plan and execution of the work does very great credit both to the projector, Mr. Barlow, and to the engineer and contractor. With the exception of a slight leak in the iron tubing of the shaft on the south side, and which has been remedied after but a short delay, not the slightest mishap has occurred in the execution of the work, nor has a single fatal or even serious accident happened to any of the men. Last month the junction between the north and south side was effected, and the error of direction from the two ends was found not to amount to one inch. The passage under the river will be made in an omnibus, by means, probably, of a stationary engine; and lifts on either side will take the passengers up and down. A few minutes will suffice for the journey, and it is hoped that the work may be opened to the public in a few weeks. A remarkable feature of this interesting work has been its small cost. Mr. Barlow's estimate was 16,000*l.*, and it is now tolerably certain that the entire cost will be under 18,000*l.* Another feature has been the rapidity of execution. The shaft on the north side was commenced on the 16th of February last. On the 26th of April the tunnel, which is 1,320 feet long, was commenced, and on the 8th of October the passage under the river was safely effected. Before the public at large was aware that another Thames Tunnel was completed, the old London wonder has been duplicated.

As the object has been chiefly to speak of the geological problem, a section is annexed to show the structure of the ground at this part of the river.

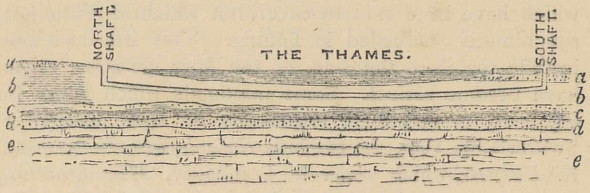


FIG. 2

Very few fossils were found, and these chiefly in the clay of the north shaft. They consist of *Cryptodon angulatum*, *Corbula globosa*, *Pinna affinis*, *Dentalum nitens*, *Fusus*, and column of *Pentencrinite*. In the tunnel pieces of wood pierced by the *Teredo*, and some teeth of Shark, were met with. As the London Clay thickens to the west and north-west, and extends uninterruptedly to Windsor on the one hand and to Watford on the other, covered in places near London by beds of gravel and sand, which never, however, exceed thirty to forty feet in thickness, and rarely exceed fifteen feet, there is thus in this area a formation which lends itself singularly well to the construction of subways and tunnels.

J. PRESTWICH

THE MAMMALIA OF SWITZERLAND.

Faune des Vertébrés de la Suisse. Par Victor Fatio Dr. Phil. Vol. I. *Histoire Naturelle des Mammifères.* (H. Georg, Genève et Bale, 1869.)

M. FATIO'S book is one which will be valuable to all Swiss naturalists, and to those who take an interest in the productions of the mountainous region of central Europe. It fulfils its function admirably as far as it goes, but, like all works treating of local Faunas or Floras, its general interest is diminished in proportion to the diminution of the area investigated. It has not, for example, the importance or value to a distant reader which such a volume as the "Naturgesch. der Säugethiere Deutschlands und Mitteleuropas" of Blasius possesses; but to local natu-

ralists it will be as useful as are the various volumes on British Zoology published by Mr. Van Voorst, to British zoologists. At the same time, there is always a gain where there is a loss in these matters : what we lose in comprehensiveness we gain in detail ; and accordingly in M. Fatio's book we find much that is valuable on account of the great care which he has taken in *personal* investigation ; whilst the interest of the whole subject is enhanced by the peculiar and varied conditions of the ice-ploughed Switzerland, to which it relates. Such a valley as that of the Rhone in the Valais presents conditions of climate and vegetation comparable with those of the southern shores washed by the Mediterranean ; whilst an extensive region of perpetual snow is within a few hours' walk of this favoured spot. The Alpine valleys of the Grisons, again, present peculiar conditions in their great elevation. M. Fatio finds, however, that the encroachments of man, and his destruction of forest, have a more powerful influence on the distribution of animals than mere circumstances of altitude.

M. Fatio gives the number of mammals inhabiting Switzerland in the wild state—that is, excluding the cat, dog, horse, ass, ox, sheep, and goat—as fifty-eight, or as sixty-one, if the rabbit (which is not indigenous, but has been imported of late years) be reckoned, and the two minute forms, *Sorex pygmæus* and *Mus minutus*, which have been said to occur, but which M. Fatio has not himself succeeded in finding. This list does not include the ibex, the stag, or the *Mus agrarius*, which have become extinct. Some mammals which occur in adjoining countries are remarkable for their absence in Switzerland : thus, the two bats *Rhinolophus clivosus* and *R. Euryale*, which occur in Lombardy, *Mus agrarius*, occurring near the Rhine on the north, and by Como to the south, *Arvicola subterraneus*, also found near the Rhine, and *A. Savii*, found in Lombardy, are not met with in Switzerland.

M. Fatio has increased the catalogue of Swiss mammals, as given by some of his predecessors, by the addition of nine species of bats, two insectivora, and four rodents, one of which is considered a new species altogether.

This new species of M. Fatio, is a little black mouse, very much like the common house mouse (*Mus musculus*), but having a very dark black-coloured fur ; the two presenting much the same contrast as do the *Mus rattus* and *Mus Alexandrinus*, which M. Fatio agrees with M. Arthur de l'Isle in considering one and the same species. The new mouse, however, which is called *Mus Poschiavinus*, from the locality where it was observed, presents more important differences when compared with *Mus musculus* than those of colour and proportion only, The palatine ridges in *M. Poschiavinus* are *four* in number, in place of *five* in the common species, and the anterior simple ridges are of a different form.

The strange thing about this little black mouse, which is found at Poschiavo in the Grisons, is that it lives on tobacco. It was first noticed in a tobacco-factory, and was found to make great ravages among the stores of the nicotian weed. When first caught, M. Fatio thought he had possibly got hold of young specimens of the black rat, but subsequently he obtained specimens bearing evident signs of maturity. It does not appear to have suggested itself to M. Fatio's mind, that his *Mus Poschiavinus* may be only a sample of the deleterious effect of indulgence in the noxious herb to which these rodents are addicted. What if this new black mouse is but a stunted race of the black rat? It would furnish an invaluable argument to the anti-tobacconists.

A very pretty coloured plate, representing two Poschiavinian mice helping themselves to cigars, illustrates the description of this species. It is not a little remarkable that an animal should normally feed on tobacco. Monkeys, as is well known to the frequenters of menageries, are exceedingly fond of the end of a cigar, and an elephant has been seen gravely to accept such an offering ; but one would have supposed that the amount of nicotine in a pinch of snuff was enough to make a mouse unwell. The indifference of these mice to the toxic action of tobacco, calls to mind the similar indifference on the part of pigeons (rodents are like birds in many things) to the toxic action of opium in the largest doses, as lately noticed by Dr. Weir Michell.

Among the rarer and more interesting forms noticed by M. Fatio as still existing, or as having existed—for he notices the contents of the quaternary deposits in Switzerland—are the Bear (*Ursus arctos*), the Wolf (*Canis lupus*), the Wild Cat (*Felis catus*), the Lynx (*Felis lynx*), the Bouquetin or Ibex (*Capra ibex*), the Chamois (*Capella rufricapra*), and the Stag (*Cervus elaphus*). With regard to this last, it appears that, eighty years since, very fine specimens inhabited the Swiss valleys ; now it only appears when driven from the German forests lying to the north ; its remains are found in quaternary deposits. The fallow-deer is represented neither in the present nor in the quaternary fauna ; the Roebuck, or Chevreuil, is the only cervine species still inhabiting the country. Wolves, lynxes, and wild cats are not uncommon in the forests of the Jura ; but the lynx has not been found in the quaternary deposits, which is noteworthy, since Dr. Ransom, of Nottingham, has found it in England in such beds.

The bear is commonest in the Grisons ; every year there is some bear-hunting to be done in these wild and elevated valleys. The ibex, though no longer found in the Swiss Alps, occurs in the immediately adjacent territory of Lombardy ; where, however, it is now strictly preserved. The ibex of the Alps, of the Pyrenees, of Siberia, and of Crete, each have very distinctive characters, in the direction and length of their horns, but are hardly to be considered as distinct species. Some naturalists, however, distinguish a second species in Spain, as *Ægyceros Hispanicus*, occurring farther south than the so-called *Ægyceros Pyrenaicus*. The domesticated *Capra hircus*, has no doubt largely taken the place of the indigenous ibex ; natural hybrids between the two are not uncommon. The industrious Swiss have sometimes exhibited to curious tourists an eccentric specimen of the common goat as a living ibex. M. Fatio mentions such an instance, which may put naturalist travellers on their guard. A specimen presented by the King of Italy may be seen in the Zoological Gardens, Regent's Park. The chamois are still very numerous in Switzerland, though the large herds of eighty and a hundred, which used to be seen in past times, are not now met with. A certain amount of care is exercised now in regard to the time of hunting, and the animals are allowed to breed in security, so that they are on the increase in localities

where they had become scarce. M. Fatio mentions an old hunter who boasted of having killed as many as 3,000 chamois.

The Alpine marmot, which is so common and so well known to Alpine tourists, is not the mammal which attains the highest elevation of habitat in Switzerland; another little rodent, the *Arvicola nivalis*, has that distinguished honour, living at a greater altitude than any other European mammal.

Both this species and the marmot live among the oases of rock and herbage which stand out amidst the vast masses of mountain ice. The Bobac marmot does not occur in Switzerland, being confined to the north-eastern districts of Europe. The Alpine marmot inhabits the Carpathians and the Pyrenees, as well as the Alps.

M. Fatio's book is illustrated by eight plates, giving figures of new or rare forms. Synoptical tables of the families and genera are also given, so as to enable the least experienced naturalist to determine with facility the species which may come before him. A second volume, to include the reptiles, batrachia, and fishes, and a third, treating of the birds, are soon to be brought out by the same careful and enthusiastic observer.

E. Ray Lankester

OUR BOOK SHELF

Mining Geology.—*Die Lagerstätten der nutzbaren Mineralien.* Von Johann Grimm. (Prague: J. G. Calve).

The author of this volume is an Oberbergrath, and also Director of the Imperial Mining Academy at Pribram. During the last seventeen years he has from time to time published notices of the mineral veins and other mining features of Transylvania, Hungary, and Bohemia; and he now presents to the public a general treatise or handbook of the useful minerals. His experience has not been wide enough to enable him to write a book that fully justifies the title he has chosen for it, and his acquaintance with the literature of his subject appears to be limited to the German language. But the book is the work of a practical man, is well arranged, and contains much useful information. Fresh illustrations even of well-known facts are always interesting, more especially when they carry with them some little features that are novel. In this respect, mining geologists in this country will find it worth their while to hear what Herr Grimm has to say of the minerals, veins, beds, faults, and other mining features of various parts of the Austrian Empire. A. G.

Practical Astronomy and Geodesy.—*Geographische Ortsbestimmungen mit Hülfstafeln.* 4to. pp. 88. By W. Valentiner. (Leipzig: 1869. London: Williams and Norgate.)

The purpose of the author was to afford the astronomers engaged in the great European Triangulation tables for facilitating the reduction of the observations made for finding azimuths and the altitude of the pole. The work is, however, of more than a transient merit, for it will probably be of much assistance to our Indian officers engaged in the great trigonometrical survey of the Peninsula, and some of the tabular matter might henceforth in a modified form be well included in works on higher geodetic operations generally.

The author, by differentiating some of the fundamental equations which connect the latitude of a place with the altitude of a heavenly body above the horizon, its declination, azimuth, hour-angle, and parallactic angle, shows the influence which the errors in the observed quantities exert upon those that are dependent upon them, and comes to the conclusion that circumpolar stars are best adapted for azimuth determinations. He especially recommends to the observers engaged in the arc measurement the star *Ursæ minoris*, which is seen at all hours with telescopes of about $1\frac{3}{4}$ to 2 inches aperture, and the succeeding formulæ have been calculated with special reference to that star. Thus, taking the fundamental equations, in which z, a, δ, t, ϕ, are the well-known symbols for zenith distance, azimuth, declination, hour-angle, and latitude respectively, the author obtains by division, transformation, and expansion, and substituting p for $90° - \delta$, the following elegant expression for the azimuth:—

$$a = p \sin t \sec \phi + M \sin 2t + N$$

The values of M and N being essentially dependent on t and ϕ alone, admit of tabulation with t and ϕ as arguments, and are given by the author for all latitudes between 36° north and 64°, this being the extent of the arc to be measured; t is given from ten to ten minutes.

The formulæ for the altitude of the pole are discussed very carefully on the same principles. The whole is the result of much labour, and M. Valentiner well deserves the sincere gratitude of the numerous computers whose work he has facilitated. B. L.

Manual of Physics.—*Lehrbuch der Physik, einschliesslich der Physik der Luft (Meteorologie), des Himmels (Himmelkunde), und der Erde (Physikalische Geographie).* Von Dr. Paul Reis. Erste Hälfte, pp. 256. (Leipzig: Quandt und Händel. 1870.)

This is the first half of a treatise on Elementary Physics from a highly scientific point of view. Dr. Reis considers that the principle of the conservation of force—as he puts it, "Die energie des Weltalls ist constant" (the energy of the universe is constant)—is at the root of all science, and that it is possible to deduce a large part of physics as a mathematical consequence of this principle. We confess to a little doubt whether it is advisable to introduce it in this form in the first instance in an elementary text-book. The attempt is one, however, that must be made no doubt at an early date, in some form or other.

The first instalment of the work contains an introduction of considerable length on the elementary ideas at the root of physics—such as space, time, matter, rest and motion, matter and force—the forces which appear in all phenomena, molecular, chemical, cohesion, adhesion, gravitation—and the fundamental axioms of physics, which he gives us in six statements not materially differing from Newton's three laws. After 80 pages out of 500 have been occupied in this way, we confess that we doubt whether sufficient room is left for the adequate treatment of the enormous range of subjects which is to follow. The mechanics of solids, fluids, and gases occupy the author for the next 100 pages, and the last 70 of this first part are given to wave-motions and acoustics.

The book is carefully worked, and full of examples for the student. The new form in which familiar things are presented makes it interesting to those who are acquainted with the subjects it treats of. It appears to be conscientiously brought up to the science of the present day, but we must reserve our opinion as to the question whether it accomplishes the task it proposes to itself, or whether, in its present form, it will be valuable as a text-book till the appearance of the second half, which completes the work. It claims to possess a plan of its own, and it must be estimated according to that claim.

W. J.

Meteorology.—*Die Theorie und Das allgemeine geographische System der Winde.* (Göttingen, 1869. London: Williams and Norgate.)

The author is an opponent of Dove's school of meteorologists. The facts discussed by him are well known, and far more concisely stated in any recent work on meteorology. The theories founded by the author on those facts are too fanciful, and of his speculations—founded on no facts at all—the least said about them the better.

ON THE PERIODICITY OF THE SOLAR SPOTS

MOST of our readers are aware that the Kew observers, Messrs. De la Rue, Stewart, and Loewy, have for some time past been engaged in investigations, which, as far as they have already extended, go to show that there is an intimate and, as yet, unexplained connection between the configuration of the planets and the position and number of the spots on the sun. This result, which at once seems to land us in a sort of modern astrology, and which is so extraordinary, is, we suppose, on that ground, for we know of no other, questioned by many European astronomers. In this state of the case, no apology is needed, then, for reproducing, from the *Proceedings* of the American Philosophical Society, the results of a recent independent investigation of this subject by Dr. Kirkwood, together with some historical matter of some interest.

