THURSDAY, JANUARY 1, 1874

THE YORKSHIRE COLLEGE OF SCIENCE

NOW that a scheme for a College of Science at Leeds has been all but completed, under the chairmanship of Lord F. C. Cavendish, M.P., it seems somewhat surprising that such an institution in connection with Yorkshire has not been thought of long ere now. It is the largest county in England, carries on a greater variety of industries all more or less dependent for success on the results of scientific research, and boasts of a larger number of local scientific societies and field-clubs than any other county in the three kingdoms, as we have shown in our articles on that subject. However, "better late than never;" and to judge from the prospectus and subscription lists, a very fair start is likely to be made. The scheme proposed by the committee formed at Leeds in 1869 involved an expenditure of 100,000*l.*, but it is not intended at present to carry out the whole of this scheme, but to commence on a smaller scale in temporary premises and with a limited number of professors. We have no doubt, from the hearty way in which the proposal has so far been met, that the college will be a success, and that ere long it will be possessed of a handsome building of its own, with a full staff of professors.

From what follows, it will be seen that the teaching will have a practical or technical aspect, having regard to the processes connected with the multifarious arts and manufactures which occupy the large population of Yorkshire. In the midst of an eminently practical people, there can be no fear of this consideration being neglected, but we hope that in the long run the claims of pure science will not be overlooked, for it is every day being more and more clearly proved that a preliminary training in pure scientific research is the best introduction to a "technical" education; and very many of the industrial applications of science have been found out by students who took no thought of the practical issues of their investigations. There is more than one institution in America which might, in this respect, be taken as models for a technical college.

The Yorkshire College of Science, the Prospectus tells us, is intended to supply an urgent and recognised want, viz.:—Instruction in those Sciences which are applicable to the Industrial Arts, particularly in their relation to Manufactures, Engineering, Mining, and Agriculture. It is designed for the use of persons who will afterwards be engaged in those callings as foremen, managers, or employers; and also for the training of teachers for ordinary Science Schools and Classes.

To carry out the object of the College, it is proposed to establish Professorships in (1) Chemistry and its application to Metallurgy, Manufactures, and Agriculture; (2) Civil and Mechanical Engineering; (3) Physics and Mathematics; (4) Geology and Mining.

The Provisional Committee seem to have right notions as to how scientific men ought to be treated. To obtain the services of eminent scientific men, they say, the payment to each Professor cannot be less than 300*l.* per annum, in addition to a proportion of the students' fees. A precarious income, if raised by annual subscriptions, would not secure Professors of high scientific qualifications, to whom the permanency of the scheme has to be assured. Besides the stipends of the Professors, sundry annual expenses for working and maintenance will be required, and these will be paid out of the general fund. The Committee therefore appeal for contributions upon a generous scale commensurate with the importance of the proposed scheme. This appeal has been well answered already; but we hope that the Committee will not rest until the whole of the original scheme has been realised.

The Committee refer to the sum raised for the Newcastle College of Science, 22,025*l.*, with an annual contribution of 1,000*l.* from the University of Durham, and say with justice, that, considering that the wealth of the district over which the benefits conferred by the Yorkshire College of Science will extend is at least equal to the Newcastle district, it is to be hoped that the public spirit of Yorkshiremen in behalf of the College will be as freely expressed.

To the Owens College, Manchester, the sum of 13,500*l.* has been contributed by the engineering profession towards the endowment of the chair for Engineering; and the hope is entertained that towards the endowment of the Professorship in that subject in the Yorkshire College of Science, aid may be forthcoming from a similar source. The chair for Chemistry has also peculiar claims for support upon the manufacturers of the county whose business requires the aid of chemical science.

Arrangements will be made for the establishment of scholarships at the College. All donors of 500*l.* and upwards towards the College funds will be entitled to nominate to a free studentship for a term of years.

It is proposed to vest the government of the College in a board of governors, consisting of (*a*) all subscribers of 250*l.* and upwards; (*b*) fifty governors elected by the general body of subscribers; (*c*) two professors elected by the professorial staff. The governors shall hold two meetings in the year, shall appoint trustees, shall audit the accounts, shall receive the annual report from the council of the College, and shall constitute a court of appeal in certain cases. The ordinary administration shall be in the hands of a body called the council. This shall consist of fifteen members, including a chairman, to be elected out of and by the governors.

One of our wealthy City Companies, the Clothworkers' Company, we are glad to see, has generously come forward in the interests of the College as well as in the interests of the particular branch of manufacture with which the Company is connected, by endowing a Professorship of Textile Fabrics with 300*l.* a year. The subscription of the coal-owners alone amounts to some thousands of pounds, and we have no doubt, when the time comes to extend the sphere of the College and to give it a permanent building of its own, this wealthy class will see it to be their duty largely to add to this subscription. We hope also that others of our City Companies will see it to be their interest to lend a helping hand to the young institution. There are several such technical institutions on the Continent, and it is on this account that in several respects Continental manufactures are much superior to those of Britain. Let us hope that this may not be much longer the case, but that by the establishment of the Yorkshire

College of Science, and similar institutions in other districts, all who are in any way connected with our arts and manufactures may be trained to work on a method so really scientific that Britain shall in this, as she certainly is in some other respects, be foremost among the nations.

REFRACTION OF LIGHT MECHANICALLY ILLUSTRATED

In preparing an elementary lecture on Light, intended to be given at the Taunton College School, I have had to consider how best to explain the somewhat abstruse principle of optical refraction. It is true that Sir John Herschel, in the sixth of his "Familiar Lectures on Scientific Subjects," giving the explanation of refraction on the undulatory theory, describes it as being "exceedingly simple." The fact is, however, that it involves conceptions of wave-motion, difficult for any but advanced students, and even they feel grateful to the eminent physicist for the help afforded by a familiar illustration with which he follows it. He desires his readers to imagine a line of soldiers marching across a tract of country divided at a straight boundary into two regions, the one level ground suited for marching, the other rough and difficult to walk over. Now if the line of soldiers march with their line of front oblique to the boundary, the men on the side just engaged in the heavy ground

Fig. 1

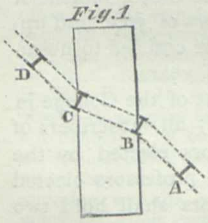
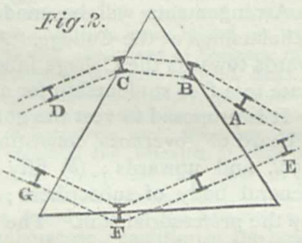


Fig. 2



will be retarded as soon as they cross into it, so that if the line be kept unbroken, the consequence must be a change of front, which will leave the whole body of men marching across the heavy ground in a new direction—in a word, their direction of march will have been refracted. Now the light-waves emitted from a radiant point being compared to the circles spreading from a stone thrown into a pond, it is easily understood how a sensibly straight portion of such a light-wave, passing obliquely from one medium to another of different resistance, will be refracted in a new direction. This simple conception of change of front is at once apprehended by the learner, to whom refraction thenceforth ceases to be a molecular mystery, and becomes an intelligible mechanical act dependent on the resistance of the two media and the form of their limiting surface. Probably no point in all Herschel's lectures has fixed itself in the memory of so many intelligent readers.

In following up the train of thought started by Sir John Herschel's comparison, it occurred to me that an instrument made to perform refraction mechanically would be useful in teaching optics, and that such a contrivance would only require a pair of wheels running on a table, into and out of a resisting medium. After a number of trials, made with the help of Mr. R. Knight, a simple arrangement has been completed, which answers satisfactorily in showing the behaviour of a ray of light under the various circumstances of ordinary refraction. Pieces of a thick-piled velvety plush known as "imitation sealskin" are cut out to represent the sections of a thick plate, a prism, a convex and a concave lens, and glued on to smooth boards. The runner consists of a pair of boxwood wheels mounted loosely on a stout iron axle, and is trundled across the board, or still better, the board itself

Fig. 3

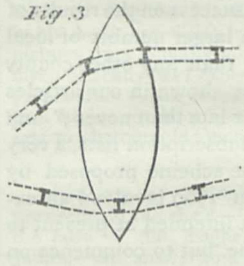
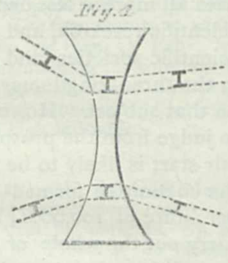


Fig. 4

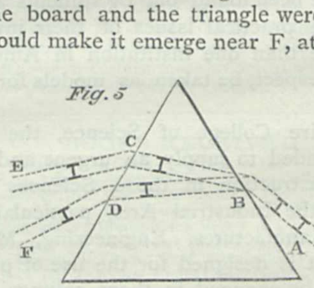


is tilted up, and the runner let go in the proper starting direction. The following figures show the path of the wheels, always from right to left of the page.

In Fig. 1, the runner starting from A, enters the rectangle of velvet at B, where its left wheel being first retarded, it shifts round into the direction BC, till it reaches C, where the left wheel first emerging gains on the right, so as to bring back the runner to the ultimate direction CD. This illustrates the refraction of a ray of light in entering and quitting parallel plane surfaces of a resisting medium, such as a plate of glass. When the runner enters at right angles to the boundary, its direction is of course unchanged, as with the ray of light.

Fig. 2 shows the path ABCD of the runner across a triangle, corresponding with the course of a ray traversing a prism. Also, by causing the runner to enter at about a right angle near E, a direction is given to it which, if the surface of the board and the triangle were similar as to resistance, would make it emerge near F, at a small angle

Fig. 5



to the side. But the left wheel passing on to the smooth surface gains so much on the right wheel still in the velvet, that the axle slews round, the left wheel re-enters th velvet, and the runner goes off in the direction FG, thus illustrating the total reflexion which takes place when a ray of light is directed to emerge very obliquely from a more into a less resisting medium, as from a glass prism or a surface of water into air.

The action of the double-convex lens in causing parallel or divergent rays to converge is shown by the path of the runner in Fig. 3, which requires no further explanation, nor does that corresponding to the divergent action of the double-concave lens, Fig. 4. By starting two runners at once from the right-hand side of the board, so as to traverse the upper and lower parts of the convex lens, they are made to run into one another, thus illustrating the meeting of rays in a focus.

Lastly, by using two runners with wheels of different diameters, as the refraction depends on the resistance to the wheels by the velvet, the apparatus may be so inclined as to show plainly their consequent difference of refractive angles. The courses of the two are seen in Fig. 5. This experiment, however, requires some nicety of arrangement

Now the separation of rays of different refrangibilities by a prism being due to a like cause, this experiment serves to illustrate mechanically the decomposition of white light. Let the large-wheeled runner represent the red ray, and the small-wheeled runner the violet ray, the principle of the prismatic spectrum becomes at once evident.

For the information of any who may wish to reproduce this simple apparatus, I may state the dimensions I have found convenient. The wheels may be 1¾ in. and 2 in., with rounded edges, mounted on a nearly half-inch iron axle, turned down to ⅛ in. at the ends. The boards may be 2 ft. 6 in. by 1 ft. 6 in., with velvet on each side. It is convenient to place the velvet nearer to one end of the board to leave room at the other for starting the runner; and care must be taken to cut the velvet so as to present a good resisting surface, as this varies with the direction of the pile. In using the apparatus for teaching, care in manipulation is required to neutralise the defects of the texture. Some kinds of "Utrecht velvet," to be had from the upholsterers, are more uniform than the "imitation seal-skin," and thus work more equally, but their effect is not so striking. Wet sand will answer equally well with the velvet, if metal wheels be used.

EDWARD B. TYLOR

THE FRESHWATER FISH OF INDIA AND BURMAH

Report on the Freshwater Fish and Fisheries of India and Burmah. By Surgeon-Major Francis Day, F.L.S. and F.Z.S., Inspector-General of Fisheries in India. 8vo. (Calcutta, 1873.)

IN the introductory part the author states that the present report is the result of investigations commenced by him in the year 1868, into whether a wasteful destruction of the freshwater fisheries is or is not occurring in India and Burmah. He comes to the conclusion that a wasteful destruction of fish is going on to a very great extent, that these fisheries are more and more deteriorating, and that immediate legislation is called for, to prevent the entire failure of a most important article of food.

The steps taken by the Inspector-General to ascertain the facts on which he bases his report were twofold. He personally inspected districts of various parts of the Indian Empire, and supplemented his own observations by collecting the opinions of European and Native officials, to whom he addressed a series of questions bearing upon the subject. Accordingly the book before us is divided into two parts :—(1) The report proper, pp. 1-118; and (2) A *résumé* of the answers returned, with marginal notes by the reporter, pp. i.-ccxxxvi. An article on "Fish as Food, or the reputed Origin of Disease," an Enumeration of the Indian freshwater fishes, and Notes on preserving specimens of fish, conclude the volume.

Europeans who have formed favourable ideas respecting Indian rivers and their abundance of fishes from the accounts which so frequently enliven the sporting papers of the day, will find them rudely dispelled by this report. It is true that not a few of the resident officials deny the decrease of fishes, and deprecate legislative interference altogether. Thus, for instance, the Commissioner of the Agra Division writes that there is no reason to apprehend that any wholesale destruction of fish goes on in these parts. A close-time might no doubt be introduced by law for the protection of fish during the breeding season, but it does not appear to him that it would be easy to carry out such a measure, or that there is any compensating object to be gained; that "it is a useful maxim—*de minimis non curat lex*—minute legislation is unbefitting our position in this country, and more likely to expose our Government to ridicule than to any results of important benefits to the people;" "it is in the highest degree undesirable that the public mind should be disturbed by gratuitous interference on the part of an alien administration, enforced by not very trustworthy agency." On the other hand, the Inspector adduces such incontrovertible evidence in favour of the conclusion he has arrived at, that we can but agree with him that in numerous districts the freshwater fisheries are in danger of being utterly destroyed, and this must appear to call for speedy interference by the Government all the more, as those districts are among the most populous, in which this article of food can be least spared.

Naturally one looks first for the causes by which the Indian fisheries are said to have been thus reduced; and it is not very flattering to be told by the author that this disastrous effect has been caused by the change from the Native to the British rule. He states that, under the former rule, fisheries formed royalties mostly let out to contractors, who alone in the district possessed the right to sell fish, and that they permitted the people, on payment, to capture fish for their own consumption; that the men who followed the occupation of fishing formed distinct crafts or castes, exercising their calling with certain restrictions and regulations. Under British rule the renting system was abolished; with the most philanthropic intentions, the British gave to the people liberty to fish when and where they pleased; where everybody could fish, fishing ceased to be a distinct calling; breedingfish were captured without regard to season; and when the supply of larger fish commenced to fail, it became the practice to catch undersized fish and fry. Add to this, that a number of irrigation weirs and dams were erected, preventing the fish from resorting to suitable spawning-beds, that fixed engines for the capture of fish are now used, where previously they were never permitted, and the natural result is the lamentable state as represented by the Inspector.

We need not enter at present into the remedial measures provisionally proposed by Mr. Day. His proposals, as well as the opinions of his opponents, will no doubt find due consideration on the part of the Indian Government. But I will not conclude this notice, without alluding to one or two of the reports of European officials, which will show that, however weighty their evidence may be as regards the practical side of the question, their opinions in scientific matters are open to criticism. Mr. Day had drawn attention to the destruction of fish by various kinds of crocodiles, very properly recommending that rewards should be paid for their eggs. To this one of the officials replies :—" Waging war against such fish-destroying animals as crocodiles appears to me absurd. I have no doubt at all but that a general destruction of crocodiles would directly frustrate the end hoped for by their destruction. Their very presence in numbers, it being given that they live on fish, shows that the supply of fish is abundant, which is all that anyone requires, and nature in these matters, if left alone, keeps the balance even, and resents interference." This is exactly the same view as that held by the modern advocates of a general preservation of birds, who would preserve even such as the sparrow-hawk and cormorant, and who forget that nature itself, in distributing animal life, does not always consult the convenience of man. In India, the presence of tigers, poisonous snakes and crocodiles, would appear to prevent this doctrine from being generally adopted by the European community. Another official refers to a "very exhaustive and carefully drawn up report" from a Civil Surgeon in his district ; this report is accompanied by a list of the freshwater fishes, in which occur some species with Buchanan-Hamilton designations, others with Latin terms derived from a dictionary, a cod-fish, a john dory, and "a very common fish, the scientific name of which is supposed to be *Lacerta scincus!*" Can anyone doubt after this that a comprehensive and well-illustrated hand-book of Indian Freshwater Fishes with an introductory treatise on the elements of Ichthyology is called for?

ALBERT GÜNTHER

KOHLRAUSCH'S "PHYSICAL MEASUREMENTS"

An Introduction to Physical Measurements, with Appendices on Absolute Electrical Measurement, &c. By Dr. F. Kohlrausch. Translated from the Second German Edition by T. H. Waller, B.A., B.Sc., and H. R. Procter, F.C.S. (London: J. and A. Churchill, New Burlington Street, 1873.)