Dr. Kirkwood commences by reminding us that the most ancient observations of sun-spots of which we have any record, are those of the Chinese in the year 321 A.D.; the first notice of their detection by Europeans being found in the annals of the Frankish kings. A black spot, according to Adelmus, was seen on the sun's disc, March 17th, 807, and continued visible 8 days. Similar phenomena were again observed from the 28th of May to the 26th of August, A.D. 840. The year 1096 was also signalised by the appearance of spots so large as to be visible to the naked eye. The next date, in chronological order, is that of 1161, when a spot was seen by Averroës. Finally, on the 7th, 8th, and 16th of December, 1590, "a great blacke spot on the sunne," apparently "about the bignesse of a shilling," was observed at sea by those on board the ship "Richard of Arundell." The foregoing are, we believe, the only undoubted instances in which these phenomena were observed previous to the invention of the telescope.

From 1610 to 1750 the sun was frequently observed through instruments of various optical power, and the sparseness, or even the entire absence of spots, during considerable intervals of time, as well as their great number and magnitude at other epochs, were noticed by different astronomers. We come now to a most interesting and most remarkable epoch in the history of solar physics—an epoch in which the periodicity of the spots gradually come out.

The 11-Year Period of Schwabe.—In 1826, Hofrath Schwabe, of Dessau, commenced a series of sun-spot observations, which have been continued without interruption to the present time (1869).

Schwabe has shown a very marked periodicity in the spots; the interval between two consecutive maxima or minima being, according to him, about 10 years. Soon after the announcement of this interesting discovery, Dr. Lamont, of Munich, detected a corresponding decennial period in the variation of the magnetic needle; the epochs of maxima and minima in the latter coinciding with those in the former. These results have also been confirmed by other observers in places quite remote from each other; so that the decennial *magnetic* cycle may be regarded as well established. The equality of this period with that of the solar spots naturally suggested the hypothesis of their intimate relationship. Such a causal connection may be difficult of explanation; the fact, however, is placed beyond doubt by the researches of Wolf and Sabine.* The former, besides carefully observing the sun-spots since 1847, has discussed all accessible recorded observations, both solar and magnetic, bearing on the subject. He had thus ascertained a number of epochs of maxima and minima anterior to those observed by Schwabe,—from all of which he has determined the period of the spots to be 11·11 years. He undertakes to show, moreover, that this period coincides more exactly with that of the magnetic variation than the 10-year cycle of Lamont.

The 56-Year Period.—Besides Schwabe's period of 11 years, Wolf finds a larger cycle of 55 years, in which the solar activity passes through a series of changes. It is not, however, so distinctly marked as the cycle of Schwabe. Its last maximum was about 1837, and that preceding, about 1780.

The 233-Day Period.—Professor Wolf, after carefully discussing his own and Schwabe's observations, claims to have discovered two or three minor periods of solar activity. "By projecting all the results in a continuous curve, he finds in it a series of small undulations succeeding each other at an average interval of 7·65 months," or 233 days.

The 27-Day Period.—The same astronomer thinks he has detected a short period of variation corresponding to the sun's time of rotation with respect to the earth, or about 27 days.

The 584-Day Period.—De la Rue, Stewart, and Loewy, have found a period varying between 18 and 20 months; the mean being about 584 days. Other periods of maxima and minima will probably be detected; but those we have enumerated are perhaps the only ones sufficiently well established to justify any attempt at explanation.

That the solar spots are produced in some way by the planetary disturbance of the photosphere, is now generally admitted. As yet, however, the manner in which this influence is exerted can be little more than matter of conjecture. If the action is analogous to that of the moon on the earth, the relative disturbing power of the different members of the system will be as follows: *

Name.	Mass.	In Aph.	At M. Dist.	In Perih.
Mercury	$\frac{1}{4\,8\,6\,\frac{1}{3}\,7\,5\,1}$ (Encke)	63	111	219
	$\frac{1}{3\,0\,0\,0\,0\,0\,0}$ (Leverrier)	102	180	355
Venus	$\frac{1}{4\,0\,\frac{1}{3}\,2\,1\,1}$	203	207	211
Earth	$\frac{1}{3\,1\,4\,\frac{1}{7}\,6\,0}$	95	100	105
Mars	$\frac{1}{2\,9\,9\,\frac{1}{4}\,7\,5\,0}$	2	3	4
Jupiter	$\frac{1}{1\,0\,\frac{1}{3}\,4\,7}$	194	214	236
Saturn	$\frac{1}{3\,\frac{1}{3}\,9\,6}$	8	10	12
Uranus	$\frac{1}{2\,2\,\frac{1}{3}\,9\,9}$	0	0	0
Neptune	$\frac{1}{1\,5\,\frac{1}{3}\,8\,0}$	0	0	0

The connection between the number of sun-spots and the positions of the planets was noticed by Wolf as long since as 1858. In the interesting memoir of De la Rue, Stewart, and Loewy, the causal connection between the positions of Venus and Jupiter and the behaviour of sun-spots seems to be clearly established. An inspection of the Table shows that writers generally have given undue weight to Saturn's influence. Again, although Mercury's action at aphelion is but feeble, and even, at his mean distance, less than that of Venus or Jupiter, his perturbing power at *perihelion* is the greatest of all planets—a fact which certainly demands consideration in any theory which refers the origin of solar spots to planetary agency. After giving the subject much study and attention, Dr. Kirkwood deems it impossible, *without the introduction of any modifying cause*, to establish a general correspondence between the different sun-spot periods and those of regularly recurring planetary configurations.

But the hypothesis that a particular portion of the sun's surface is more favourable to spot formation—or, in other words, more susceptible to planetary influence—than others, will, he believes, obviate all difficulty. Is

* These magnetic variations, which will not be discussed in the present paper, are mentioned to give completeness of view to the phenomena under consideration. It is also worthy of remark that the Aurora Borealis is believed to exhibit a corresponding periodicity. [We believe that Sir E. Sabine was the first to remark the connection between sun-spots and magnetic disturbances.—ED.]

* The table is derived from the formula $\delta = \frac{m}{a^3}$, where δ represents the disturbing power of a planet, m its mass, and a its distance.

there, then, any independent probability of the truth of this hypothesis? It is well known that the formation of spots occurs chiefly between particular parallels of *latitude*, and that the numbers are greater in the northern than in the southern hemisphere. It seems, therefore, at least not improbable that a like difference may exist in regard to *longitude*. "Sömmering directs attention to the fact, that there are certain meridian belts on the sun's disc, in which he had never observed a solar spot for many years together."* Buys-Ballot, of Utrecht, has found, from an elaborate discussion of a great number of meteorological observations, that there is a short period of variation in the amount of solar heat received by our planet; the period from maximum to maximum coinciding, at least approximately, with that of the sun's rotation with respect to the earth. Sir William Herschel also believed that one side of the sun, on account of some peculiarity in its physical constitution, was less adapted to radiate light and heat than the other.

On Dr. Kirkwood's hypothesis, the sun-spot period would be equal to the interval between two conjunctions of the disturbing planets on the heliographic meridian (designated by M) of that part of the surface most susceptible to their influence. It would depend, therefore, on the ratio of the sun's period of rotation to the interval between two consecutive conjunctions of such planets. Or, as Mercury's influence is extremely variable, a maximum would be produced by this planet's perihelion passage, when the most susceptible part of the sun's surface had the same, or nearly the same, heliocentric longitude. In order, then, to test this hypothesis, we must first inquire what is the most probable period of the sun's rotation?

On account of the *proper* motion of the solar spots, the time of the sun's rotation as determined by their *apparent* motion across the disc, varies from about 25 to 29 days. The *proper* motion of the spots has recently been discussed with great labour and ability by Professor Spörer, of Anclam, and Mr. Carrington, in England, who have shown conclusively that the rapidity of movement varies regularly with the latitude. The equatorial portions have the greatest angular velocity; in other words, the proper motion of the spots is in a direction contrary to that of the sun's rotation. The formulæ by which the astronomers named expressed the law for the dependence of the sun's apparent period of rotation on the latitude are as follows:—

According to Carrington, $\xi = 865' - 165' \sin \frac{7}{4} l$ . . (1)

" " Spörer, $\xi = 16{\cdot}8475^\circ - 3{\cdot}3812^\circ \sin (41^\circ\ 13' + l)$ . . . . . (2)

where ξ is the arc described in a solar day. The true time of rotation is supposed to be that indicated by an equatorial spot; and on this assumption, (1) gives

$$P = 24{\cdot}9711d. = 24d.\ 23h.\ 18m.\ 23s. \quad . \quad . \quad . \quad . \quad . \quad (3)$$

or, (2) gives

$$P = 24{\cdot}62447d. = 24d.\ 14h.\ 59m.\ 0s. \quad . \quad . \quad . \quad . \quad . \quad (4)$$

The true value is probably between the results here given.

But will this modifying element in the theory of planetary action afford a satisfactory explanation of the periodic recurrence of maxima and minima of solar spots? Let us consider.

(*a.*) *The* 11-*Year Cycle.*—The anomalistic period of Mercury is 87·9702*d.*, and

$$87{\cdot}9702d. \times 46 = 4046{\cdot}6292d. = 11{\cdot}077y. = T_1 \quad . \quad . \quad (5)$$

This is very nearly equal to Wolf's value of the cycle, and agrees at least equally well with recorded facts.†

Again, $\frac{T_1}{163} = 24{\cdot}82594d. = 24d.\ 19h.\ 49m.\ 21s.$ . . (6)

which is nearly a mean between Spörer's and Carrington's values of the sun's period of rotation. With this, therefore, as the time of the sun's axial revolution, we have 46 times the period of Mercury—equal to 163 times that of the sun's rotation. The recurrence of maxima at mean intervals of 11·077 years would thus be accounted for.* Again, the epochs at which sun-spots were seen before the invention of the telescope may be presumed, with much probability, to have been nearly coincident with the maxima epochs of Schwabe's cycle. Now, it is a remarkable fact that all of those dates, except perhaps the last, harmonise with the value which we have adopted for Schwabe's period of variation. Thus:

From 321, A.D.	to	1860,	we have	139	periods of	11·072 +	yrs. each.
,, 321	,,	807	,,	44	,,	11·045	,,
,, 807·22	,,	840·5	,,	3	,,	11·093	,,
,, 840·5	,,	1096	,,	23	,,	11·109	,,
,, 1096	,,	1161	,,	6	,,	10·833	,,
,, 1161	,,	1590·9	,,	39	,,	11·024	,,
,, 1590·9	,,	1750·0	,,	14	,,	11·367(?)	,,
,, 1750·0	,,	1829·0	,,	7	,,	11·286	,,
,, 1829·0	,,	1860·5	,,	3	,,	10·500	,,

The variability of the period will be hereafter considered.

(*b.*) *Wolf's Cycle of* 56—57 *Years.*—The synodic revolution of Mercury is 115·87748*d.*, and

$$115{\cdot}87748d. \times 177 = 20510{\cdot}31396d. = 56{\cdot}15324y. = T_2 \quad (7)$$

In this period the line of conjunction of Mercury and the earth advances 56·15324 revolutions. Now,

$$\frac{T_2}{826{\cdot}15324} = 24{\cdot}82628d. = 24d.\ 19h.\ 49m.\ 50s. \quad . \quad . \quad (8)$$

This value of the sun's period of rotation differs from that in (6) by only 29 seconds. Adopting it, therefore, we find that Mercury and the earth will be in conjunction on the same heliographic meridian at regularly recurring epochs of 56 years and 56 days.

(*c.*) *The* 233-*Day Period.*—The mean interval between the consecutive conjunctions of Venus and Jupiter is 236·992*d.* The close agreement of these periods leaves little room to doubt that the latter is the true period of spot variation.

(*d.*) *The* 27-*Day Period.*—This is at once satisfactorily accounted for.

(*e.*) *The* 584-*Day Period.*—The identity of this period with that of the synodic revolution of Venus has already been indicated by De la Rue, Stewart, and Loewy.

Remarking that Dr. Kirkwood advances other facts in support of his argument, we pass at once to his conclusions.

1. A connection between the behaviour of sun-spots and the configurations of certain planets has been placed beyond reasonable doubt.

2. The theory, however, of spot formation by planetary influence is encumbered with anomalies and even inconsistencies, unless we admit the co-operation of a modifying cause.

3. The hypothesis that a particular part of the solar surface is more susceptible than others to planetary disturbance is rendered probable by the observations of different astronomers.

4. The 11-year cycle of spot variation is mainly dependent on the influence of Mercury.

5. The marked irregularity of this period from 1822 to

* Humboldt's Cosmos, vol. iv., p. 378.

† The following astronomical cycles are also nearly equal to this period of variation:—

1. 18 periods of Venus = 11·074*y.*	4. $17t_1 = 11{\cdot}030y.$
2. 35 syn. per. of Mer. = 11·104	5. $28t_2 = 11{\cdot}082$
3. 1 period of Jupiter = 11·860	6. $45t_3 = 11{\cdot}063$

where t_1 = the syn. per. of Venus with respect to Jupiter; t_2 = syn. per. of Mercury with respect to Venus; and t_3 = that of Mercury with respect to Jupiter.

* It is not probable that Mercury is on the meridian M precisely at the epoch of perihelion passage. It is only necessary to suppose this coincidence to occur when the planet is *near* the perihelion point. Even at the distance of 20° the diminution of the disturbing power would be extremely small.

1867, is in a great measure due to the disturbing action of Venus.

6. Wolf's 56-year cycle is determined by the joint action of Mercury and the Earth. And,

Finally, *the hypothesis proposed accounts, as we have seen, for all the well-defined cycles of spot-variations.*

NOTE ON THE CORRELATION OF COLOUR AND MUSIC

WHILST engaged in the preparation of an article on the Analogy of Light and Sound for the current number of the *Quarterly Journal of Science*, I was led to examine the grounds of the frequently-assumed relationship between the colours of the solar spectrum and the notes of the musical scale. It is well known that Newton found a connection between the relative spaces occupied by each colour and the relative vibrations of the notes of the scale. But this, I presume, cannot be more than an accidental coincidence. The common basis of comparison is obviously the ratio of the wave-lengths in the two cases. Although according to the tables given in text-books no satisfactory connection can be found, yet many considerations appear to justify a stricter comparison of these natural scales of colour and sound.

The ratio of wave-lengths of the two extremes of the spectrum is usually taken as 1 : 0.57, or corresponding to the interval of a seventh in music.

But this statement is only true when a glass prism is employed; the ultra-violet rays are then suppressed. Substituting quartz for glass, light of higher refrangibility is seen: the limits of the spectrum can thus be extended from the solar line A to the solar line L.* Now, the wave-length of A (according to Ångström) is 760 millionths of a millimetre, and the wave-length of L (according to Mascart) is 381 millionths of a millimetre, or as the ratio of 1 : 0·50, exactly corresponding to the interval of an octave in music.

The ratios of the extreme colours of the spectrum and the extreme notes of an octave are coincident.

The next object is to compare the ratio of wave-lengths giving rise to the intermediate colours of the spectrum with the ratio of wave-lengths giving rise to the intermediate notes of the scale.

The most careful localisation of the colours of the spectrum with which I am acquainted is that by Prof. Listing.† In his recent memoir on the wave-lengths of the spectra of the metals, M. Thalén gives Prof. Listing's estimation of the extreme limits of each colour as follows:‡

TABLE I.

Name.	Limiting Wave-lengths in ten-millionths of a millimetre.
Red	7234 to 6472
Orange	6472 to 5856
Yellow	5856 to 5347
Green	5347 to 4919
Blue	4919 to 4555
Indigo	4555 to 4241
Violet	4241 to 3967

Taking the *mean* of the two limits to represent the average wave-length of each colour, we have the following series:—

TABLE II.