MESSRS. T. H. WALLER and H. R. Procter have furnished us with a translation of the second edition of Dr. Kohlrausch's "Physical Measurements," to which they have added several useful Appendices and Tables.

Their work is intended to serve as a text-book for students in experimental physics, and consists mainly of a collection of the formulæ used in correcting and applying the results of the simpler experiments in weighing and measuring, heat, light, electricity, and magnetism, accompanied in each case by such an account of the method of observation employed as may suffice to render them intelligible.

The limits which the author assigned to himself are very clearly laid down in the Translators' preface, in which we are informed that "descriptions of apparatus are but rarely given, as students mostly have instruments provided for them," and also that "the mathematical knowledge required is but very elementary, as the proofs of the formulæ are only given when they present no complex arguments," but it should perhaps have been added that, even in cases where the apparatus is simple, outlines of the mode of performing an experiment are generally alone supplied, the teacher being left to explain to his pupils the niceties of arrangement and manipulation.

Regarded as a syllabus of a course of physics, the book is incomplete, no account, for instance, being given of Favre and Silberman's Calorimeter, or, with the exception of saccharimetry, of experiments on polarised light; and if the author's plan be thought to justify the exclusion of these, the same reason can hardly account for the omission of methods for determining melting points, or the specific gravity of substances whose constitution is altered by exposure to the atmosphere, or the ratio of the intensities of the illuminations produced by two sources of light, or of all experiments relating to the capillary elevation of liquids in fine tubes.

It is, however, as a collection of formulæ that "Physical Measurements" is likely to prove most useful, and from this point of view the "Introduction" seems to us one of the best parts of the book. It contains the rules for finding the mean and probable errors of a set of observations, and for determining empirical constants by the method of least squares, together with hints as to how to shorten the labour often wasted in the calculation of corrections; points on which a short practical treatise like that here provided will afford great assistance to those who are not mathematicians.

The sections devoted to weighing and measuring are full and good, especially those which relate to the use of the balance, but heat and light are not treated of in an equally satisfactory manner.

The experiments on these subjects which are described are not numerous enough to satisfy the requirements of large laboratories. Moreover, sufficient attention seems scarcely to have been paid to the fact that students should be encouraged to apply corrections to the results of experiments which they perform, not so much on account of the more accurate numerical values thereby obtained, as for the sake of the excellent practice the necessary observations often afford, and the insight gained into the theoretical principles on which they are founded. A case in point is the omission in the article on the Determination of Specific Heats by the Method of Mixtures of any account of the correction employed by Regnault for the loss of heat by radiation.

We miss all mention of the optical bank, and the mathematical expressions for results involving the determination of distance in terms of differential measures on that instrument. In the article on the spherometer, which is in other respects incomplete, we see no instructions for finding the radius of a spherical surface too small to permit the instrument to be placed upon it; and omissions are made in the pages devoted to the spectrometer, the goniometer, and elsewhere, which combine to render the section on Light very imperfect.

Nearly one half of the book is given up to Electricity and Magnetism, subjects in the study of which assistance can be more readily rendered by the method of treatment here adopted than in those we have been discussing, as numerous mathematical formulæ are required which are in many cases obtained by calculations beyond the grasp of the less advanced pupils; and the Translators have considerably improved what was already good by several Appendices, among which one of the most important is that on Thomson's electrometer. Some preliminary sections are devoted to the reduction of observations made with the mirror and scale to angular measure, to the determination of the position of equilibrium and time of oscillation of a magnetic needle and similar topics, while the methods of reading the various magnetometers and galvanometers, and the measurement of resistance and electromotive force, are afterwards discussed.

On the whole the principal fault we have to find with the book is a want of fulness, especially in the earlier portions. It aims at supplying a want already felt, and which will become still more pressing as the number of those who make some progress in the study of Natural Science increases, and we are not aware of the existence of any manual which gives the information contained in it in an equally compact and handy form; while the tables, thirty in number, which fill the concluding pages, will often save time and trouble to those engaged in laboratory work. Although, then, as we have already pointed out, we consider it capable of very considerable improvement, yet probably most teachers of Experimental Physics will obtain some useful hints from its perusal, even if they do not adopt it as a text-book for their pupils. A. R.

OUR BOOK SHELF

Pheasants for Coverts and Aviaries. By W. B. Tegetmeier, F.Z.S. (London: Horace Cox. 1873.)

ANY work on animals which appeals to so many different human weaknesses as the Pheasants, must be popular if the least effort has been made to do the subject justice. The one before us has merits which make it peculiarly acceptable. It is by the hand of an author who has devoted his life to the careful study of the natures and habits of the Gallinaceous birds and Pigeons, and who has long since made himself well known by works on some of the genera, which have become the standard literature of the points on which they treat. In the handsome volume before us Mr. J. W. Wood's excellent and truthful illustrations add greatly to its value, though the absence of coloration has made it more than difficult in some cases to produce an approach to the gorgeous appearance of some of the species depicted. Among those that suffer most from this deficiency, are the Japanese Pheasant (*Phasianus versicolor*), whose chief beauty consists in the richness and delicacy of the shades of its plumage, and the Golden Pheasant (*Thaumelia picta*), with its ally, the Amherst Pheasant (*T. amherstiæ*), whose resplendent hues even the best artist finds it difficult to represent. The Reeves' Pheasant (*P. reevesii*), and the Eared Pheasant (*Crossoptilon mantchuricum*), however, form excellent and most truthful pictures, colours in them not being such important features. Mr. Tegetmeier, besides describing each of those species which are the love of the sportsman and the pride of the aviary, devotes the earlier part of his work to the discussion of points of great practical interest. After a short history of the Pheasants as a family, from which it is clear that they were introduced into this country from Asia Minor, the native home of the common Pheasant (*P. colchicus*), as early as the reign of King Harold, and probably by the Romans, a series of chapters is given on the management of the bird in preserves and in confinement, together with an account of the diseases to which it is most liable. These are replete with practical detail that must be most valuable to the many who spend such large sums on preserving game, and to those who have the actual superintendence of the coverts themselves. Particular attention is drawn to the great difference between birds, like the common Fowl (*Gallus bankiva*), which are capable of domestication in the true sense of the word, and the Pheasants, which, though individuals are frequently known to become tame, can never be really domesticated; even the young ones taking to the woods on the earliest opportunity, whilst the opposite inherent peculiarities of the poultry have given rise to the proverb—"Curses, like chickens, come home to roost." Altogether this work supplies a long-felt want, and its perusal will well repay anyone who takes it up.

LETTERS TO THE EDITOR

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

Wasps

PERHAPS it may be of interest to some of your readers, who make entomology their study, to know that the wasps in a nest about a mile from this were still tolerably active on the 13th of this month, when my attention was attracted by the loud buzzing of three or four wasps at the entrance, apparently ventilating it with their wings after the manner of bees. I again visited the place on the 23rd. There were at first no signs of life outside; but stamping on the ground above caused a considerable number to come out after a minute or a minute and a half and hover in the air above the entrance. I attribute this unusual circumstance to the mildness of the season (the minimum temperatures having been 26° in October, 25° in November, and 29° on the 10th and 11th of December, and the 13th having been mild, and so also the 23rd) and the bad conducting power of the nearly cut out peat bog in which the nest was situated.

Birr Castle, Parsonstown, Dec. 24, 1873 ROSSE

The Potato Disease and Lord Cathcart's Prize

NO one acquainted with botanists and botanical science can feel surprised at the decision of the committee in this matter, and it must be confessed that, however well meant, the offer of the 100*l.* prize was a great mistake which has only ended in producing ninety-four unsatisfactory essays and the loss of a year.

Little else could have been expected, for the Council of the Royal Agricultural Society must surely be aware that the men (in this country at least) who are competent to write anything *new* on the subject could certainly be counted in units, and these men could not enter into the competition for more reasons than one, not the least being the loss of status such a proceeding would entail.

It appears to me that the committee have even now hardly hit the right nail upon the head in recommending a grant of money to "some competent mycologist" to investigate the life history of the fungus during a certain period of its life. If the investigation is carried on by any *one man* it is sure to end in failure. It would be far better for the committee to recommend that *five or six* competent botanists should each write an essay on the subject from his own point of view, each essay to be published in the Society's journal. There are many reasons why this would be best. I will give one. Payen has figured and described certain ciliated bodies found in spent potatoes, and which Berkeley and other botanists have looked upon as the probable resting-spores of the *Peronospora*. Montagne has referred these same bodies to the *Sepedoniei*, whilst I am by no means sure that the objects do not belong to the *Stilbacei*, and are no other than *Volutella ciliata*. However this may be, I have met with the last in spent potatoes in immediate connection with the *Peronospora* itself. Where competent observers differ in opinion it is better to get the views of all. It would be very unwise to restrict the observations to any particular period of the growth of the plant, and very little would be added to our knowledge were the resting spores themselves found; for, resting spores or no resting spores, it is an ascertained fact that the living fungus has a season of rest underground, and whether in the condition of resting spores, a sclerotioid mass or a number of myceloid threads, the principal fact remains that the fungus lives through the winter in a state of rest. As to certain potatoes being able to resist the disease, I shall shortly be able to show that whilst certain breeds of potatoes *entirely resist* it in one place, they fall a *ready prey* to it in another.