Name.	Mean wave-lengths in ten-millionths of a millimeter.	Ratio.
Red	6853	100
Orange	6164	89
Yellow	5601	81
Green	5133	75
Blue	4737	69
Indigo	4395	64
Violet	4104	60

* Mr. Crookes informs me that on favourable occasions he has even seen beyond L.

† Poggendorff's "Annalen," 1868, vol. 131, p. 564.

‡ Trans. Roy. Soc. Upsal, third series, vol. vi.: also Annales de Chimie et de Physique, October 1869, and NATURE, No. 2.

Calling the wave-length of the mean red 100, the numbers in the third column express the corresponding ratios of the mean wave-lengths of the other colours.

In the next table is given the similar data as regards sound. The *first* column contains the names of the musical notes; the *second* their actual wave-lengths starting from the middle C; the *third* column gives the relative wave-lengths in fractions of C; and the *fourth*, the ratio without fraction, C being taken as 100.

TABLE III.

Name.	Wave-length in inches.	Ratio of wave-lengths.	
C	52	1	or 100
D	$46\frac{1}{3}$	$\frac{8}{9}$	89
E	42	$\frac{4}{5}$	80
F	39	$\frac{3}{4}$	75
G	35	$\frac{2}{3}$	67
A	31	$\frac{3}{5}$	60
B	$27\frac{1}{2}$	$\frac{8}{15}$	53
C_2	26	$\frac{1}{2}$	50

Placing together the ratio given in the last columns of Tables II. and III., the following remarkable correspondence comes out:—

TABLE IV.

Colour.	Ratio.	Notes.	Ratio.
Red	100	C	100
Orange	89	D	89
Yellow	81	E	80
Green	75	F	75
Blue . 69 / Indigo 64 } mean,	67	G	67
Violet	60	A	60
[Ultra-Violet	53]	B	53
[Obscure	50]	C_2	50

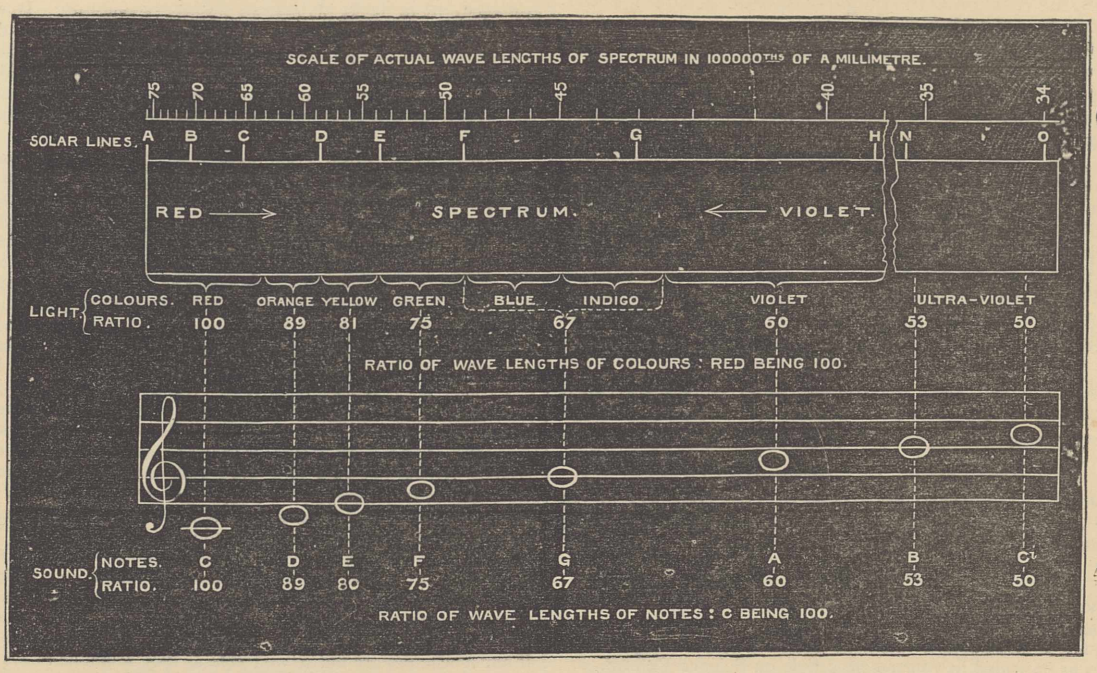
Assuming the colour *red* to correspond to the note C, then we find *orange* exactly corresponds to D; *yellow* is almost exactly the same as E; and if we take the wave-length of E from observation and not from theory, we have 52 : 42 = 100 : 80·8, a still closer approximation to yellow. The ratio of green is identical with that of F. *Blue*, however, does not correspond to G, nor *Indigo* to A; but blue and indigo are practically one colour in the spectrum,—the line of demarcation, difficult to fix between any other colours, is impossible to be established here. I think, therefore, I am justified in putting them together, and if we do so we find their mean ratio exactly corresponds to G. Violet now exactly corresponds to the ratio given by A. Here all distinct colour ends. But beyond this region Sir John Herschel detected a lavender colour, which finally shades away into a dusky grey. The wave-length of this ultra-violet region is not given by Prof. Listing; hence the ideal position is calculated and inserted in the table within brackets. As the lower C is placed at the *mean* red, the upper C would then correspond to a region in the spectrum altogether obscure: viz., at the solar line O. But as already stated above, if we place the lower C at the *extreme* red, then its higher octave would fall on the line L, or within the range of vision.* The great difference of position thus produced at the violet extremity by a slight movement at the other end of the spectrum, is caused by the crowding together of the colours at the red end. This is shown, together with the correspondence of the ratios of sound and colour, in the accompanying diagram.

The musical scale is thus literally a rainbow of sound. Harmony in colour and music may thus, probably, be found to have a common physical basis. There are many indications that this is the case. For example, the juxtaposition of two colours nearly alike is bad, and so also two adjacent notes of the scale sounded together produce discord. The succession of colours in the spectrum

* A suggestion, made, I believe, by Sir J. Herschel, that the colours of the spectrum would probably repeat themselves if we could see beyond the lavender, both supports, and gains support from, this analogy.

and of notes in the scale is the most harmonious that can be found ; any disturbance of the order in either case makes the succession less pleasant. Discord or harmony may be the result of the combination of certain notes, by C and G, or the harmonious interval of a fifth ; the latter combination corresponds to C and F, or the slightly less pleasant interval of a fourth.

This apparent correlation of music and colour suggests



and so also with colours. A pleasant effect is produced by the juxtaposition of red and blue, or of red and green : the former combination corresponds to the ratios given many other speculations, but at present I would only venture to submit the foregoing considerations to the opinion of physicists.

W. F. BARRETT

THE SLAVONIANS IN TURKEY

A VERY careful and complete account of the result of the latest researches in the ethnology and geography of the Turkish Slavonians is given in the new number of Petermann's *Mittheilungen* by Professor Francis Bradashka, of Agram. The author is himself a member of that branch of the great Slavonic race to which the Turkish Slavonians belong, and evidently takes a strong political as well as scientific interest in their position ; but his work is on the whole singularly free from political bias, and may be safely referred to by those who desire to increase their knowledge of the subject. The facts of Turkish ethnology are scattered in a variety of books and articles in periodicals, most of which are very difficult of access, and the only place where they could hitherto be found in a condensed form is an appendix to the fourth number of the *Mittheilungen* by M. Lejean, published in 1861. M. Lejean's paper, however, though full of valuable information and accompanied by an excellent ethnological map, gives little more than a bird's-eye view of the subject ; and Professor Bradashka, besides correcting some important errors in it, has added much statistical and geographical detail which throws a new light on some of the most interesting questions of Turkish ethnology. One of these is the origin and development of the Albanian (Shkipetar) settlements in Turkey. Herr von Hahn, one of the best known authorities on this subject, holds that the Shkipetars were the original inhabitants of old Servia and the districts between Albania and the Vardar river ; and that while these countries were under the Servian rule, the Shkipetars were compelled by their conquerors to take refuge in the hills, whence they afterwards descended when the Servians were beaten in their turn by the Turks. Professor Bradashka, on the other hand, shows, as we think, conclusively, that the countries in question were originally inhabited by Servians, and that the Shkipetars who now occupy them are the descendants of immigrants from Albania who settled there after the break-up of the Servian Empire. A very interesting and important fact brought out by the Professor in connection with this subject is, that the Shkipetars are gradually edging out the Slavonians from many districts which were formerly occupied almost exclusively by the latter race. This is especially observable in the towns. In Vuchitrn, Novo Brdo, and Dyakova, nearly all the inhabitants are now Shkipetars ; and in Matochia, the ancient residence of the Servian kings, there are more Shkipetars than Servians. Old Servia was almost entirely Servian when Shafazyk wrote in 1849 ; it is now predominantly Shkipetar. There are also now Shkipetar settlements, not mentioned by M. Lejean, at the mouth of the Maburitza, and on the eastern and western shores of the lake of Scutari (Skodra).

The acceptance of the Mahometan religion by many of the Slavonians in Turkey has led to great confusion as to the Turkish population of the country. Some unscrupulous partisans of the Ottoman rule have not hesitated to state that there are six millions of Turks in European Turkey—an absurd exaggeration which can only impose on people who are totally ignorant of the facts. Professor Bradashka agrees with the best authorities in estimating the Turkish population at under a million, and points out a singular blunder made by M. Lejean, in his otherwise very accurate map, as to the Turkish inhabitants of Bulgaria. According to his map the whole of Eastern Bulgaria, or about a third of the whole province, is Turkish. This the Professor shows to

be impossible, for there are only 375,000 Turks in the province, most of whom reside in the towns in all parts of Bulgaria, while the total population is between four and five millions. Evidently M. Lejean reckoned among his Turks the Mahometan Bulgarians, who reside for the most part in the eastern districts.

The whole of this valuable little pamphlet is contained in seventeen pages, and its usefulness is considerably increased by a good map. The map embraces all the country occupied by the Southern Slavonians, from Galicia to the Ægean Sea, and seems to be very accurate ; but it is a pity that Dr. Petermann did not leave out the shading of the mountains. This, in a map on such a small scale, is totally useless for topographical purposes, and only occupies space which would be much more profitably employed by the insertion of more names of places, besides obscuring the names which already exist. The districts inhabited by Slavonians are painted green, thus showing at a glance their geographical position. It would have been better to distinguish by a different colour the Bulgarians—who, like the Russians, are Slavonians grafted on a Turanian stock, from the pure Slavonians, such as the Servians, Croats, and Ruthenians.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Government Aid to Science

I VENTURE to hope that you will allow me space in your columns to express opinions on this subject which are not popular with scientific men, and which are evidently opposed to your own views as indicated in your recent article on Science Reform.

The public mind seems now to be going mad on the subject of education ; the Government is obliged to give way to the clamour, and men of science seem inclined to seize the opportunity to get, if possible, some share in the public money. Art education is already to a considerable extent supplied by the State,—technical education (which I presume means education in "the arts") is vigorously pressed upon the Government,—and Science also is now urging her claims to a modicum of State patronage and support.

Now, sir, I protest most earnestly against the application of public money to any of the above specified purposes, as radically vicious in principle, and as being in the present state of society a positive wrong. In order to clear the ground let me state that, for the purpose of the present argument, I admit the right and duty of the State to educate its citizens. I uphold national education, but I object absolutely to all sectional or class education ; and all the above-named schemes are simply forms of class education. The broad principle I go upon is this,—that the State has no moral right to apply funds raised by the taxation of all its members to any purpose which is not directly available for the benefit of all. As it has no right to give class preferences in legislation, so it has no right to give class preferences in the expenditure of public money. If we follow this principle, national education is not forbidden, whether given in schools supported by the State, or in museums, or galleries, or gardens, fairly distributed over the whole kingdom, and so regulated as to be equally available for the instruction and amusement of all classes of the community. But here a line must be drawn. The schools, the museums, the galleries, the gardens, must all alike be *popular* (that is, adapted for and capable of being fully used and enjoyed by the people at large), and must be developed by means of public money to such an extent only as is needful for the highest attainable *popular* instruction and benefit. All beyond this should be left to private munificence, to societies, or to the classes benefited, to supply.

In art, all that is needed only for the special instruction of artists, or for the delight of amateurs, should be provided by artists and amateurs. To expend public money on third-rate prints or pictures, or on an intrinsically worthless book, both of immense value on account of their rarity, and as such of great interest to a small class of literary and art amateurs and to them only, I conceive to be absolutely wrong. So, in science, to provide museums such as will at once elevate, instruct, and entertain all who visit them is a worthy and a just expenditure of public money ; but to spend many times as much as is necessary for this purpose in forming enormous collections of all the rarities that can be obtained, however obscure and generally uninteresting they may be, and however limited the class who can value or appreciate them, is, as plainly, an unjust expenditure. It will, perhaps, surprise some of your readers to find a naturalist advocating such doctrines as these ; but though I love nature much I love justice more, and would not wish that any man should be compelled to contribute towards the support of an institution of no interest to the great mass of my countrymen, however interesting to myself.

For the same reason I maintain that all schools of art or of science, or for technical education, should be supported by the parties who are directly interested in them or benefited by them. If designs are not forthcoming for the English manufacturer, and he is thus unable to compete with foreigners, who should provide schools of design but the manufacturers and the pupils who are the parties directly interested ? It seems to me as entirely beyond the proper sphere of the functions of the State to interfere in this matter as it would be to teach English bootmakers or English cooks at the public expense in order that they may be able to compete with French *artistes* in these departments. In both cases such interference amounts to protection and class legislation, and I have yet to learn that these can be justified by the urgent necessity of our producing shawls and calicoes, or hardware and crockery, as elegantly designed as those of our neighbours. And if our men of science want more complete laboratories, or finer telescopes, or more expensive apparatus of any kind, who but our scientific associations and the large and wealthy class now interested in science should supply the want ? They have hitherto done so nobly, and I should myself feel that it was better that the march of scientific discovery should be a little less rapid (and of late years the pace has not been bad), than that Science should descend one step from her lofty independence and sue *in formâ pauperis* to the already overburthened taxpayer. So if our mechanics are not so well able as they might be to improve the various arts they are engaged in, surely the parties who ought to provide them with the special education required are the great employers of labour, who by their assistance are daily building up colossal fortunes ; and that great and wealthy class which is, professionally or otherwise, interested in the constructive or decorative arts.

I maintain further, not only that the money spent by Government for the purposes here indicated is wrongly spent, but also that it is in a great measure money wasted. The best collectors are usually private amateurs, the best workers are usually home students or the employés of scientific associations, not of governments. Could any Government institution have produced results so much superior to those produced by our Royal Institution, with its Davy, Faraday, and Tyndall, as to justify the infringement of a great principle ? Would the grand series of scientific and mechanical inventions of this century have been more thoroughly and more fruitfully worked out, if Government had taken science and invention under its special patronage in the year 1800, and had subjected them to a process of forcing from that day to this ? No one can really believe that we should have got on any better under such a *régime*, while it is certain that much power would have been wasted in the attempt to develop inventions and discoveries before the age was ripe for them, and which would therefore have inevitably languished and been laid aside without producing any great results. Experience shows that public competition ensures a greater supply of the materials and a greater demand for the products of science and art, and is thus a greater stimulus to true and healthy progress than any Government patronage. Let it but become an established rule that all institutions solely for the advancement of science and art must be supported by private munificence, and we may be sure that such institutions would be quite as well supported as they are now, and I believe much better. If they were not, it would only prove more clearly how unjust it is to take money from the public purse to pay for that which science-and-art-amateurs would very much like to have, but are not willing themselves to pay for.

The very common line of argument which attempts to prove the wide-spread uses and high educating influences of art and of science, are utterly beside the question. Every product of the human intellect is more or less valuable ; but it does not therefore follow that it is just to provide any particular product for those who want it, at the expense of those who either do not want, or are

not in a condition to make use of it. Good architecture, for instance, is a very good thing, and one we are much in want of; but it will hardly be maintained that architects should be taught their profession at the public expense. The history of old china, of old clothes, or of postage stamps, are each of great interest to more or less extensive sections of the community, and much may be said in each case to prove the value of the study; but surely no honest representative of the nation could vote, say, the moderate sum of a million sterling for three museums to exhibit these objects, with a full staff of beadles, curators, and professors at an equally moderate expenditure of £10,000 annually, and a like sum for the purchase of specimens. But if we once admit the right of the Government to support institutions for the benefit of any class of students or amateurs however large and respectable, we adopt a principle which will enable us to offer but a feeble resistance to the claims of less and less extensive interests whenever they happen to become the fashion.

If it be asked (as it will be) what we are to do with existing institutions supported by Government, I am at once ready with an answer. Taking the typical examples of the National Gallery and the British Museum, I maintain that these institutions should be reorganised, so as to make them in the highest degree entertaining and instructive to the mass of the people;—that no public money should be spent on the purchase of specimens, but what they already contain should be so thoroughly cared for and utilised as to make these establishments the safest, the best, and the most worthy receptacles for the treasures accumulated by wealthy amateurs and students, who would then be ready to bestow them on the nation to a much greater extent than they do at present. From the duplicates which would thus accumulate in these institutions, the other great centres of population in the kingdom should be proportionately supplied, and from the Metropolitan centres trained officers should be sent to organise and superintend local institutions, such a proportion of their salaries being paid by Government as fairly to equalise the expenditure of public money over the whole kingdom, and thus not infringe that great principle of equality and justice which I maintain should be our guide in all such cases.

This communication will doubtless call forth much opposition, but I trust it will also elicit the support of some of those eminent scientific men, who I know hold similar general views, and who are so much better able than I am to explain and support them.

ALFRED R. WALLACE

Kant's View of Space

IN the very remarkable contribution by Professor Sylvester, (NATURE, No. 9) this sentence occurs: "It is very common, not to say universal, with English writers, even such authorised ones as Whewell, Lewes, or Herbert Spencer, to refer to Kant's doctrine as affirming space to be a 'form of thought' 'or of the understanding.' This is putting into Kant's mouth (as pointed out to me by Dr. C. M. Ingleby) words which he would have been the first to disclaim."

It is not on personal grounds that I wish to rectify the misconception into which Dr. Ingleby has betrayed Professor Sylvester. When objections are made to what I have written, it is my habit either silently to correct my error, or silently to disregard the criticism. In the present case I might be perfectly contented to disregard a criticism which any one who even glanced at my exposition of Kant would see to be altogether inexact; but as misapprehensions of Kant are painfully abundant, readers of Kant being few, and those who take his name in vain being many, it may be worth while to stop *this* error from getting into circulation through the channel of NATURE. Kant assuredly did teach, as Professor Sylvester says, and as I have repeatedly stated, that space is a form of intuition. But there is no discrepancy at all in also saying that he taught space to be a "form of thought," since every student of Kant knows that intuition without thought is mere sensuous *impression*. Kant considered the mind under three aspects, Sensibility, Understanding, and Reason. The *à priori* forms of Sensibility, which rendered Experience possible, were Space and Time: these were forms of thought, conditions of cognition. It was by such forms of thought that he reoccupied the position taken by Leibnitz in defending and amending the doctrine of innate ideas, namely, that knowledge has another source besides sensible experience,—the *intellectus ipse*.

While, therefore, any one who spoke of space as a "form of the understanding" would certainly use language which Kant would have disclaimed, Kant himself would have been surprised to hear that space was not held by him as a "form of thought."

January 3 GEORGE HENRY LEWES

Transcendent Space

AS my name has been mentioned by Prof. Sylvester, at p. 238 of NATURE, in connection with this subject, I must ask you to allow me to make a brief remark thereupon. With the late Prof. Donkin I have not the least doubt as to this notion being "only a disguised form of algebraical formulisation." I observe that Prof. Sylvester, while *hypothetically* mentioning his own blindness, backs up his belief by the names of seven great mathematicians, who are *hypothetically* assumed to have "an inner assurance of the reality" of space of four dimensions. A roll-call of great names is no evidence of a strong position, and in the present case the citation is somewhat unfortunate. My old friend Dr. Salmon, who is one of the seven mathematicians cited, would, I am sure, disclaim any such "inner assurance." Without any breach of confidence I may quote his own reply to a question which I put to him long before the delivery of Prof. Sylvester's address. It was in these words: "I do not profess to be able to conceive *affairs* of four dimensions. . . . I advise you to believe whatever Sylvester tells you, for he has the power of seeing things invisible to ordinary mortals."

It would be more satisfactory to unbelievers like myself if the gifted author of the address were to assure the world that he had an insight into, or clear conception of, this transcendent space, According to my own view, *space cannot have more or less than three dimensions;* but if a form of extension having four dimensions were once revealed to us, tridimensional space (in which we now "live and move and have our being," and which is for us one of *two only universal forms of sense*), together with all that it contains, would become zero, and thenceforward we should only be able to conceive tridimensional space as a limit to the finite contents of quadridimensional space. Nay, more, the new space would be inevitably fatal to the law of gravitation, which is a transcendental deduction from the three only dimensions of space. Of course I see plainly enough that the Hamiltonian theory of "quinaries" (which is at present concretely interpretable only in time, *i.e.* as applied to sets of five points in time) might be developed into a rectorial system of *Quinions*, where the four symbols of operation would express the rotation of a straight line about four symmetrical axes; but the form of extension required for the interpretation of such a system is not only inconceivable, but is seemingly opposed to the very intellect itself.

Ilford, January 8 C. M. INGLEBY

The Cyclone

IN answer to the request of your correspondent, F.R.A.S., of Plymouth, in No. 8 of NATURE, I venture to send the following observations of the storm of Dec. 16, in West Suffolk. The barometer is reduced to sea level and 32° Fahr.

Dec. 16—2 p.m. : bar. 29·598, having fallen about ·15 since the morning: air temp. 44° max. of day hours; wind fresh, S., sky overcast.

5 p.m. : bar. 29·334, air temp. 42°; wind S.S.E. high, with heavy rain, which had begun about 4.

10 p.m.: bar. 28·821, a fall of ·5 in 5 hours; wind S.W. gale; rain stopped. The rainfall amounted to ·53 in. During this gale the temp. rose to 54°. The wind veered, at times blowing with great violence, attaining its maximum a little before 11 p.m. Direction nearly W. After 11 the force began to abate.

12 mid. : bar. 29·031, a rise of ·2; wind high from W.N.W.

Dec. 17.—Bar. 29·625, wind still very fresh from W.N.W.

The movement of the barometer from 2 to 10 p.m. of 16th, was 0·78 in., and on morning of 17th the pressure returned to the same point as on 2 p.m. of 16th. The maximum of the wind force occurred a little after the minimum of air pressure, when barometer was rising (compare Capt. Toynbee's "Isobaric Curves" pp. 6, 7). The veering of the wind shows that the track of the centre of the storm passed to the N. of this latitude (52° N.) M.A.

Haverhill, Suffolk, Dec. 28

I ONLY noticed this morning a request of one of your correspondents, who wishes some one in the north or east of England to give an account of the storm which occurred on the 17th instant, as he considers it a remarkable instance of a cyclone.

I enclose the hourly readings of the barograph and anemograph at Stonyhurst during the storm that occurred on the 17th and 19th, but I doubt whether they will be found very confirmatory of the supposed nature of the storm. The fall and rise of the barometer agree remarkably with the complete circuit through which the wind veered from W.S.W. through S. and N. back to W.S.W., but the storm, as is usually the case, began about

four hours after the barometer had passed its minimum : the storm lasted 14 hours 30 minutes. The rainfall was moderate. I have given you the readings on the 16th on account of the interesting coincidence between the veering completely round of the wind, and the gradual fall and rise of the barometer. On the 19th a greater storm occurred, but with a less marked connection between barogram and anemogram.

Stonyhurst, Whalley, Dec. 29 S. J. PERRY

G.M.T.	Barom.	Wind. Direction.	Force.
Dec. 16...2 a.m.	29·244	WSW	7
3	·240	..	7
4	·235	..	12
5	·235	..	15
6	·229	..	12
7	·226	SW	16
8	·213	..	14
9	·194	..	15
10	·184	..	14
11	·161	..	15
Noon	·126	..	15
1 p.m.	·066	..	9
2	·005	S	17
3	28·946	..	17
4	·860	..	16
5	·784	..	15
6	·690	SE	4
7	·608	ENE	7
8	·570	NE	10
9	·581	NNE	10
10	·629	NW	13
11	·664	WNW	17
Mid.	·713	W	11
Dec. 17...1 a.m.	28·738	W	22
2	·804	..	30
3	·853	..	28
4	·894	..	25
5	·930	WNW	28
6	·980	..	26
7	29·014	W	26
8	·064	..	31
9	·090	..	32
10	·134	..	31
11	·170	..	31
Noon	·212	..	30
1 p.m.	·250	..	26
2	·288	..	19
3	·328	..	17
4	·360	WSW	10
5	·368	..	13
6	·382	W	10
7	·391	WSW	6
Dec. 18...8 a.m.	28·964	SSW	5
9	·952	SW	7
10	·938	WSW	10
11	·912	SW	14
Noon	·888	..	13
1 p.m.	·872	..	16
2	·867	..	16
3	·836	..	15
4	·822	..	16

G.M.T.	Barom.	Wind. Direction.	Force.
Dec. 18...5 p.m.	28·803	SW	17
6	·770	..	22
7	·740	SSW	22
8	·721	..	24
9	·706	SW	26
10	·683	..	26
11	·684	..	27
Mid.	·722	WSW	24
Dec. 19...1 a.m.	28·759	W	20
2	·783	SW	13
3	·800	..	11
4	·808	..	12
5	·809	..	13
6	·810	..	12
7	·792	..	17
8	·786	SSW	17
9	·769	..	23
10	·743	..	23
11	·704	SW	18
Noon	·681	..	16
1 p.m.	·676	WSW	26
2	·694	..	24
3	·713	W	23
4	·740	WSW	20
5	·740	..	23
6	·748	SW	23
7	·758	..	23
8	·765	WSW	25
9	·794	SW	25
10	·833	W	27
11	·898	WNW	27
Mid.	·937	W	24
Dec. 20...1 a.m.	·960	..	23
2	29·001	WSW	15
3	·001	W	22
4	·021	WSW	21
5	·041	..	16
6	·040	..	16
7	·044	..	14
8	·063	..	16
9	·079	..	14
10	·088	WNW	14
11	·088	WSW	15
Noon	·090	..	14
1	·081	..	14
2	·081	..	15
3	·089	..	10
4	·081	..	13
5	·079	..	6
6	·068	..	2

The Suez Canal

SINCE I last addressed you I have had an opportunity of inspecting the Suez Canal under the most favourable circumstances. After a careful personal examination, and having heard the various opinions of others differing in every conceivable respect, I think that, considering all things, M. de Lesseps and his staff have much cause to feel proud of the success they have attained. To return to my previous letter, I may say, without fear of any objections which may hereafter be raised, that not only do I think the suggestions I then made are sound and practical, but that to carry them out would be most economical to the shareholders of the Canal, while to the Egyptian Government it would add probably 25 per cent. to the land revenue, by reclaiming a vast extent of desert that only requires water to make it most productive.

From inquiries also into the land settlement question of Egypt, I believe that this project of raising the canal-levels by fresh water could be carried out without any complaint being raised by the cultivators, who do the earth work, and would be repaid by title-deed to the land to be reclaimed ; for, after all, the work would not be great, simply widening the present sweet-water canal some 30 metres. By a set of locks just before entering Lake Ballah from the south, and a similar set of locks before entering the bitter lakes from the north, the surface level of the water in Lake Timsah could be held up 2½ metres. Thus much of the expensive deepening and widening of the canal would be saved, which is all the more important as it is in this division of the canal that rock has been found.

It may be said that the Nile could not supply sufficient water, but with a weir or "anicut" across the Nile at Cairo, where stone is plentiful, not only could a supply of water be obtained, but I believe the whole system of irrigation in Egypt would be greatly improved.

So much for the interests of the shareholders and the people of Egypt, but what would the ship captains say at being detained by having to pass two sets of locks?

In reply to this objection I may say, that as the passage from the Timsah Lake takes seven or eight hours of daylight either way, half an hour's detention is of no consequence, for all sea-going ships must remain a night in Lake Timsah ; so that as the ship would thus be some eighteen hours in *fresh* water, the marine animals and weeds would most probably all drop off the ship's bottom, and so the hour's loss of time by lockage would be more than compensated by the days saved on the voyage.

I have not time at present to speak of the deposits at Port Said, or the currents at the Suez end of the Canal, but will address you on these interesting questions on some future occasion after I arrive in India. In conclusion, I must add, that the Canal authorities have one and all been most civil and obliging, showing and explaining everything.

T. LOGIN, C.E.
Late of the Ganges Canal

P. & O. Co.'s Ship *Nubia*,
Suez, November 29, 1869

NOTES

PROFESSOR HELMHOLTZ, of Heidelberg, has been elected a corresponding member of the Physical Section of the Paris Academy of Sciences in the room of M. Marianini. Votes :—Helmholtz 37, Kirchhoff 3, Sir W. Thomson 2, Ångström 1, Mayer 1. At the same meeting the Secret Committee appointed to nominate candidates for the place of corresponding member vacant owing to the death of M. Matteucci, announced the following list :—In the first rank,—M. Mayer of Heilbronn. In the second rank,—M. Ångström of Upsala, M. Billet of Dijon, M. Dove of Berlin, Mr. Grove of London, Mr. Henry of Philadelphia, M. Jacobi of St. Petersburg, Mr. Joule of Manchester, M. Kirchhoff of Heidelberg, M. Riess of Berlin, Mr. Stokes of Cambridge, Sir W. Thomson of Glasgow, Mr. Tyndall of London, M. Volpicelli of Rome. The election takes place at the next meeting of the Academy.

HER MAJESTY has been pleased to signify her desire that the Historical and Archæological Association of Ireland be henceforth called the Royal Historical and Archæological Association of Ireland, and that the members of the Association be styled "Fellows."

AT the meeting of the Paris Academy held on the 29th ult., the death of M. Erdmann, the Swedish geologist, was announced. M. Erdmann was chairman of the commission for the Geological Survey of Sweden.

MR JAMES NICOL and Dr. G. Dickie, the Professors of Natural History and Botany in the University of Aberdeen, have addressed a joint letter to the *Aberdeen Free Press*, defending the science-teaching of the university from some remarks made by Professor Geddes in his pamphlet on Classical Education in the North of Scotland. They show that the students have given the greater part of their school life to the classics ; that the time allowed for scientific work at the university is only one-sixth of that assigned to classical studies ; that the 3,000*l.* a-year given as bursaries were until recently confined solely (and still are chiefly) for merit in classics ; and that a considerable sum is devoted to Classical prizes, whilst the highest honours in Natural Science have been rewarded for the last two years with the magnificent sum of 10*l.* Notwithstanding these disadvantages, and in spite of the deliberate endeavour of the commissioners appointed "for the advancement of religion and learning in the universities" to suppress the teaching of Natural Science in the university, Professors Nicol and Dickie are able to point with justifiable pride to the list of honours in Natural Science, a list

"including the names of the two Murray scholars, the chief prize now given for general proficiency in the university."