Hence any experiments carried on in one place by one person, though valuable in themselves, must be inconclusive and imperfect.

The great question is, "How can the disease be evaded or destroyed?" and this can only be answered, if answered at all, by men who thoroughly know the fungus and its allies.

WORTHINGTON G. SMITH

The Denudation of Limestone Hills of Sarawak

THERE is an agency in the denudation of the limestone rocks of Saràwak which I do not think has been noted, but which is very efficient locally in its operation.

The limestone in question is a dark-blue compact rock (probably the oldest stratified formation in this part of Borneo) full of fissures and joints, and forming hilly tracts in Saràwak proper and Samarahan. It is a not uncommon occurrence during periods of unusual drought for the jungle clothing these hills to take fire in some unascertained way, and for large tracts of the vegetation to be destroyed before the conflagration dies out or is extinguished by rains. Such an accident took place two years ago on the Jambusan hill, and a short time previously on Gunong Añgus (whence the present name, "Burnt Hill"), and on Marajah, a large hill near Bidi; and I have been informed by natives that similar fires are known at the head of the Undup, where I have observed from a distance extensive masses of limestone.

When such a fire takes place, not only may we take for granted that a great deal of surface-rock is more or less calcined, so as to be easily removable by the heavy tropical rains; but, there being no covering of soil to speak of, and the exterior rock having been merely bound together by a matted network of roots and creepers, large masses of rock—long loosened by weathering, or freshly detached by the expansion of air and water in the fissures—keep falling from the higher parts of the hill as their supports are burnt away; whilst groups of burning trees go crashing down the scarps, assisting the work of degradation by collision with the inequalities in their paths.

It is, however, subsequently to the fire that its most important effects become apparent. For the next year or two fresh dislodgments of rock will be continually taking place, particularly when, after the almost daily rains, the sun shines out, striking on the bared rock with rays of tropical fervour. Many years elapse before sufficient soil collects in the crevices of the rock to support vegetation; and until the whitened face of the hill is once more shrouded in jungle, it remains immediately exposed to steady sub-aërial denudation; so that, bearing in mind the immense rainfall, the abundance of fissures and joints in the stone, and its solubility, I am inclined to believe that the degradation of these hills which goes on during the interval before they again become efficiently shielded with vegetation, is comparable to centuries of waste of the same rock under ordinary conditions.

Were the limestone hills of Saràwak more gently rounded and less scarped, their destruction through the agencies above described might not be noteworthy; but, owing to the frequency of lines of old sea-cliffs and mural precipices, nearly the whole of the detached rock passes at once to the bases of the hills, where it is again attacked by the rains, assisted now by running streams or standing water.

Saràwak, July 1 A. HART EVERETT

An Appeal to our Provincial Scientific Societies

NOW that our provincial museums are yearly increasing in number, it appears desirable to draw the attention of the provincial scientific societies to their importance as the centres for the private collections illustrative of the local geology, natural history, and archæology which from time to time come into the market. We are entirely indebted to private energy for any British collections which we possess. How lamentable then is it that there is no public system for centralising them in our public museums, and thus saving them from dispersion by their passing into the hands of dealers or private collectors, or into the possession of foreign or metropolitan museums. Every year witnesses such losses, which are regarded with complete indifference by our local representatives of Science. It is unaccountable that not one of our provincial Societies has as yet had the public spirit, energy, or foresight to see the importance of this work and of raising a fund for the purpose of ultimately securing such collections for the district.

It is a question of national scientific importance. The collections which are formed during the present century may be said to represent the "pick" of the country. By-and-by, when localities are worked out, and the rarity and value of specimens greatly increased, we may awaken to a sense of the mistake we have made in not devoting our energies less to palæontological literature, and more to the formation of complete and exhaustive local series and collections, and thus smoothing the path of, and providing interest for, the investigators of our fossil and recent flora and fauna.

Such is the lack of originality displayed in this country, and precedent is so blindly followed, that everywhere we find narrow scientific cliques, so-called "Societies," apparently formed merely for the sake of having social gatherings and by means of a local periodical facilitating the cheap publication of the papers of such as contribute.

The energy thus expended is almost entirely thrown away. Indeed, so far as the journals of these "societies" are concerned, these societies are mere hindrances to the progress of Science, for, did they not exist, the papers which appear in their obscure journals (or "napkins," in which the "talents" of these societies lie hid) might be contributed to such as have a general circulation, and thus benefit the world at large. I would most earnestly impress on our scientific Societies the great importance of devoting their energies more to the formation and preservation of complete and exhaustive local collections. With such division of labour how much more accurate and rapid would be the progress of the sciences of Geology and Biology.

S. G. P.

The Killing of Entomological Specimens

A NOTE in a recent number of NATURE, reminds me of some experiments I made about 15 years ago upon the action of the vapours of volatile liquids (hydrocarbons, chloroform, &c.) on insects, my object being to find an expeditious and painless method of killing entomological specimens. Several vapours produced insensibility from which the insects recovered more or less rapidly, but bisulphide of carbon vapour killed them effectually.

My method of applying it was to place a few layers of blotting paper, lint, or cotton wool, on the bottom of a wide-mouthed bottle, pill box, or other convenient place of execution; then to pour a few drops of the liquid upon this and confine the insect in the receptacle, which on account of the great density of the vapour need not be very accurately closed. The action of the vapour must be continued a few minutes after signs of life have disappeared, or the insect will recover.

The most obstinate of beetles succumb without a struggle, and the most delicate of moths or butterflies are uninjured, provided the liquid itself does not touch them. Butterflies may be killed after they are pinned out, by simply placing a little cotton wool soaked with the bisulphide in a box near to them.

W. MATTIEU WILLIAMS

Lecture Experiments

THE result of convection in a liquid, tending to cause the upper part of the mass to be constantly at a higher temperature than the lower, may be well illustrated by the two following experiments:—

Two large glass beakers are placed in front of a sheet of white paper, one of them filled with cold the other with boiling water. A boiling-tube filled with freshly prepared starch solution which has been coloured deep blue by gradual addition of aqueous solution of iodine, and has then been heated until the colour just disappears, is plunged into the beaker of cold water; the blue colour, caused to return by the cooling of the solution, will appear first at the bottom of the tube and then gradually creep upwards, showing that the lower part of the heated liquid first becomes sufficiently cooled to cause the return of the colour. In order to insure the disappearance of this colour by heat, an excess of iodine must be carefully avoided.

In the boiling water contained in the other beaker is immersed a boiling-tube filled with the blue liquid obtained by adding caustic soda in excess to a solution of copper sulphate and tartaric acid, with which has been mixed a little grape sugar (a small quantity of "set" honey): the formation of yellow cuprous oxide commences at the surface of the liquid, and is seen gradually to extend to the lower parts, showing that the upper parts first attain the temperature requisite to cause the reaction to occur which precipitates cuprous oxide.

These experiments are easy of execution, and by the above arrangement, or still better by being projected on the screen, may be rendered visible at a considerable distance.

Queenwood College FRANK CLOWES

Mr. Garrod's Theory of Nerve-Force

THE thermo-electric theory of nerve-force propounded by Mr. Garrod (NATURE, vol. viii. p. 265) seems capable of extension. If a pole of metal, cased in a non-conducting sheath, were sunk in an artesian boring so as to reach from the level of constant temperature to the greatest depth attainable, how far would such pole fulfil the conditions of a sheathed nerve penetrating from the cool surface of an animal to the warmer interior? And with so little difference of temperature in so great a length, would its dynamic effect be at all appreciable?

A quarter of a mile of submarine cable let down the shaft of our Carnbrea mine might represent a sheathed nerve; and any existing nerve-force might there be tested. Abandoned mine-shafts are the terrors of our Cornish moorlands. Is it within the power of Science to convert them into earth-nerves, say by lining their sides with non-conducting material, and then packing them tight with conductive slag or some kind of metallic refuse? And is it possible, even in theory, to make such earth-nerves work some kind of earth-muscle? For ignorant me to speak of this subject is ultracrepidism (NATURE, vol. vii. p. 262). Yet it seems a fair extension of Mr. Garrod's ingenious theory.