WE have received the report of the Council of the Birmingham Midland Institute, presented at the annual meeting on Monday last. It is altogether of a satisfactory character. Additional accommodation is required, and an appeal to the town is about to be made, which we hope will be heartily responded to. The following statistics of the use made of the Science Classes by students, will show the gradually increasing utility of this single side of the Institution:—1857, 578 students; 1862, 717 students; 1866, 1,371 students; 1869, 1,538 students.

WE learn from the *British Medical Journal* that the following courses of lectures will be given at the Royal College of Surgeons during the present year:—1. Six Lectures "On Dermatology," by Prof. Erasmus Wilson, F.R.S., commencing on the 31st inst. 2. Eighteen lectures by Prof. Flower, F.R.S., "On the Anatomy of the Mammalia," commencing February 14th. 3. Six lectures "On the Nature and Treatment of New Growths," by Prof. Birkett. 4. Three lectures "On the Minute Anatomy of the Eye," by Mr. Hulke, F.R.S. Professors Wilson and Flower will lecture on Mondays, Wednesdays, and Fridays, at 4 o'clock. The third and fourth courses will be given in the month of June.

THE following course for the Experimental and Natural Science Gold Medals in Trinity College has been agreed on for 1870. Physics: Jamin, Cours de Physique; Lloyd, Elementary Treatise on the Wave-Theory of Light. Chemistry: Regnault, Cours de Chimie; Naquet, Principles of Chemistry, Second Edition by Cortis; Fresenius, Chemical Analysis, Fourth Edition. Mineralogy and Geology: Dana, System of Mineralogy; Rose, Elements de Crystallographie, Edit. par Regnault; Dana, Manual of Geology, Parts I. II. and IV. Botany, Zoology and Palæontology: Henfrey, Elementary Course of Botany, Parts I. and III.; Lindley, Descriptive Botany, 1858; Bentham, British Flora; Haughton, Three Kingdoms of Nature, Part III.; Greene, Manual of Protozoa and of Cœlenterata; Huxley, Lessons in Elementary Physiology; Dana, Manual of Geology, Part III.

THE Erasmus Smith Professorship of Natural and Experimental Philosophy in Trinity College, Dublin, is now vacant. The second half of the examination for candidates will be held on the 21st. The examiners are the Provost (Dr. Lloyd) and Professors Apjohn, Galbraith, and Jellett. The emoluments of the office are, to a Fellow, if elected, about 600*l.* a year; to the Professor not being a Fellow, 200*l.* a year.

THE Horticultural Society of Cologne is about to extend its original scheme so as to include a school for the scientific teaching of horticulture. It is stated that a range of buildings, to include halls, lecture-rooms, chemical laboratory, dwelling-rooms, &c., is to be immediately erected; and that the society intends to enlarge or rebuild the present orangeries, conservatories, and forcing-houses.

THE *Pall Mall Gazette* of Monday last reports at great length a lecture "On the Forefathers and Forerunners of the English People," given by Professor Huxley, at a meeting held on the preceding evening, under the auspices of the National Sunday League. The lecturer, referring to the arguments now commonly brought forward, upon the assumption that the Irish and English nations belong essentially to different races, denied that there was sufficient proof of the existence of any difference whatever between Celt and Anglo-Saxon, except that of language. He thinks it probable, moreover, that Ireland as a whole contains less Teutonic blood than the eastern half of England, and more than the western half. Our readers may remember that the question of the amount of the Celtic element in the existing English nation was prominently brought before the public in a recent Chancery suit. The claims to originality put forward by the plaintiff in that suit are now disputed by Dr. Daniel Wilson, of Toronto, who communicates to the last number of the *Canadian Journal* a somewhat verbose article pointing out that the results obtained by the plaintiff from craniological investigations were anticipated in all essential particulars in earlier writings of Dr. Wilson's.

THE pressure on our space is so great that we have been unable to lay before our readers the communications on the Suez Canal, presented to the Royal Society by Mr. Bateman, and to the Geographical Society by Lord Houghton; they have, however, been given at some length in the daily press. One point of great scientific interest came out in the discussion at the Geographical Society. Mr. Fowler stated that the evaporation from the Bitter Lakes would require a supply of 250,000,000 cubic feet daily, *i.e.*, a flow in the Canal of $1\frac{1}{2}$ miles per hour. On all hands the Canal is acknowledged to be a complete success, and its probable influence on the trade of Mediterranean ports may be estimated from the fact mentioned by Lord Houghton, that the Emperor of Austria said that "he was there to represent Trieste."

WE are glad to learn from the *Architect* that it has been decided to establish a School of Science and Art at Dover.

THE Swiss are about to supplement, or supersede, their great "Dufour" Map, by another upon a much larger scale. The "Dufour" Map, on a scale of $\frac{1}{100000}$ (about $\frac{5}{8}$ of an inch to a mile), is in twenty-five sheets, and is printed in black only; but the new map is to be on a scale of $\frac{1}{25000}$ for the plains, and $\frac{1}{50000}$ for the mountainous districts. It is to be printed in three colours, and will contain no less than 540 sheets. Roads, towns, and trees are inserted in black, and rivers and glaciers in blue: the third printing, in red, is devoted to contour lines. The distance between each contour line expresses a height of 100 Swiss feet in the mountains, and 33·3 Swiss feet in the plains. It was intended at first to have a fourth printing, in green, for the forests, but this has been abandoned on account of the expense. Several sheets of this map, all admirably executed, have already been issued. At the same time they are reducing the "Dufour" Map to the scale of $\frac{1}{250000}$. This reduction will be in four sheets, and for tourists or for general use will be much more handy than the larger map. It is said that it will be even superior to the original map in the picturesque relief, for which the latter is so remarkable. Three years more will be required to finish the reduced map, of which two sheets are already published.

M. BOUIS has been appointed Professor of Toxicology at the Upper School of Pharmacy in Paris.

WE cull the following notes from the last number of the *Journal of the Society of Arts*:—

The Royal Agricultural Society has been giving its attention to the adulteration of manures and feeding cakes, and is conducting some analyses.

The oxy-hydrogen light is now largely used in Paris for illuminated advertisements and theatrical purposes. Carts with metal reservoirs containing the compressed oxygen for the supply of customers may be seen in the streets. At the Gaieté Theatre, which is one of the largest consumers, cylinders of magnesia or zirconia take the place of the lime cylinders ordinarily used for this light.

In connection with the systematic destruction of timber in Australia, it is mentioned that in the Ballarat district this destruction has been accompanied by a corresponding diminution in the rainfall, and that since 1863 there has been a more or less regular reduction from 37·27in. in 1863 to 14·23in. in 1868. The Government has recently appointed an Inspector of State Forests, whose duty it will be to prevent the waste of timber, and establish nurseries of forest trees in various parts of the colony.

THE BESSEMER PROCESS UNDER PRESSURE

MR. BESSEMER has lately patented a method of conducting his process of converting cast-iron into steel *under pressure*, in order to raise the temperature of the metal during the process of conversion, and to obviate the inconvenience experienced when certain of the purer qualities of Swedish pig-iron made with charcoal, and also some of the less grey and the white hematite pig-irons of this country, when treated by the ordinary process, do not produce sufficient heat in the converting vessel to allow all the steel made from them to retain complete fluidity until it is poured into moulds.

The following description of the apparatus is extracted from *Engineering*, to the editor of which journal we are indebted for the use of the woodcuts.

In the annexed engravings, Fig. 1 is a vertical section of a Bessemer converter constructed on this plan, *a* being the upper part of the converting vessel; *a* ×, the lining of ganister; and *q*, the strong riveted iron shell or vessel on the inside of the mouth of which the iron hoop, *c*, is riveted; while *d* is a flanged iron ring bevelled on the inside, and secured by screwed studs or cotter bolts to the hoop, *c*. A moulded ring, *e*, of fire-brick or other suitable refractory material, forms the escape opening or mouth of the vessel; it is retained in place by means of the flanged ring, *d*.

FIG. 1.

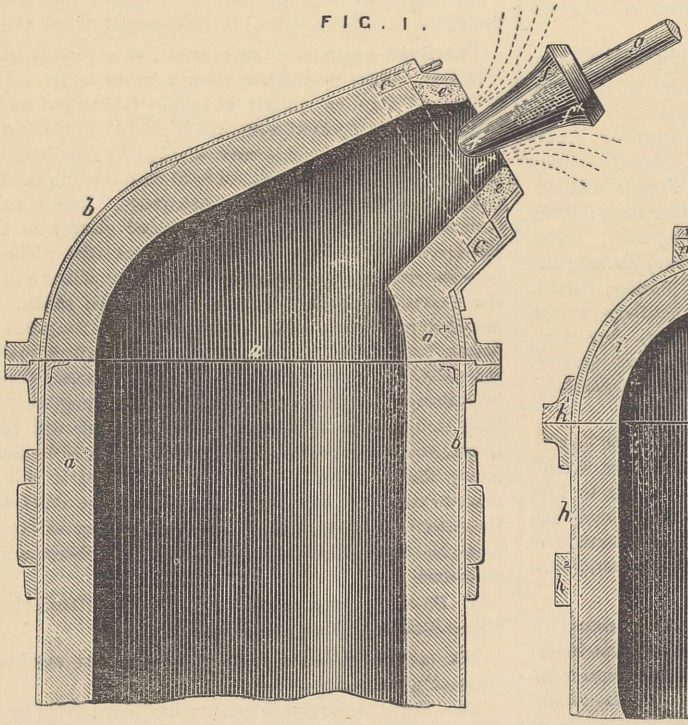
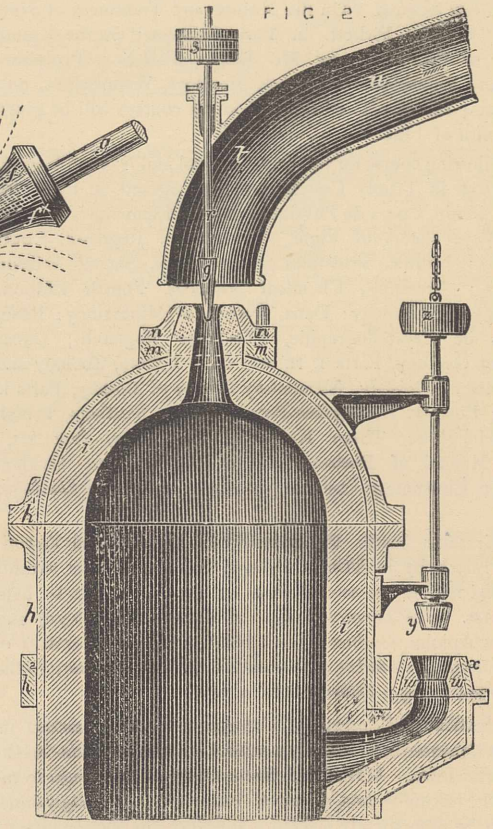


FIG. 2.



The aperture in the movable mouth of the vessel thus formed may in some cases be made small enough to retain the gaseous products resulting from the combustion of the carbon or other matter contained in the pig-iron under a pressure much above that of the surrounding atmosphere, so that the combustion going on in the converting vessel may be under "high pressure," and by reason of the combustion so taking place under a pressure much greater than that of the external atmosphere a more intense heat would be produced and imparted to the metal. As a guide to the workmen, Mr. Bessemer states that for the conversion of the purer kinds of Swedish charcoal pig-iron and for mottled or white hematite pig-iron mixed with grey a back pressure in the vessel from 8 to 15 lb. on the square inch will give good results, and in but few cases will a pressure of 20lb. per square inch be necessary. It will be understood that the pressure of the blast of air forced into the converting vessel must be increased in proportion to the back pressure caused by the penning up of the gases within the vessel.

Another arrangement is illustrated in Fig. 2, which represents a vertical section of the upper portion of a converting vessel or chamber in which molten pig or other carburet of iron is to be treated either by the injection of the fluid nitrate into the molten metal, as patented by Mr. Bessemer in March last, or in which vessel the nitrates or other oxygen-yielding salts or substances are so brought in contact with the hot metal as to be decomposed. The outer shell, *h*, of the vessel or chamber is made of thick plates of iron or steel securely riveted and caulked at all joints, and capable of withstanding safely a pressure of from five to ten or more atmospheres. For the convenience of lining the vessel, the upper part may be removed by unbolting the stout flanges, h^1, and one or more hoops, h^2, are riveted to the exterior of the vessel to strengthen it. A lining of fire-brick, ganister, or other refractory material, *i*, is used to defend the outer shell from the high temperature generated within; and previous to its use for conversion, Mr. Bessemer prefers to make a fire in the interior, so as to highly heat the lining and lessen its power of absorbing heat from the metal.

On the upper part of the dome an iron ring, *m*, is riveted, to which a flanged ring, *n*, is fitted. The inside of this ring is conical, and is made to embrace the conical fire-clay ring, *p*, through which the gaseous matters evolved during the process are allowed to escape. A cone of fire-clay or of iron, *g*, is attached to the guide rod *r*, for the purpose of closing or diminishing the area of the outlet opening in the fire-clay ring *p*, and on the upper end of the rod *r* are placed weights, *s*, to regulate the pressure. The rod *r* is guided vertically upward and downward by passing through the tubular guides and stuffing-box formed at *t t*, on the curved exit passage *u*, which leads to a chimney and conveys away the gaseous products escaping from the con-

verting chamber. On one side of the vessel or chamber is a projection, *v*, on the upper part of which a ring of fire-brick, *w*, is retained in place by a conical flanged iron ring, *x*. The opening in the ring *w* serves for the admission of the molten metal to the vessel, after which the cone *y* smeared with fire-clay is lowered down into the opening of the moulded fire-brick *w*, and by means of the weight *z* is retained in place and prevents the escape of gaseous matters during the converting process.

The cone, *y*, and its rod and weight, *z*, are suspended by a chain in the position shown during the period of running in the metal. When the metal so run in comes in contact with the nitrate or other oxygen-yielding materials, large volumes of gaseous matters are evolved, these matters instead of escaping freely from the converter rapidly accumulating in the vessel until the pressure within it is sufficient to raise the cone *g*, and escape by the small annular opening thus made, the pressure being regulated by the weight *s*. Hence the combustion of the carbon contained in the molten iron by reason of its union with oxygen derived from the decomposition of the nitrates or other oxygen-yielding materials will be effected under considerable pressure; and the gaseous products, instead of expanding freely as under the ordinary conditions of combustion, will be in a highly condensed state, by which means their temperature will be considerably raised, and the intense heat so generated will be imparted to the metal and cause it to retain its fluidity.

It will be extremely interesting to watch the working of this new process.

BOTANY

[We have been favoured by the Count Marshal of Austria with the following abstracts of Botanical papers read at the Innspruck Congress.]

Prof. Hildebrand on the Impregnation of Plants

PLANTS intermediate between *Papaveraceæ* and *Fumarieæ* gave the greatest quantity of seeds when impregnated with the pollen of another individual of the same species, less when the pollen was taken from another flower of the same individual, and least when the impregnation took place within the flower itself. For *Eschscholtzia Californica*, the proportion of seeds in these three cases was as 24 to 9 to 6. Professor Fenzl says that he obtained abundance of seeds from two species of *Abutilon* by fecundation with pollen from other individuals, and that these operations are best performed between 8 and 9 A.M.

Prof. Fenzl on the Genus Lupinus

SEEDS are with difficulty obtained from plants of this genus in the gardens of Vienna, probably on account of the unfavourable condition of the soil. The species of this genus are still very far from being duly determined, and two-thirds of them, at least, may be eliminated. Professor Koch observes, that the greatest amount of seeds is to be obtained in sandy soil, and that the great number of hybrids are merely varieties in form; the different colours of blossoms being a result of external agents, in the same way as *Nymphæa* gives us lengthened leaves when impregnated with the pollen of *Magnolia*.

Bail on Androgynous Inflorescence

SUCH inflorescences have been found on *Zea*, *Populus*, *Fagus*, *Carpinus*, *Betula humilis* and *Betula alba*, as also on *Pinus nigra*, the small scale, considered as a part of the female blossom, developing itself into an anther.

Prof. Koch on Transformations of Parts of Flowers

IN a fruit of *Solanum melongena*, the five anthers have been transformed into five smaller capsules. A capsule of poppy offers, in the centre of its cavity, a small elevation (the continuation of the axis), bearing a number of smaller capsules.

Prof. Bail on Parasitic Fungi on Insects

Empusa, attacking especially the larvæ of the Fir-Moth, invades also those of *Bombyx Caja*, which were found, sitting on branches of oaks, birches, and firs, killed by this parasite. Larvæ of *Cossus ligniperda*, of all sizes, all thickly covered with the white mucor issuing from their bodies, were found beneath the bark of a completely dried-up birch. These larvæ being kept in moist pots, *Penicillium glaucum* broke out first from their bodies, and was soon superseded by *Isariæ*, the larvæ being covered with moist moss. Those of *Melolontha majalis* are, as well as the perfect insect, destroyed by fungi. The destructive action of the fungi has, however, been exaggerated by the periodical press. Of more than 4,000 larvæ from about ten forest-districts of Prussia and Pomerania, scarcely 29 to 30 per cent. have been destroyed by fungi. The chief morbific fungi were *Isaria farinosa*, identical in all details of structure with *Penicillium*, and *Cordiceps militaris*. The *Melanospora parasitica* Tulasne, found (1858) on all specimens of *Isaria* in the environs of Meran, and on those which had come to their full development, is considered by Dr. Bail to be the higher form of fructification of *Botrytis Bassiana*. *Cordiceps militaris*, with thick, carneous, orange-yellow fructiferous clubs, differs altogether from *Isaria*.

Prof. Koch on the Formation of the Germen

THIS is not, as generally supposed, a concretion of so-called "Fruit-leaves." The germen is part of an axis, supporting the parts of a flower; it may be longer or shorter, as these parts are more or less distant from each other. The apex of the receptacle, or of the axis in general, may become suddenly stationary, and be wrapped up in plastic cellular tissue, a cavity open above, including the ovules (inferior germen), being thus formed; or this cavity includes the germina, either non-connate with the inner wall (*Rosa*, *Calycanthus*, *etc.*), or connate with it (*Cotoneaster*, many *Leptosperms*), or mutually connate, as in the Pomaceous fruits. Such a fruit-receptacle not infrequently includes whole blossoms (*Ficus*). The development of the genuine apex proceeds in two ways. Either the formation of cellules proceeds from the apex itself (as generally in inferior germens), and then its basis is the newest and the apex the oldest portion; or the new formations proceed from the margin of the wall, enlarging upwards, the increase ending in the uppermost portion, as in the fig. Professor Schuler observes, that this takes place only in figs ripened in the second half of the year, whenever the refrigerating action of the north wind has retarded their growth. Professor Koch replies, that the same increase of the margin is observable in the fruit of the *Leguminosæ*. Probably the germina of *Papayaceæ*, *Passifloreæ*, *Capparideræ*, and genuine *Liliaceæ*, likewise take their origin from the axis. The abnormal growth often observed on roses, a sudden prolongation of the axis through the cavity of the fruit-bearing blossoms (sometimes 3 above each other) and leaves, proves the new formations to proceed from the included centre of the extreme apex.

Prof. Martins on the Flora of Southern France

MANY genera of the miocene and pliocene deposits of this and other countries are represented in the living flora of South France. Such are *Laurus nobilis*, L. (=*Laura canariensis*), *Ficus carica*, *Punica granatum*, *Pinus Aleppensis* (found fossil in Unalaska), *Cercis siliquastrum* (near Aix), and *Nerium oleander*, in some localities near Toulon and Nice. All these species have lived through the glacial period; they exist now, however, only on the banks of rivers and rivulets, in localities protected against cold. It must be observed that severe cold is not the necessary consequence of extensive glaciers. A decidedly Indian form, not yet found fossil, is *Anagyris fœtida* (*Piptanthus Nepalensis*, Don.), which brings forth its leaves in October, and its blossoms in January and February. Other extraneous forms are: *Myrtus communis* (represented in Peru by *Myrtus myricoides*), *Chamærops humilis* (near Villefranche and Toulon, represented in the Caroline Islands by *Cham. serrulata*, Pursh, and *Cham. hystrix*), and *Ceratonia siliqua*, whose native country is still doubtful. *Cham. humilis* is now extirpated by the avidity of collecting botanists. Professor Koch says that *Anagyris fœtida* belongs rather to the Cytiseæ, or Genisteæ, than to any exotic family, and doubts *Ceratonia silliqua* being a leguminose. Professor Martins replies that he thinks *Anag. fœtida* to be closely related to *Thermopsis*, and observes that about 200 Lapland species occur in South France; that the littoral plants are partly the same as those on the coasts of the Atlantic, except *Spartina versicolor*, an exclusively American form, and hints at the importance of the study of fossil plants for the thorough knowledge of those existing in the present period.

Prof. Hildebrand on Marsilia

SPECIMENS of this plant, growing beneath the surface of water, regularly produce leaves which spread over its surface, and follow its level, while, if kept dry, they never produce such leaves. The leaves grown in air have stomata on both their surfaces; those grown in water have stomata only on their upper surface. Dr. Reichardt observes, that wild specimens of *Marsilia* have constantly been found provided only with large floating leaves. Professor Hoffmann says, that abundant fruits are obtained from *Marsilia* by cultivating it in slimy soil. Professor Hildebrand remarks, that specimens grown in water, and not bearing fruit, propagate themselves with astonishing rapidity without any fecundation.

SCIENTIFIC SERIALS

THE January number (N.S., No. 37) of the *Quarterly Journal of Microscopical Science* opens with an article entitled "Notes on Sponges," by Prof. E. Perceval Wright. In this the author indicates some peculiarities of the structure of the sponge-body of *Hyalonema mirabilis*, and describes two new species of deep-sea sponges, namely *Aphrocallistes Bocagei*, which is exquisitely figured by Mr. Ford, and the type of a new genus which the author names *Wyvillethomsonia Wallichii*. We cannot help protesting against this new generic name, as being barbarous in the highest degree. Mr. William Archer, of Dublin, continues his valuable descriptions of new or imperfectly-known fresh-water Rhizöpoda, and Mr. W. S. Kent describes and figures a curious new form of Polyzoön, from the Victoria Docks, where the animal lives attached to the surface of specimens of the *Cordylophora lacustris*. For this Polyzoön, which the author regards as the type of a new family (*Homodictidæ*) of the Ctenostomata, he proposes the name of *Victorella pavida*. A singular crustacean parasite found on *Nereis cultrifera* is described and figured by Dr. W. C. McIntosh. Besides these, we have a paper on the distribution of nerves to the vessels of the connective tissue in the hilus of the pig's kidney, and on the ganglia connected with these nerves, by Dr. James Tyson, of Philadelphia; an abstract of a dissertation on the minute structure of the human umbilical cord, by Dr. Köster; a translation of Dr. E. Van Beneden's description of his *Gregarina gigantea* (with a plate); and an abstract of an important memoir, by Dr. Kowalewsky, on the relationship of Ascidians and Vertebrates. The only original article on the microscope itself is one by Dr. G. W. Royston-Pigott, on certain imperfections and tests of object-glasses. This number also contains a review of Mr. Hincks's "History of British Hydroid Zoophytes."

IN the *Geological Magazine* for the present month (No. 67), the most important paper is the first part of a memoir on the sequence of the Glacial Beds, by Mr. Searles V. Wood, jun., in which the author indicates his views as to the best classification to be adopted in the treatment of these difficult deposits, and discusses the characters of the beds and evidence attainable as to the sequence of the phenomena attending their deposition. Mr. David Forbes publishes some remarks on the contraction of igneous rocks in cooling, in which he again maintains, chiefly from his own experiments, that the amount of this contraction is much less than is generally believed, on the authority of Bischof. His paper is really a vindication of himself from some remarks in a memoir by the Rev. O. Fisher. Mr. John Rofe describes some peculiar perforations observed in the lower surfaces of slabs of mountain limestone, at considerable elevations, in various localities, which have already been noticed by several writers, and ascribed by some to lithodomous marine mollusca. Mr. Rofe regards them as produced by snails, either by the rasping action of their odontophores alone, or by this aided by an acid salivary fluid. Mr. Ruskin continues his notices of banded and brecciated concretions. Mr. J. Clifton Ward remarks upon the denudation of the lake-district, which he ascribes chiefly to subaërial action. In a paper on the formation of the Chesil Bank, Mr. T. Codrington maintains, in opposition to Messrs. Bristow and Whitaker, that the streams coming from the land have had nothing to do with the production of this bank, or the excavation of the channel by which it is separated from the mainland. He ascribes the formation of this and similar banks solely "to the heaping-up action of waves breaking when they reach a depth of water about equal to their own height."

THE *Revue des Cours Scientifiques* for the 8th inst. contains a lecture, by Prof. Lorain, on the application of the graphic method to the clinical study of disease. Translations are likewise given of Prof. Helmholtz's address to the meeting of German Naturalists and Physicians at Innspruck, and of Mr. Geikie's account of the same meeting, published in the first number of NATURE.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 16, 1869.—The following were among the papers read:—"On the Thermodynamic Theory of Waves of Finite Longitudinal Disturbance," by Prof. Rankine, F.R.S.; "On Approach caused by Vibration," by Prof. Guthrie. The author observes that when a vibrating tuning-fork is held near to a piece of cardboard, the latter has a tendency to approach the fork. Starting from this experiment, a series of experiments is described, having for their object the determination of the cause and conditions of the fundamental observed fact. It is shown that no sensible permanent air-currents, having their source at the fork's surface, are established; and hence that the approach of the card to the fork is not due to the expansion of such currents, as in M. Clement's experiment. The modifications are examined which Mr. Faraday's surface-whirlwinds on a vibrating tuning-fork undergo when the fork vibrates in the neighbourhood of a sensibly rigid plane. It is shown that a delicately-suspended card approaches the fork when either of the three essential faces of the fork is presented to the card, and that the approach takes place from distances far exceeding the range of Mr. Faraday's air-current. That the action between the card and fork is mutual, is shown by suspending the latter. Also one vibrating fork tends to approach another in whatever sense their planes of vibration may be towards one another. The mean tension of the air surrounding a vibrating fork is examined by enclosing one limb of the fork in a glass tube. It appears that the vibrating fork displaces air. The question whether the equilibrium between two equal and opposite forces acting on a body is disturbed by submitting one of the forces to successive rapid, equal, and opposite alterations in quantity, is answered in the negative by an experiment which shows that the equilibrium of a Cartesian diver is not disturbed by submitting the water in which it floats to vibration. Various modifications are introduced into the nature of the surface which receives the vibrations, such as making it a narrow cylinder with one end closed, making it of cotton-wool, &c. It is found that in all cases the suspended body approaches the vibrating one. The author concludes that the effect of apparent attraction is due to atmospheric pressure, and that this pressure is due to undulatory dispersion. It is suggested that the dispersion of the vibrations which constitute radiant heat may cause bodies to approach, being pushed, not dulled.—"On Abstract Geometry," by Prof. Cayley. "I submit to the society the present exposition of some of the elementary principles of an abstract m-dimensional geometry. The science presents itself in two ways: as a legitimate extension of the ordinary two-and three-dimensional geometries; and as a need in these geometries and in analysis generally. In fact, whenever we are concerned with quantities connected together in any manner, and which are, or are considered as, variable or determinable, then the nature of the relation between the quantities is frequently rendered more intelligible by regarding them (if only two or three in number) as the co-ordinates of a point in a plane or in space; for more than three quantities there is, from the greater complexity of the case, the greater need of such a representation; but this can only be obtained by means of the notion of a space of the proper dimensionality; and to use such representation, we require the geometry of such space. An important instance in plane geometry has actually presented itself in the question of the determination of the curves which satisfy given conditions; the conditions imply relations between the co-efficients in the equation of the curve; and for the better understanding of these relations it was expedient to consider the coefficients as the co-ordinates of a point in a space of the proper dimensionality. A fundamental notion in the general theory presents itself, slightly in plane geometry, but already very prominently in solid geometry; viz., we have here the difficulty as to the form of the equations of a curve in space, or (to speak more accurately) as to the expression by means of equations of the twofold relation between the co-ordinates of a point of such curve. The notion in question is that of a k-fold relation,—as distinguished from any system of equations (or one-fold relations) serving for the expression of it,—and giving rise to the problem how to express such relation by means of a system of equations (or onefold relations). Applying to the case of solid geometry my conclusion in the general theory, it may be mentioned that I regard the twofold relation of a curve in space as being completely and precisely expressed by means of a system of equations ($P=0$, $Q=0$, . . $T=0$), when no one of the functions, P Q, . . . T as a linear function, with constant or variable *integral* coefficients, of the others of them; and when *every surface whatever* which passes through the curve has its equation expressible in the form $U=AP+BQ \ldots +KT$, with constant or variable integral coefficients, $A+B \ldots K$. It is hardly necessary to remark that all the functions and coefficients are taken to be rational functions of the co-ordinates, and that the word integral has reference to the co-ordinates."

January 6.—"Some account of the Suez Canal in a letter addressed to the president," by J. F. Bateman, F.R.S.

Entomological Society of London, January 3.—Mr. H. W. Bates, president, in the chair. The fifth part of the "Transactions for 1869" was on the table. A splendid collection of butterflies was sent for exhibition by Mr. Hewitson; it included 135 new species, and many other rarities, the whole having been captured by Mr. Buckley in South America. Observations thereon were made by Mr. Buckley, the President, Mr. Higgins, and Mr. Wallace.—Professor Westwood, Mr. Bond, Mr. Pascoe, Mr. Albert Müller, and Mr. Quaritch, also exhibited various objects, and made remarks thereon.—Papers were read on *Ephemeridæ*, by the Rev. A. E. Eaton; on *Callidryas*, by Mr. A. G. Butler; on *Catasareus*, by Mr. F. P. Pascoe; and on the genera of *Coleoptera*, studied chronologically (Part I., from 1735 to 1801), by Mr. G. R. Crotch.