AUGUSTINE CHUDLEIGH

Carnbrea, Cornwall

Genesis in Borneo

MR. CAMERON's paper read at the Society of Biblical Archæology, testifies to the early diffusion of Semitic traditions by the agency, it may be inferred, of Moslem converts.

The same traditional coincidences recorded of Borneo are found in New Zealand and elsewhere, and would naturally accompany the diffusion of Malayan dialects throughout Polynesia, an influence the duration of which may be counted by centuries.

A. HALL

Dec. 11

Indian Snakes

IN a small treatise on Indian snakes by Dr. Nicholson, R.A., the author states his belief that cobras will not feed in captivity unless forced to, starving themselves voluntarily to death. He thinks, also, that jugglers in this country either "feed their cobras with liquid nourishment, or else let them loose when their lives are in danger," recapturing them at a future time.

To test the correctness of this, I questioned a snake-charmer a few days ago, and he informed me that he fed his cobra every week with frogs. His snake had then been recently fed, so he was told to bring it to the bungalow again in a few days. A frog (*R. tigrina*) was procured, and placed in the small basket in which the cobra was kept. The latter seized it at once; but as I was anxious to see the whole process, which could not be done whilst the snake was coiled up in the basket, I requested the man to place the frog on the ground. As it struggled away (the hind limbs of the poor reptile had been broken) the cobra followed it eagerly, and again and again seized it. The want of fangs, and the size of the frog, which in its inflated state exceeded considerably the circumference of its enemy, rendered these attempts ineffectual; so a smaller frog was caught, and placed with the cobra in the basket. This was swallowed in a short time, the snake pushing its victim against its coils, and working down the hind limbs by a lateral motion of the lower jaw, very similar to that of a cow chewing the cud.

The large frog was now placed in the basket, and the cover put on, and in about half an hour had followed its companion. The cobra's appetite was now appeased, for after seizing a third frog it let it go, on its croaking a remonstrance.

A laughable incident occurred whilst the snake was following the frog over the gravel path. A performing monkey belonging to the juggler, in a spirit of mischief, or perhaps fearing that its master's property was escaping, stepped gravely after the snake and laid hold of it by the tail. As a natural consequence, round came the cobra and menaced the monkey, which, retreating with sundry grimaces, took refuge with the juggler, in great alarm at the turn events had taken.

This cobra is a small one, and as it is one of those very pale, almost cream-coloured varieties, that finds no mention in Günther's able work, I am anxious to examine it thoroughly. The owner, however, affirms that he has to draw its fangs about once a month, and as he is most cautious in handling the reptile, it is probable that the fang matrix has not been destroyed, and examination will be safest just after the operation of extracting the fangs.

Mangalore, Sept. 12 E. H. PRINGLE

CLASSIFICATION OF CLOUDS*

IN an essay on the "Modifications of Clouds, read to the Askesian Society in 1802, Howard first proposed his classification of clouds, which has since been the generally received authority on the subject. His system has thus stood its ground for more than half a century, in spite of its defects and of the misconstruction not unfrequently put on the two terms, "stratus" and "nimbus" since the publication of Kaemtz's Meteorology. These misapprehensions and the obscurity and confusion arising from them are pointed out by Prof. Poey, but the errors have not been followed so generally as is asserted, at least by British meteorologists. In a series of papers issued at intervals during the past eleven years, Prof. Poey has endeavoured to develop a new classification of clouds, of which the volume before us is the result.

The following is Poey's classification compared with that of Howard:—

POEY'S CLASSIFICATION.

		Cloud composed of
First type:	cirrus	spicules of ice.
Derived:	cirro-stratus	
	cirro-cumulus	snow.
	pallio-cirrus	
Second type:	cumulus	vesicular aqueous vapour.
Derived:	pallio-cumulus	
	fracto-cumulus	

HOWARD'S CLASSIFICATION.

First type:	cirrus.
Derived:	cirro-stratus.
	cirro-cumulus.
Second type:	cumulus.
Derived:	cumulo-stratus.
Third type	stratus.
Derived from the three types:	nimbus.

In forming his system, Prof. Poey first strikes out the "stratus" as being from Howard's own definition not a true cloud, but only "mist;" the "cumulo-stratus" as not differing really from the cumulus; and the "nimbus" as being not a single cloud, but rather a system of clouds. He retains the word "stratus" as part-descriptive of the "cirro-stratus," but in this case it is exclusively restricted to those instances where the cirrus arranges itself in a stratified form, and is not applied when the arrangement is an extended sheet or continuous layer of considerable thickness totally impervious to the sun's rays. To this latter condition, the new term "pallium" is applied.

In his classification Poey arranges the clouds in the order in which they severally appear, from the cirrus, the most elevated, its height being from 30,000 to 50,000 feet, to the fracto-cumulus, the lowest of all; and groups them into three divisions according as they are composed of ice-crystals, snowy particles, or vesicular vapour.

But the most fundamental change which he has introduced into the system is the *pallium* or *sheet-cloud*, in its two distinct forms of *pallio-cirrus*, and *pallio cumulus*, according as it is formed from the cirrus or the cumulus. The pallium is the greyish, or ash-coloured cloud which overspreads the whole sky, and from which rain falls continually for hours or days together. On the approach of rain the pallio-cirrus is formed by the rapid increase and thickening of the cirrus downwards from the enormous

* "Nouvelle Classification des Nuages suivie d'Instructions pour servir à l'Observation des Nuages et des Courants Atmosphériques." Par André Poey, Havane. (Extrait des Annales hydrographiques, 1872.) Paris, 1873. (17 Planches).

accessions of moisture that take place, by which this high ice-cold region of the atmosphere over a great extent and thickness, is brought to the point of saturation and condensation. Underneath this leaden-hued mass of cloud which uniformly covers the sky, but separated from it by a clear space, is extended the dense cloud covering of the *pallio-cumulus*, which is formed by the watery vapour of the atmosphere reduced to the points of condensation and precipitation. This is the true *rain-cloud*, and it is fed and increased by the rapid drifting in from below of torn masses of cumulus constituting the *fracto-cumulus* or *wind-cloud*. The fracto-cumulus may be of all sizes, has no determinate shape, is the lowest and swiftest moving of the clouds, and is whitish, greyish, or slate-coloured, as may be determined by the hygrometric condition of the air. On the return of fine weather accessions of vapour by the fracto-cumulus slacken and then cease, the pallio-cumulus diminishes in thickness and gradually clears away, showing through its intervals the pallio-cirrus above it, which in its turn is broken up, revealing still higher up the delicate tracery of the cirrus. The pallio-cirrus is negatively electrical, whilst the pallio-cumulus is positively electrical, the clear stratum between being neutral; and between these oppositely electrified strata, discharges frequently take place in thunderstorms.

The merits of Prof. Poey's work are very considerable, whether they be regarded as expository of Howard, or as a contribution to this difficult branch of meteorology; and it is just those meteorologists who have paid particular attention to the observation of the clouds who will be readiest to recognise its merits. It must, however, be conceded that, as a descriptive classification of clouds, as well as explanatory of the phenomena they present, Prof. Poey's work leaves the subject in a state still too incomplete to warrant us in recommending his system for general introduction. It is a step in the right direction, and will materially contribute to place this vitally important department of atmospheric physics on a satisfactory footing.

Toward this end, what is now urgently wanted is an extensive collection of the data of cloud-phenomena in all countries, particularly of those clouds interesting in themselves or from their known relations to weather changes. We have more than enough of unmistakeably pure typical forms scattered through the pages of weather-literature, but such do not greatly assist us, in describing and classifying many of the forms of clouds which occur. Hence what is required is faithfully accurate delineations of these forms in their different aspects, and systematic inquiries set on foot into the relations of the forms of clouds to the mode of their formation, to the states of the aqueous vapour which compose them, and to the varying elasticity, temperature, and electricity of the atmosphere.

In connection with this part of the subject, Prof. Poey investigated in 1862-64, by means of the thermo-electric pile, the temperature of different parts of the sky under different conditions, and of the clouds which passed across it. Among other highly interesting results, he has shown that the cumulus, properly so called, and the cumulo-stratus of summer are the clouds of highest temperature; then follows the fracto-cumulus, except when it comes after the rain which accompanies a thunderstorm, in which case it is of a whitish colour, very rapid in its motion, much torn at the edges, and partakes of the low temperature prevailing on such occasions. The cirro-cumulus is colder than the cumulus and the cirrus the coldest of all the clouds. These are very suggestive results. We are convinced that the key to the position in meteorology is a better knowledge of the vapour of the atmosphere in its various states and changes; and the science will not make the advances it is destined to make till meteorologists generally recognise the necessity of equipping their first-class observatories with the requisite appliances for carrying on those physical researches which are intimately allied to meteorology.

FERTILISATION OF FLOWERS BY INSECTS

V.

More conspicuous flowers adapted to cross-fertilisation, and less conspicuous ones adapted to self-fertilisation, occurring in different species of the same genus.

WHAT has been described in the two last articles as occurring in varieties of the same species (using the term "species" in its widest sense) we propose now to investigate as existing likewise in species of the same genus.

Malva sylvestris and *rotundifolia*

are two closely allied, but, as acknowledged by all botanists, undoubtedly good and distinct species, differing in their flowers in a manner similar to the two varieties of *Lysimachia vulgaris* and the other species previously considered. In both these species of Malva an oval mass of anthers in the first place occupies the middle of the flower, enclosing the stigmatic branches as yet undeveloped and lying close together (Fig. 23). At a later period the stigmatic branches, growing out of and overtopping the mass of anthers, spread and bend outwards and downwards so as to occupy nearly the same place as was before occupied by the anthers (Figs. 24, 25). Insects, therefore, seeking for the honey which is secreted and contained in five cavities between the lowest parts of the petals (*n*, Fig. 23) and covered by a fringe of hairs (*pr*), carry away on their hairy bodies the large prickly pollen-grains from younger flowers, leaving many of them on the stigmatic papillæ of the branches of the style of older flowers, which they can scarcely avoid grazing in seeking for the honey. Hence, in both species, whenever insects frequently visit these flowers, cross-fertilisation in the manner described is largely effected, whereas self-fertilisation can scarcely take place, neither spontaneously nor by means of insects, nearly all the pollen-grains having been removed before the unfolding of the stigmatic branches. Since, however, *Malva sylvestris* and *rotundifolia* grow for the most part in the same locality, and flower during several months at the same time, insects flying about and seeking for honey are much more likely to find out and visit the highly conspicuous flowers of *M. sylvestris* than the far less conspicuous ones of *M. rotundifolia;* the former, when fully opened, presenting bright rose-coloured bells of from 40 to 50 mm. diameter, the latter, on the contrary, light rose-coloured bells of only from 20 to 25 mm.

Direct observation, indeed, fully confirms this supposition, the flowers of *M. sylvestris* being always found in sunny weather visited by a variety of insects, whereas those of *M. rotundifolia*, especially when growing intermixed with *M. sylvestris*, are commonly overlooked by them all. Thus, during the six last summers, I have observed on the flowers of *M. sylvestris* and collected more than 50 species of insects, many of them very frequently (2 Lepidoptera, 3 Diptera, 5 Coleoptera, 40 Apidæ, some Ichneumonidæ); while in the same space of time I found on the flowers of *M. rotundifolia* but 5 species (4 Apidæ, 1 Hemipter), and those only in single or a few cases.

It is evident from these facts, that wherever our two species of Malva grow together in the same locality, *M. rotundifolia* would be rapidly extinguished, unless it were enabled to produce seed by self-fertilisation; *M. sylvestris*, on the other hand, is so commonly visited and cross-fertilised by insects that self-fertilisation, if it were possible, would never be effected, or only exceptionally. Accordingly natural selection must have preserved and accumulated those slight individual variations of *M. rotundifolia*, which afford facility for self-fertilisation, whereas in *M. sylvestris* the possibility of self-fertilisation being quite useless, might be lost, and, indeed, has been, completely or nearly lost. Thus in the flowers of *M. sylvestris*, when precluded from the visits of insects by covering them with a net, the anthers remain filled with pollen-grains, and never, or only exceptionally, come spontaneously into contact with the stigmatic branches, the free ends of their filaments at a later period bending downwards, and the branches of the styles remaining considerably above them (Fig. 24). Conversely in the flowers of *M. rotundifolia*, when the visits of insects are prevented, the anthers, filled with pollen-grains, remain in so high a position, and the stigmatic branches bend so far downwards as to come abundantly into contact with the pollen-grains, self-fertilisation being thus inevitable (Fig. 26).

Epilobium angustifolium and *parviflorum*

differ most strikingly in a similar manner. The flower of *E. angustifolium*, being of larger size, brighter colour, grouped in long splendid clusters, and exciting attention at a great distance, are so largely visited and cross-fertilised by insects* as never to have need of self-fertilisation, which has actually become impossible; the four stigmatic branches unfolding so long after the maturity of the eight anthers, and so far overtopping them, as to be completely shut out from the pollen of the same flower. The flowers of *E. parviflorum*, on the other hand, being of smaller size, lighter colour, and single, are so inconspicuous that insects but very rarely visit them. Accordingly, its four upper anthers so closely surround the four-lobed stigma, which is mature at the same time, as to cover it largely with their pollen, whilst the pollen-grains of the four lower anthers lying on the way to the honey, cannot reach the stigma of the same or of another flower unless transferred by insects.

Polygonum

Among the many species of the genus Polygonum which grow in our country there are two, *P. Fagopyrum* and *Bistorta*, most distinguished by their attractiveness for insects, which is due not only to the size and colour of the single flowers and to their collection into handsome spikes, but also, and even more perhaps, to their abundance of honey secreted by eight globular nectaries at the base of the filaments (*n*, Figs. 26, 27). With reference also to the frequent visits paid them by insects,† these two species have been adapted to inevitable cross-fertilisation by their visitors, self-fertilisation having at the same time become difficult or almost impossible. The manner in which this advantage has been attained being very different in the two species, it is evident that in this case the adaptation to cross-fertilisation by the visits of insects cannot have been inherited from the common parents of the genus, but must have been acquired by the single species during their evolution.

P. Fagopyrum has acquired, as shown in Figs. 26 and 27, the same kind of dimorphism which has been so fully explained by Darwin in Primula ‡ and Linum.§ In both of the two kinds of flowers (which occur only on different plants) there are three styles and eight stamens, three of the stamens closely surrounding the styles and opening outwards, the five others inserted more outwards, alternating with the leaves of the perianth and opening inwards. An insect, therefore, visiting a flower for honey and pushing its head or proboscis between the inner and outer stamens into the base of the flower, cannot avoid being charged with pollen, especially in those parts of its body which, whilst it is sucking the honey, are pressed against the anthers. Now, the place occupied in one of the two kinds of flowers by the anthers, is occupied in the other kind by the stigmas, the same parts of the body of the insect which in the long-styled form were pressed against the anthers, come into contact in the short-styled with the stigmas, and conversely. Thus it is inevitable that insects effect chiefly what is called legitimate fertilisation, *i.e.* transmission of the pollen of the long-styled flowers to the stigmas of the short-styled, and of the pollen of the short-styled to the stigmas of the long-styled form. Fertilisation by pollen of the same form, however, and even of the same flower, is not impossible, and in the short-styled flowers even spontaneous self-fertilisation may happen, by pollen-grains falling down from the anthers upon the stigmas.

The same advantage which *P. Fagopyrum* has attained by dimorphism (Darwin) or heterostyly (Hildebrand), has been gained in the flowers of *P. Bistorta* by protandrous dichogamy, *i.e.* by the anthers so far preceding in their development the stigmas that in the first period of the flower (Fig. 28) only mature anthers, at a later period (Fig. 29) only mature stigmas are present, the anthers having then commonly fallen off. It is readily seen that such flowers also, when perseveringly visited by insects, are always inevitably intercrossed, no other mode of the transmission of pollen being possible than from younger flowers to the stigmas of older ones. It is only when the visits of insects are completely wanting during the first period and the anthers remain clothed with pollen while the stigmas attain their maturity, that self-fertilisation by insects or even spontaneous self-fertilisation is possible.

The least attractiveness for insects, on the contrary, among all native species of Polygonum is possessed by *P. aviculare*, its flowers (Figs. 30 and 31) being of small size, of greenish and white or reddish colour, standing singly on procumbent plants and offering only a small quantity of pollen to insects, but, as far as I have been able to see, no honey. No wonder that insects are induced only in very rare cases to visit and fertilise them,* and that, in compensation for the loss of cross-fertilisation, these little flowers regularly experience spontaneous self-fertilisation, the three inner anthers lying so close to the stigmas that their pollen-grains inevitably come into contact with them (Figs. 30 and 31).