Royal Horticultural Society, December 21, 1869.—*Scientific Committee.*—Mr. W. W. Saunders in the chair. The secretary, Rev. M. J. Berkeley, exhibited a leaf of Aerides "Fox-brush" with a peculiar form of spot, differing from any he had previously seen.—Mr. Laxton sent specimens of peas of the most varied character, the result of a single cross.—A very interesting paper "On the Fertilisation of Grasses," from Dr. R. Spruce, from which the following are extracts, was communicated through Dr. Masters. The paper had reference to the statement of M. Bidard that grasses are usually self-fertilised while in the bud: it will be published *in extenso* in the Journal of the Society:—

"In gently-flowing rivers of tropical America grow many fine aquatic grasses, species of *Luziola*, *Oryza*, *Leersia*, &c. The following note is from my journal, under date December 1849, when threading in my canoe among the islands of the Trombetas:—'This channel was lined on both sides by a beautiful grass—a species of *Luziola*—growing in deep water, and standing out of it two or three feet. The large male flowers, of the most delicate pink, streaked with deep purple, and with six long yellow stamens hanging out of them, were disposed in a lax terminal panicle; while the slender green female flowers grew on the bristle-like branches of much smaller panicles springing from the inflated sheaths of the leaves that clothed the stem. As the Indians disturbed the grassy fringe with the movement of their paddles, the pollen fell from the anthers in showers,' and would, doubtless, some of it, attain the female flowers disposed for its reception. A parallel case to the above is that of the common maize (*Zea Mays*, L.), where the male flowers are borne in a long terminal raceme or panicle, and the female flowers are densely packed on spikes springing from the leaf-axels. Here the male flowers must plainly expand before the pollen contained in their anthers can be shed on the female organs below, whether of the same or of a different plant. That there are frequent cross-marriages in maize is evidenced by the numerous varieties in cultivation in countries where it is a staple article of food, as in the Andes of Ecuador, where nine kinds, varying in the colour of the grain (through white, yellow, and brown, to black), in its size, consistence, and flavour, are commonly cultivated; besides many others less generally known. In *Phœrus scaber* (H. B. K.) another tall broad-leaved grass, the spikelets stand by twos on the spike—a sessile female spikelet, and a stalked male spikelet. In the same forest grasses of the genus *Olyra*, whereof some species, such as *O. micrantha* (H. B. K.), rise to 10 feet high, and have lanceolate leaves above 3 inches broad, and a large terminal panicle, with capillary branches, like those of our *Aria cæspatosa:* it is the lower flowers that are male, with large innate (not versatile) anthers, and the upper that are female, with two large stigmas, that are either dichotomously divided, or clad with branched hairs, thus exposing a wider surface to the access of the pollen. And as the panicle is often pendulous, many of the male flowers, although placed lower down the axis, are actually suspended over the terminal female flowers. It is generally to be remarked of diclinous grasses, that either the male flowers are very numerous, as in *Zea Mays*, or the stamens are multiplied in each male flower, as in *Pariana*, *Leersia*, *Guadua*, &c.; or the stigmatic apparatus of the female flowers is enlarged, so as almost to insure impregnation, as in *Olyra* and *Tripsacum*. In the *Bambuscæ* I have gathered belonging to the genera *Guadua*, *Merostachys*, and *Chusquea*, the flowers are more or less polygamous, and the stamens of the male flowers often doubled. But there is scarcely a genus in the whole order which is not described as having some flowers by abortion, neuter or male, and especially those that have biflorous spikelets, such as the *Paniceæ*. Some grasses, of normally hermaphrodite genera, are not unfrequently truly unisexual, such as certain species of *Andropogon*. I have occasionally seen panicles of *Orthocladus rariflorus* (Nees), a grass peculiar to the Amazon, quite destitute of stamens, and therefore purely female. To come home to our own country: is all the pollen wasted that a touch or a breath sets free from the flowers of grasses in such abundance? Watch a field of wheat in bloom, the heads swayed by the wind, lovingly kissing each other, and doubtless stealing and giving pollen. Consider, too, that throughout Nature, heat or moisture, or both, are essential to the emanation of the impregnating influence. In all our *Festuceæ*, as well as in *Cynodon*, *Leersia*, and some other genera, the stigmas are protruded from the side or from the base of the flower at an early stage, often before the stamens of the same flower are mature—thus as it were inviting cross-fertilisation from the more precocious stamens of other plants which are already shedding their pollen. All who have gathered grasses will have remarked that some have yellow anthers, others pink or violet anthers; and that anthers of both types of colours may co-exist on distinct individuals of the same species. The same peculiarity is just as noticeable in tropical grasses, and (without professing to give a complete physiological explanation of it) this is what I have observed respecting it. The walls of the anther-cells are usually of some shade of purple, but are so very thin and pellucid, that when distended with mature pollen the yellow colour of the latter is alone visible. When the pollen is discharged, the anthers resume their original purple colour, shortly, however, to take on the pallor or dinginess of decay. Where the anthers emerge of a purple hue, and change from that to brown, it will probably be found that they have discharged their pollen while still included in the flower. These observations, made without any reference to the question now in hand, require to be renewed and tested; and in them, as in all that precedes, I am open to correction. Of grasses with bisexual flowers, there are two ways in which the ovary may be fertilised, viz., either by the pollen of its own flower (closed or open), or by that of other flowers, after the manner of the diclinous species. In the latter case, the pollen may be transported by the wind, or in the fur of animals (as I have observed the seeds of *Selaginellas* in South America), or in the plumage of birds. The agency of insects has not been traced in the fertilisation of grasses, but may exist. The little flies I have seen on the flowers of grasses seemed bent on depositing their eggs in the nascent ovaries, but may also have aided in cross-fertilisation. In the Amazon Valley grasses are often infested by ants, who, indeed, leave nothing organic unvisited throughout that vast region; and they also, I think, cannot help occasionally transferring grains of pollen from one flower to another. The flowers of palms and grasses agree in being usually small and obscurely coloured, but contrast greatly in the former being in many cases exquisitely and strongly scented, whereas in the latter they are usually quite scentless. The odour of palm-flowers often resembles that of mignonette; but I think a whole acre of that 'darling' weed would not emit more perfume than a single plant of the fan palm of the Rio Negro (*Mauritia Carara*, Wallace). In approaching one of these plants through the thick forest, the sense of hearing would perhaps give the first notice of its proximity, from the merry hum of winged insects which its scented flowers had drawn together, to feast on the honey, and to transport the pollen of the male to the female plants; for it is chiefly dicœcious species of palms that have such sweet flowers. The absence of odoriferous flowers from the grasses seems to show that insect aid is not needed for effecting their fecundation, but does not render its accidental concurrence a whit less unlikely. That grasses, notwithstanding their almost mathematical character, vary much as other plants do, is plain from the multitude of osculating forms (in such genera as *Eragrostis*, *Panicum*, and *Paspalum*), which puzzle the botanist to decide when to combine and when to separate, in order to obtain what are called 'good species.' Hence the conclusion is unavoidable that in grasses, as in other plants, variations of surrounding conditions induce corresponding modifications of structure, and that amongst the former must be enumerated cross marriages, however brought about. If the flowers of grasses be sometimes fertilised in the bud, it is probably exceptional, like the similar cases recorded of orchids and many other families. To conclude: the more I ponder over existing evidence, the more I feel convinced that in its perfect state every being has the sexes practically separated, and that natural selection is ever tending to make this separation more complete and permanent; so that the hypothesis of Plato, that the prototype even of man was hermaphrodite, may one day be proved to be a fact!"

—Mr. Saunders alluded to the circumstance that the dead bodies of a species of fly might occasionally be found imprisoned in the flowers of *Lolium perenne*, as if the plant exerted some poisonous influence on the insect. Mr. A. W. Bennett stated, as a result of his observations, that it is impossible to predicate of any given family, whether its members are self or cross-fertilised. In the same group some species may be cross-fertilised, others self-fertilised. Many winter-flowering plants are self-fertilised, and amongst them the common *Poa annua*. Mr. Horne stated that in India different varieties of maize remain constant, even though grown in adjacent fields, so that it would seem as if no crossing took place in this instance.—A conversation then ensued as to the best method of conducting in future the meteorological observations at Chiswick, when Mr. Glaisher stated that he would be willing to reorganise the system of observation in such a manner as to introduce the requisite changes, without impairing the value of the record kept at Chiswick for upwards of forty years. In reference to ground temperature, he stated that at a depth of twenty-five feet the ground was coldest in July, and warmest in January.

Institution of Civil Engineers, December 21.—Annual General Meeting. Charles Hutton Gregory, Esq., president, in the chair. Referring to the business at the ordinary general meetings, of which there were twenty-two during the past session, attention had been directed by the papers read, and by the discussions upon them, to the use of machinery in lieu of gunpowder for "getting" coal; to cylinder foundations for bridges and other similar structures; to the Midland line of the Mauritius railways, where exceptionally steep gradients and sharp curves were necessarily adopted; to some of the chief peculiarities of American locomotives and rolling stock; to works carried out in connection with the river Witham and estuary, for the drainage of the fens and the improvement of the navigation; to the past and present condition of the outfall of the river Humber, and of its peculiar feature, Spurn Point; to the New Ferry and the New Brighton piers and landing-stages on the river Mersey; to the Low-water Basin at Birkenhead, and the extensive sluicing operations for maintaining the basin at its proper depth; to the lagoons and marshes on certain parts of the shores of the Mediterranean; to the mechanical details of construction of lighthouse apparatus and lanterns; to the Roman Rock lighthouse, Cape of Good Hope; to the standards of comparison for testing the illuminating power of coal-gas; and lastly, to an able summary, by a foreign engineer, of the present state of knowledge as to the theory of the strength and resistance of materials of construction. The originality, labour, and ingenuity displayed in these communications, had led to the award of Telford Medals and Premiums of Books to Messrs. Jules Gaudard, W. Shelford, T. N. Kirkham, J. Ellacott, and D. T. Ansted, F.R.S.; of a Watt Medal and a Telford Premium of Books to Mr. Z. Colburn; of Telford Premiums of Books to Messrs. W. H. Wheeler, J. R. Mosse, I. Bell, J. Milroy, S. P. Bidder, jun., and C. J. Chubb; and of the Manby Premium of Books to Mr. D. M. Henderson.

In addition to the ordinary general meetings, there were six supplemental meetings, for the reading and discussion of papers by the students. For the papers read at these supplemental meetings, Miller Prizes had been awarded to the following students: Messrs. E. Bazalgette, F. H. Mort, T. J. Ellis, T. R. Gainsford, C. H. G. Jenkinson, and G. H. Roberts.

After a statement of the financial condition of the institution, it was announced that the council had recently taken vigorous measures to vindicate the honour of the profession, which had been unjustifiably assailed by the Government of India, in a notification, the plain intention of which could only be to charge civil engineers with recognising as legitimate the receipt of commissions from others than their immediate employers, and in addition to their salaries, where so remunerated. The Secretary of State for India had put on record "that he regards with implicit confidence the indignant repudiation by the institution of the recognition of any such practice as that referred to," and that he would call upon the Governor-General in Council for an explanation of the circumstances which led to the issue of the objectionable notification. A sufficient time had not yet elapsed for an answer to be received from India to the remonstrance of the institution. In the meantime, the council felt assured that the steps they had taken would meet with cordial approval. In inviting attention to this report, the presentation of which terminated the trust confided to them by the last annual general meeting, the council observed that they had laboured so to direct the affairs entrusted to them, that the discharge of their duties might be attended with advantage to the institution.

The following gentlemen were elected to fill the several offices in the Council for the ensuing year:—Charles Blacker Vignoles, President; Joseph Cubitt, Thomas Elliot Harrison, Thomas Hawksley, and George Willoughby Hemans, Vice-Presidents; James Abernethy, William Henry Barlow, John Frederic Bateman, Joseph William Bazalgette, Nathaniel Beardmore, Frederick Joseph Bramwell, James Brunlees, John Murray, George Robert Stephenson, and Edward Woods, Members; and Edward Middleton Barry and Lieut.-Col. Andrew Clarke, C.B., R.E., Associates.

EDINBURGH

Royal Physical Society, December 22.—Professor Duns, president, in the chair. The following gentlemen were elected members:—Messrs. Gibson and Durham. The office-bearers for the sessions were elected as follows:—Presidents, Professor John Duns, D.D., R. F. Logan, C. W. Peach; Council, E. W. Dallas, T. S. Wright, M.D., James M'Bain, M.D., R.N., R. Brown, Stevenson Macadam, A. Wilson; Secretary, John A. Smith, M.D.; Treasurer, G. Logan, W.S.; Assistant Secretary, J. Boyd Davies; Honorary Librarian, A. Taylor.—Notice of the occurrence of *Gonoplax angulata* off the coast of Mull, by M. Watson, M.D. This rare crab was taken in September last by Dr. Watson, when dredging in "Bloody Bay," on the north coast of Mull, in about twenty-five fathoms water. The dredge was filled with soft mud, along with a great quantity of the *Pennatula* and *Virgaelaria*. As far as he could learn, it was the first time it had been taken on the Scottish coasts. Mr. Bell, in his "Brit. Crustacea," says it is not known to have been taken in Scotland. This species has not been taken on the east coast of Scotland nor in Shetland. Mr. Peach stated it was got on the south coast of England, on the Welsh coast, and also in Ireland. It is a Mediterranean species. The specimen was a young male, and was an interesting addition to the list of Scottish crustacea. Dr. Duns exhibited a fine species of Gurnard (*Trigla*), which had been forwarded to the New College Museum by the Rev. Walter Wood, Elie, to whom it had been brought as a novelty by a fisherman. He pointed out a number of features in which the specimen differs from those described by Yarrell, Fleming, Gunther, and others, but was inclined to regard it as a variety of *Trigla pini* (Block).

DUBLIN

Natural History Society, January 5.—The Rev. Professor Haughton, M.D., F.R.S., in the chair. Mr. W. Andrews read a paper "On the inhabitants of rockpools and caves, Dingle Bay." The rockpools of Dingle Bay had been examined in October 1868, and were teeming with animal life. After reminding the members of the pleasure of being naturalists, Mr. Andrews said that in the present paper he would speak of the Actinozoa that he had met with in Dingle Bay, and among the species that he mentioned the following appear to be of most interes as being apparently unrecorded as Irish:—*Aiptasia couchii; Cerianthus*, a species near *C. Lloydii*, *Stromphia churchiæ*, *Balanophyllia regia*. Living specimens of *Caryophyllia smithii* were dredged in fifty fathoms of water. Mr. Jeffrey's paper "On Deep-sea Dredging" (*Vide* NATURE, p. 135), was referred to, as proving that this coral was a deep-sea species, whereas Mr. Gosse and Professor Wright twelve years ago described it as being a littoral zone species. Great quantities of *Nullipora compressa* were met with, and many beautiful coloured specimens of the egg-cases of *Pyrpura lapillus* with the young shell in them. The author then proceeded to refer to coral-reefs, and stated that he now believed that the *Millepora alcicornis* Linn. was not a coral. It was a true *Eschara*, and took the place in these seas of the *Pœcillopora* of the tropics. At another time he would refer again to the stony corals met with in Dingle Bay, and enter into the full history of their affinities and structure.—Dr. A. Macalister read a paper "On the Mode of Growth of Univalve Shells." Referring to Canon Moseley's memoir on the geometrical forms of turbinated and discoid shells, he stated that he had made a large number of measurements to determine the logarithmic spiral of the different families of Gasteropods, with the hope that the number found to express the ratio of the geometrical progression of the dimensions of their whorls might be of use in classification. In this he had to a certain extent succeeded, as the tables exhibited showed. Mr. Lalor was glad to see the result of Dr. Macalister's work, as it quite corroborated some investigations that he had made on this interesting subject several years ago.—The Rev. Professor Haughton then read a

paper "On the Geometrical Characters of Muscles." He alluded to the researches of J. A. Borelli, as given in his "De Motu Animalium," published at Rome in 1680, and stated that the classification of muscles therein mentioned was surprising for its accuracy. Dr. Haughton had modified and added to it as follows :—I. Muscular fibres being on same plane : 1. The fibres parallel ; 2. The fibres intersect ; 3. The fibres curved (sphincter). II. Muscular fibres being on curved surfaces : 1. Where the fibres formed right lines ; 2. Where no line on the surface was a right line.—Mr. Lalor read a paper, not containing any original matter, "On the Anatomy of the Oyster."