Of the many other native species of Polygonum, which are all intermediate, as to their attractiveness for insects, between those now described, I will only remark briefly upon *P. Persicaria*, which is of more especial interest because of its flowers presenting great differences of structure. In this species, instead of eight nectaries there are only five developed, and these secrete a much smaller quantity of honey than those of *P. Fagopyrum* and *Bistorta*. Its spikes of flower, moreover, being less conspicuous than in those species, the visits of insects are somewhat rare, even in sunny weather, although far more frequent than in *P. aviculare*.† Fertilisation by insects, consequently, is by no means secured. Corresponding to this uncertain agency of insects the sexual organs of the flower are in a remarkably fluctuating condition, undecided, as it were, between adaptation to cross-fertilisation by the visits of insects, and to self-fertilisation. Thus, of the eight stamens, sometimes only the five outer ones are developed, the three others being reduced to rudimentary filaments; and this condition is apparently the most favourable to cross-fertilisation, as any honey-seeking insect must touch the anthers in every flower with one side of its proboscis, the stigma with the opposite side, to which it thus cannot fail to transfer pollen-grains

* On the flowers of *Epilobium angustifolium* I have hitherto observed 26 species of insects, 14 of them belonging to the family of bees, many of them very frequently; on those of *E. parviflorum* I found only once Meligethes, and once a butterfly (*Pieris rapæ* L.) repeatedly sucking the honey of its flowers.

† On the flowers of *P. Fagopyrum* I have observed 41 species of insects, among them 21 Diptera and 12 Apidæ; on the flowers of *P. Bistorta* 18 species of insects, among them 9 Diptera and 3 Apidæ; many of the visitors of each species very frequently.

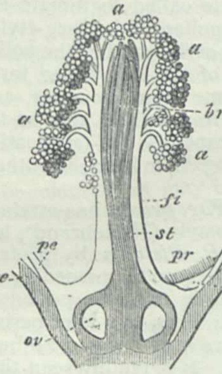
‡ On the two forms or dimorphic condition in the species of Primula and their remarkable sexual relations (Proc. of the Linn. Soc. vi. (1862); Bot. pp. 77–79.

§ On the existence of two forms and their reciprocal sexual relation in several species of the genus Linum, Ibid. 1863, pp. 69–83.

* After having repeatedly in vain watched *P. aviculare* in very hot sunny noons of the month of August 1871, I succeeded in observing some small Syrphidæ (*Ascia podagrica* F., *Syritta pipiens* L., and *Melithreptus menthastri* L.) visiting its flowers.

† I have observed in the flowers of *P. Persicaria* altogether 11 species of insects, among them 7 Diptera, and these as the most frequent visitors.

from the flowers previously visited. Sometimes, also, the three inner anthers are developed, and, completely filled with pollen, closely surround and spontaneously self-fertilise the two (in rarer cases three) stigmas, cross-fertilisation being thus almost prevented. But most of the flowers show an intermediate condition, having only one or two of the three inner anthers developed.



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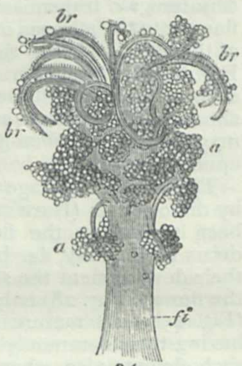

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FIG. 23.—Sexual organs of *Malva rotundifolia*, in their first period, longitudinally bisected, seven times natural size. *a*, anthers; *br*, branches of the style (*st*); *pe*, petals; *n*, nectary; *pr*, protecting hairs; *se*, sepals; *cv*, ovary; *fi*, filament-cylinder.
FIG. 24.—Side view of the same organs in their second period.

Without referring to many other genera which I have ascertained to contain species quite analogous to those just described,* we may, I think, admit as a summary of the recorded facts, the following propositions:—In many species the flowers vary and have always varied in size, colour, the quantity of secreted honey, and consequently in their attractiveness for insects. Whenever in such a varying species the one variety possesses such a degree of attractiveness for insects as to receive sufficiently frequent visits from them, those variations which afford

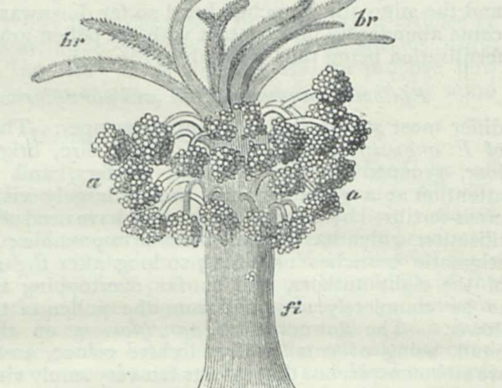

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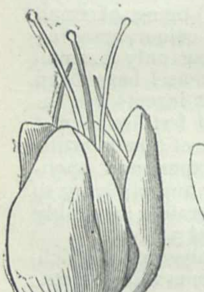
FIG. 25.—Side view of the sexual organs of *M. sylvestris*, seven times natural size.

facility for cross-fertilisation by insects have always been preserved and accumulated by natural selection, whereas the possibility of self-fertilisation has at the same time frequently been lost. Hence we may infer that cross-fertilisation is more advantageous to a plant than self-



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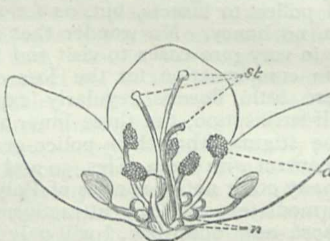

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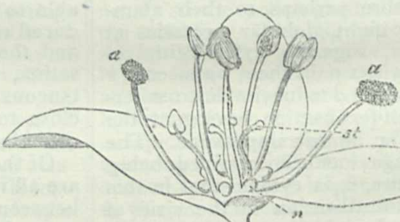

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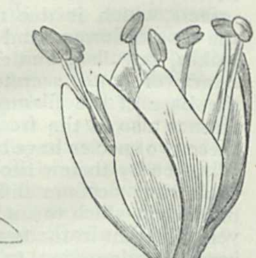

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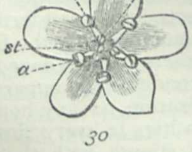
FIG. 26.—Side view of the long-styled flower of *Polygonum Fagopyrum*, two leaves of the perianth having been removed. *n*, nectaries; *a*, anthers; *st*, stigmas. FIG. 27.—Side view of the short-styled flower. FIG. 28.—Side view of the flower of *Polygonum Bistorta* in its first period. FIG. 29.—Side view in its second period.

fertilisation. Whenever, on the contrary, another variety of the same species presents so little attraction for insects as to remain commonly overlooked by them, only



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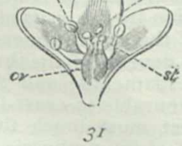

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FIG. 30.—Flower of *Polygonum aviculare* viewed from above. *a*, outer anthers; *a*¹, inner anthers; *st*, stigmas. FIG. 31.—The same flower viewed laterally, two leaves of the perianth having been removed.

such individual peculiarities as induce self-fertilisation have been preserved and accumulated by natural selection, whereas cross-fertilisation by insects has frequently become very difficult, although perhaps never quite impossible. Hence we may infer that self-fertilisation is by no means absolutely disadvantageous to a plant, but only when the offspring of self-fertilisation has to struggle for existence with the offspring of cross-fertilisation.

There is another curious point about the recorded facts. We have seen that more and less attractive flowers adapted to cross- or to self-fertilisation sometimes occur in slightly differing, sometimes in well-marked varieties, sometimes in doubtful, sometimes in good and distinct species.

If we believe the principle of evolution, and view species as originated from varieties, varieties as originated from slight individual differences, we may consider the recorded facts as presenting and explaining one of the many ways in which previously varying forms have been transformed by natural selection into different and diverging species.

HERMANN MULLER

* Geranium, Stellaria, Cerastium, Rubus, Veronica, Carduus, Hieracium, and others.

POLARISATION OF LIGHT*

II.

THE experiment described in the previous article, in which the rays reflected from the pile of glass plates are extinguished by the analyser when in one position, while those which have been transmitted are extinguished when the analyser is in a position at right angles to the former, shows that the vibrations of the reflected and refracted rays, so far as they become polarised, are at right angles to one another. And further, if these rays be severally examined with a plate of tourmalin, it will be found that the vibrations of the reflected ray are executed in a direction perpendicular to the plane of incidence, and those of the refracted ray in a direction parallel to that plane.