MANCHESTER

Literary and Philosophical Society, December 28, 1869.—J. P. Joule, LL.D., F.R.S., &c., president, in the chair. "On Pollen considered as an aid in the Differentiation of Species," by Charles Bailey. The author, having recently examined the pollen of several thousand species of plants, is led to think that the characters presented might prove useful as a means of differentiation in allied species ; the following notes are thrown out as indications of some of the more noticeable distinctions to be drawn :—

1. FORM.—It has long been noticed that certain types of pollen are characteristic of the natural order to which the plants which produce them belong, as, for instance, the peculiar pitted polyhedral pollen of the *Caryophyllaceæ*, the spherical spiny pollen of the *Malvaceæ*, the large triangular pollen of the *Onagraceæ*, the peculiar pollen of the *Coniferæ*, or the elliptical pollen of the *Liliaceæ* and other monocotyledonous orders ; in fact, most orders possess a type sufficiently marked to be characteristic of each. This statement, however, must be accepted with limitations ; the *Compositæ*, for instance, have three or more well-marked types, represented by the beautifully sculptured pollen of the Chicory, the minute oval spiny pollen of the Asters, Calendulas, Cacalias, &c., and another form wholly destitute of spines, as in the *Centaurea Scabiosa*. There are, besides, other natural orders where similar variety occurs. But differences of form are met with in plants of the same genus, by which the one species or the other is readily marked off by its pollen ; thus, the pollen grain of *Anemone sulphurea* is roundish, but that of *Anemone montana* is elliptic ; the pollen of *Aronicum Doronicum* is much more elongate than that of *A. scorpioides ;* and while the grains of *Ranunculus philonotis* are round and yellow, those of *R. platanifolius* are elliptic, white, and smaller.

2. MARKINGS.—The pollen of the *Geraniaceæ* and *Campanulaceæ* is for the most part globular, but while some of the grains are quite smooth, others are covered with spines ; thus, the pollen of *Campanula Media* has a number of short spines sparsely scattered over the surface of the grain, but *C. rapunculoides* is wholly destitute of them. In other plants these spines are replaced by tubercles, and both spines and tubercles vary greatly in length and number ; for example, in *Valeriana tuberosa* the spines are only half the length of those on the pollen of *V. montana*, the grains being also slightly smaller. The pollen of the *Liliaceæ* is often covered with a more or less prominent reticulation, which is subject to much variation ; compare, for example, the coarse network which invests the pollen of *Lilium croceum* with the finer reticulation of *L. canadense*, the grains of the latter species being much more globose and smaller.

3. DIMENSIONS.—Some instances of the differences observable in the size of pollen grains have already been published by Professor Gulliver, whose measurements of the pollen of various species of *Ranunculus* show the help that may be derived from this character ; *R. arvensis* is nearly twice the size of *R. hirsutus* their dimensions being respectively $\frac{1}{470}$ and $\frac{1}{853}$ of an inch. For some noticeable differences, compare the smaller pollen of *Epilobium brachycarpum* with the larger pollen of *E. Fleischeri*, or that of *Senecio gallicus* with *S. incanus*, the spines on the latter species being also much coarser. Again, the pollen of *Silene acaulis* is but half the size of that of *S. alpina*, the latter having some beautiful markings in addition ; the pollen grains of this genus differ from the usual caryophyllaceous type in not having the pits or depressions common in the order, so that the grains become spherical rather than polyhedral.

4. COLOUR.—This is not so reliable a character for differentiation as the others noticed, since species differ amongst each other according to the soil, &c. The pollen of *Ajuga genevensis* is yellow, but of *A. pyramidalis* is usually white ; again, while the grains of *Ornithogalum umbellatum* are large and yellow, those of *O. nutans* are small and white. In regard to the mounting of these objects for the microscope, they show to the best advantage when put up perfectly dry ; the cells should be sufficiently shallow to admit of no more than a single layer, and at the same time deep enough to permit the grains to move about. If pollen is mounted soon after it has been discharged from the fresh anthers, the fovilla is apt to condense on the covering glass, and the slide soon becomes useless. The stamens taken from an unopened flower-bud furnish the best and cleanest pollen, and these should be selected in preference to those taken from the fully-developed flower. Canada balsam, glycerine, and other media are occasionally helpful in making out structure ; thus the pores of *Campanula rotundifolia*, *Phyteuma Halleri*, and other allied species are made much more distinct when mounted in balsam.

Microscopical and Natural History Section.—December 6, 1869.—J. Watson, Esq., president of the section, in the chair. Mr. W. Boyd Dawkins, M.A., F.R.S., was elected a member of the section. Mr. J. B. Dancer, F.R.A.S., read a short paper on some of the new Hydro-carbon Compounds from which he had obtained very beautiful polarising objects for the microscope.

PARIS

Academy of Sciences, January 3.—M. Coste was elected vice-president, and MM. Chasles and Decaisne members of the general administrative committee. The outgoing president, M. Claude Bernard, gave an account of the present condition of the publications of the Academy, and announced the changes among the members and correspondents during the past year. The following memoirs and communications were then presented : "On the demonstration relative to the sum of the angles of a triangle," by M. Bertrand ; "On the nascent state," by M. H. Sainte-Claire Deville ; "On the constitution of the solar aureola, and on some peculiarities of Geissler's tubes," by Father Secchi. The publication of Father Secchi's letter is delayed on account of some illustrations which accompanied it not being ready. The memoirs presented to the Academy were as follows :—"On the poinçonnage (piercing) of metals and plastic substances," by M. Tresca ; "On a postulate of Euclid," a note by M. Lionnet, and a note on the same subject by M. Fleury. Of the correspondence addressed to the Academy, the more important were a note by M. Tréve on the action of magnetism on gases, a communication by M. Houzeau "On the origin of nitrogen gas in oxygen supposed to be pure," one by M. Gaudin indicating the process employed in the fabrication of artificial precious stones, and one by M. Prillieux on the movements of grains of chlorophyll under the influence of light. Some account of M. Tréve's note, which is of very great interest, will be given subsequently. The other elections are referred to elsewhere.

BERLIN

German Chemical Society, Dec. 27.—The following papers were read :—Ed. Schaer: "On some relations shown by Coppersalts in the presence of Cyanides."—Th. Zincke: "On the Synthesis of Aromatic Acids." (The author treated the ether of monochloroacetic acid with bromide of phenyle and molecular silver thus producing botaylic ether).—Kempf: "On Chlorocarbonate and Carbaminate of Phenyle."—Vogel: "On recognising Sulphuret of Carbon in Gas."

ITALY

Reale Instituto Lombardo di Scienze e Lettere.—"Report of Researches in the Class of Mathematical and Natural Sciences." (Session, 1868-69.) By Professor Schiaparelli.

Mathematics.—In a memoir "On the Equations which determine the points of contrary flexure of Elliptic Curves," Prof. Brioschi gives the methods of determining the points of flexure of those curves of the n'th order which have $\frac{n(n-3)}{2}$ double points or cusps. Prof. Cremona has studied "The Transformation of Hyperelliptic Curves," that is to say, of those curves whose co-ordinates may be expressed rationally by means of a parameter λ, and the square root of an integral function of even order of this same parameter. The "Number of Moduli of the Equations and Algebraic Curves of a given genus" has been investigated by Professors Cremona and Casorati, whose results tend to support the rule given by Riemann for determining the said number, also the different rule proposed for the same purpose by Cayley. A memoir by Prof. Boltrami of Bologna contains "Researches on a new element introduced by Christoffel into the Theory of Surfaces," which is nothing else than the quantity by which it is necessary to multiply the infinitesimal angle between two geodetics proceeding from the same point, in

order to obtain the length of the arc of any orthogonal trajectory to the two geodetic lines in question, comprised between the same lines. Prof. Geiser of Zurich has generalised, for any number of dimensions, or translated into an analytical fact for any given number of variables, "A theorem of Steiner relating to properties common to all the Maximum Triangles inscribed in a given Ellipse." A communication from the illustrious Clebsch, professor at Göttingen, refers to those "Surfaces which have the property of being representable point by point above a plane." Such representations are known to afford an extremely powerful instrument of geometric analysis. Prof. Bardelli has collected and demonstrated all the formulæ proposed by various geometers (Euler, Monge, Rodrigues Broschi), for the very useful problem of the "Transformation of Co-ordinates in Space," showing the relation and the geometric significance of the several systems of auxiliary variables adopted by those authors. Finally, amongst the mathematical researches may also be included a note by Schiaparelli on "The principle of the Arithmetic Mean in the calculation of Observations," and one by Prof. Porro, "On the new Cleps-cyclic Theodolite," an instrument invented by the author for rapid surveying.

Hydraulics.—The memoirs presented to the Institute under this head were chiefly of local interest, relating to the rivers and canals of Upper Italy. There is also one by Senator Lombardini, entitled "Geographical and Hydrological Researches in the Regions of the Upper Nile and Central Africa."

Astronomy, Meteorology, and Terrestrial Physics.—In a memoir entitled the "Variations of the Eccentricity of the Earth's Orbit, and of Terrestrial Climates in the Geological Epochs," Schiaparelli endeavours to prove that the changes of eccentricity in the orbit cannot be the cause of the great oscillations of temperature which have taken place in geologic epochs, and that the origin of the glacial periods must be sought elsewhere.—Prof. Cantoni, speaking of "The Rains of the Autumn of 1868 in Upper Italy," discusses the cause of the terrible inundations of that year. Cavalleri communicates an "Observation on the Aurora Borealis of the 13th of March, 1869," which was visible over a large part of Europe; and lastly, Prof. Rialti of Forli communicates a note "On the Cause of the Incandescence of Bolides," which gave occasion to Prof. Cantoni to make a calculation respecting the heat developed in bolides by the resistance of the air, analogous to those which had been made on the same subject by Reichenbach in Germany and Marsh in America.

Physics.—Prof. Cantoni has made a series of researches on "Frictional Electrical Machines," and especially that of Holtz; the "Theory of the Electrophorus and of Electro-static Induction," respecting which the author modifies essentially the ideas hitherto generally received; "The application of the Galvanometer to the study of electric phenomena," in which part of the research Cantoni was assisted by Prof. Brusotti of Pavia; "The relations between the variations of intensity of a current, and those of the temperature in a voltaic circuit;" and other subjects connected with the preceding.—The memoirs of Prof. Vilari relate to "The Influence of Magnetisation on the Electric Conductivity of Iron and Steel; the Currents induced between Iron and other Metals; the Heat developed by Caoutchouc when submitted to Traction;" and in association with Dr. Marangoni, on "The limits of perception of Sounds with respect to their duration."

Chemistry.—Prof. Polli, in examining the intimate mode of action of Sulphurous Acid and Alkaline Sulphites on Fermentable Organic Matters, has endeavoured to show that the mode of action of these preparations consists in an isomeric modification of the molecular aggregation, without alteration of the elementary chemical composition.—Prof. Selmi, of Mantua, has communicated his experiments on the miasmatic air of Mantua.

Natural History and Geology.—Under this head there are two botanical memoirs by Prof. Gorovaglio: one on a New Species of Sensitive Plant, cultivated in the Botanic Garden of the University of Pavia; the other containing a project for the establishment of a laboratory of Cryptogamic Botany, with the view of studying the maladies of plants and animals produced by cryptogamic parasites.—In connection with zoology, there is a note by Crivelli and Maggi on the *Corpora fimbriata* of the Frog, and another by Tigri, on the Silkworm Disease.—In Geology, Paolo Garini communicates a paper on a method of producing experimentally the phenomena of Glaciers.—Leopold Maggi communicates his researches on Lacustro-glacial Deposits; and, lastly, Negri and Spreafico have presented a memoir on the Geology of the Environs of Varese and Lugano.

DIARY

THURSDAY, JANUARY 13.

ROYAL SOCIETY, at 8.30.—On the Mineral Constituents of Meteorites: Mr. N. S. Maskelyne.—On Fluoride of Silver: Mr. G. Gore, F.R.S.—Approximate Determination of the Heating Powers of Arcturus and α Lyræ: Mr E. J. Stone, F.R.S.

MATHEMATICAL SOCIETY, at 8.—Equation of Centres and Foci of certain Involutions: J. J. Walker.

ZOÖLOGICAL SOCIETY, at 8.30.

LONDON INSTITUTION, at 7.30.

FRIDAY, JANUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 8.

QUEKETT MICROSCOPICAL CLUB, at 8.

MONDAY, JANUARY 17.

ROYAL ASIATIC SOCIETY, at 3.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

MEDICAL SOCIETY at 8.

TUESDAY, JANUARY 18.

STATISTICAL SOCIETY, at 8.—On the Statistics of Joint Stock Companies from 1814 to the present time, and of Companies with Limited and Unlimited Liability formed since 1856: Prof. Levi.

ANTHROPOLOGICAL SOCIETY, at 4.—Anniversary Meeting.

ROYAL INSTITUTION, at 3.—On the Architecture of the Human Body: Prof. Humphry.

PATHOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.

WEDNESDAY, JANUARY 19.

METEOROLOGICAL SOCIETY, at 7.

SOCIETY OF ARTS, at 8.

THURSDAY, JANUARY 20.

LINNEAN SOCIETY, at 8.—On the Flora of Iceland: Prof. Babington.—On New British Spiders: Rev. O. P. Cambridge.

ROYAL INSTITUTION, at 3.—On the Chemistry of Vegetable Products: Prof. Odling.

ZOOLOGICAL SOCIETY, 8.30 P.M.—Descriptions of a new genus and of eighteen new species of Eand and Marine Shells, Henry Adams. "On the geus Pelargposis of the family Alcedinidæ," R. B. Sharpe. Description of a new Fish from the vicinity of Aden, Lieut.-Colonel R. L. Playfair.

BOOKS RECEIVED

ENGLISH.—Wonders of the Deep: M. Schele de Vere (Sampson and Low).—Anatomy of the Blowfly: B. T. Lowne (J. Van Voorst).—Journal of the Scottish Meteorological Society, 10 numbers.—Ancient Classics, Homer's Iliad: Rev. W. L. Collins (W. Blackwood and Sons).—Cups and their Customs (J. Van Voorst).—Geology and Revelation: G. Mulloy (Longman and Co.).—Across America and Asia: R. Pumpelley.—The Andes and the Amazon: James Orton (Sampson Low).

AMERICAN.—Farming for Boys.—Our own Birds of the United States: W. L. Bailey (through Trübner and Co.).

FOREIGN.—Die Technisch verwendeten Gummi-arten, Harze and Balsame: Dr. Julius Weisner.—Lehrbuch der Chemie: Dr. J. Moser.—Untersuchungen über die theorie und das allgemeine Geographische System der Winde: Dr. Adolph Mühry.—Anatomische Studien: Dr. C. Hasse.—Auffassung der Organischen Natur: Prof. Wilhelm His.—Untersuchungen über die microscopische Zusammensetzung und Structur der Basalt-gesteine: Dr. F. Zirkel.—Recherches pour servir a l'histoire naturelle des Mammiefres; Livraison 5, feuilles 13 à 15: H. Miln-Edwards.

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ERRATUM.—The word "practical," in the 37th line on page 267, should have been "partial."

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH

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