The same general reasoning as that used in the case of tourmalin plates will serve, if not as actual proof, at all events as illustration in this case. Thus, suppose that a ray whose vibrations are perpendicular to the plane of incidence, that is, parallel to the reflecting surface, fall upon a plate of glass; then there is no apparent reason why a change in the angle of incidence should modify the reflection and refraction, so far as they depend directly upon the direction of the vibrations. The vibrations cannot undergo any change of direction on one side rather than on the other by incidence on a surface to which they are parallel, and will consequently remain parallel to themselves even when the incidence has taken place. And since the reflected and refracted rays both lie in the plane of incidence, the vibrations (which are perpendicular to that plane and consequently to every line in it) will fulfil the optical condition of being perpendicular to the rays in question. But if the vibrations of the incident ray take place in the plane of incidence, it is difficult to conceive that the results of reflection and refraction should be unaffected by a change in the angle of incidence. There are two mathematical and mechanical principles which, when applied to the case of vibrations in the plane of incidence, lead to the conclusion that if the ray be incident at such an angle that the reflected and refracted rays are perpendicular to one another, there can be no reflected ray.

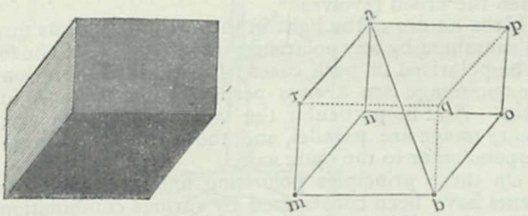

FIG. 9.

A general explanation of this very curious result seems difficult; but the following considerations may perhaps tend to elucidate the subject. Reflexion is generally, perhaps always, accompanied by refraction. Bodies are visible in virtue of rays which, after reflexion from their surface, meet the eye. But the natural colours of bodies so seen are due to rays which are not reflected until they have penetrated to some, although inconsiderable, depth below the actual surface. During this penetration the light has been deprived of certain of its component rays, and emerges as a reflected beam covered with the remaining or complementary tint. And although the colourless reflexion from polished surfaces is an apparent exception to the rule, it may still be the fact that this is only a limiting case in which the penetration is a minimum. If this be so, we may fairly conclude that refraction is the ruling feature of the phenomenon, and that it in some sense precedes reflexion. With the change of direction of the ray involved in refraction it is in the highest degree probable that a change of direction of the vibrations (supposed always to be in the plane of incidence) will be also involved. The simplest supposition would be that the vibrations within the medium are perpendicular to the refracted ray; and that the intensity of the reflected light is due to that part of them which can be resolved in a direction perpendicular to that of the reflected ray. If, therefore, the refracted and the reflected rays be perpendicular, so also will be their vibrations, and consequently

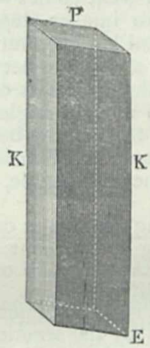

FIG. 10.

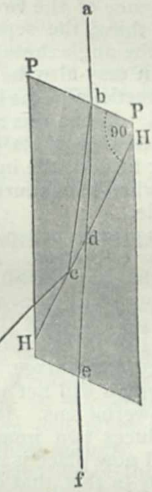

FIG. 11.

no part of the vibrations constituting the former can be resolved in the direction requisite for the latter. In other words there will be no reflected ray.

The above remarks give, it must be admitted, no mechanical theory of reflexions, nor indeed do they pretend to be even a rough explanation of the facts. They merely amount to this: If reflexion depends primarily upon refraction, and the known law of reflexion obtains independently of all questions of polarisation, then when the incident vibrations take place in the plane of incidence no reflected ray, whose direction is perpendicular to that of the refracted ray, can be produced.

We next come to the subject of polarisation by double refraction. There are a large number of crystals which have the property of generally dividing every ray which passes through them into two. But the extent of separation of the two rays varies with the direction of the incident ray in reference to the natural figure of the crystal.

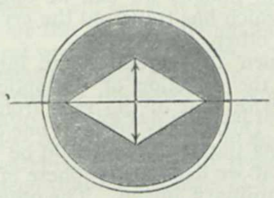

FIG. 12.

In every double refracting crystal there is at least one, and in many there are two, directions in which no such separation takes place. These directions are called optic axes. The relations between the forms of crystals and their optic axes, and optical properties arising therefrom, will be explained later.

Of such crystals Iceland spar is the most notable instance. If we take a block of such spar split into its natural shape, a rhombohedron, Fig. 9, and for convenience cut off the blunt angles by planes perpendicular to the line joining them, a b, it will be seen that a ray of light, transmitted perpendicularly to these planes, that is

* Continued from p. 129.

parallel to the line joining the blunt angles, is not divided. In fact, the image either of the aperture of the lantern projected on a screen, or of an object seen by the eye in the direction in question, appears single, as if passed through a block of glass. The direction in question (viz., the line a b itself, and all lines passing through any part of the crystal parallel to a b), is called the optic axis of the crystal. If, however, the crystal be tilted out of this position in any direction, it will be seen by the appearance of two images instead of one, that the rays are divided into two. The angular divergence of the two sets of rays, or what comes to the same thing, the separation of the two images, depends upon the angle through which the crystal has been turned; or, as it may also be expressed, upon the angle between the directions of the incident ray and the optic axis of the crystal. When this angle amounts to a right angle, the separation is at its greatest; and if the crystal be still further turned, the images begin to come together again until, when it has turned through another right angle, they coincide.

This process of separation, or doubling the rays, is called double refraction. And the following experiment will show that one set of rays follows the ordinary law of refraction, while the other follows a different law. The image produced by the first set of rays is, in consequence, called the ordinary, and that produced by the second the extraordinary image. Let us now take a sphere of Iceland spar, which will act upon the rays issuing from the lamp as a powerful lens. In every position in which it is placed it produces two images on the screen; but in that in which I now place it the two images are concentric, differing only in this, that one is larger than the other. The direction in which the light is now passing is that of the optic axis; and it is to be observed that, although there is a difference in the magnifying of the two images, there is still no divergence of rays, or separation of images in the sense used before. In fact, if we suppose the curvature of the lens to be gradually diminished, we should find the difference of the sizes of the two images, as well as the absolute size of both, diminish; until when the surfaces of the lens became flat, the difference would vanish, and the two images would absolutely coincide.

This difference in the size of the images shows, moreover, a very important property of double refracting crystals. The amount of refraction produced by a transparent medium standing in air depends, as is well known, upon the velocity with which a ray of light traverses the medium compared with that with which it traverses air. The smaller the velocity in the medium, the greater the refraction. The greater the refraction, the greater the magnifying power of a lens constructed of that medium. Hence in the two concentric images we can at once point to the system of rays which has traversed the crystal at a lower velocity than the other.

Let us now turn the crystal round into some other position, so that the direction of the optic axis shall no longer coincide with that of the rays from the lamp or from the object. During this process one of the images, the larger, remains stationary, as would be the case with the single image, if we had used a sphere of glass. This, therefore, is the ordinary image. The other shifts about, separating itself from the first, until the crystal has been turned through half a right angle, and then drawing back again until the crystal has swept round through a complete right angle. This is, consequently, the extraordinary image.

It will be noticed that when the sphere has been turned through a right angle, the extraordinary image is no longer circular, but elliptical, and that the major axis of the ellipse lies in the direction in which the motion has taken place, that is, perpendicular to the axis about which the sphere has been turned. This is due to the fact, shown above, that the nearer the direction of the incident rays to that of the optic axis, the less the divergence between the ordinary and the extraordinary rays. The distortion of the image when the sphere has turned through half a right angle is due to the difference of angles between the optic axis and the rays which enter the crystal on one side and on the other of the central ray of the beam coming from the lamp.

That the rays forming each of the images are polarised, and that the direction of their polarisation is different, is easily shown by interposing a plate of tourmalin or other polarising instrument between the lamp and the sphere of spar. But inasmuch as the polarisation in many positions of the sphere is far from uniform, the phenomenon becomes rather complicated; and the character of the polarisation of the two images is better studied by using flat instead of curved surfaces for separating the rays.

For the purpose in question there is, perhaps, no better instrument than the double-image prism. This consists of a combination of two prisms, one of Iceland spar, so cut that the optic axis is parallel to the refracting edge; the other of glass, and usually having a refracting angle equal to that of the spar. The rays passing through the crystal prism being perpendicular to the optic axis, undergo the greatest separation possible. And the chromatic dispersion caused by that prism is corrected or neutralised entirely in the case of the extraordinary, and nearly so in that of the ordinary ray, by the glass prism which is placed in a reversed position. In this arrangement the extraordinary image occupies the centre of the field, and remains fixed while the double-image prism is made to revolve in a plane perpendicular to the incident rays; while the ordinary image is diverted to a distance from the centre, and revolves in a circle about that centre, when the prism revolves.

If the nature of the light in the two images thus formed be examined by any polarising instrument, it will be found to be polarised in both cases; but that the vibrations in the one image are always perpendicular to those in the other. And in particular the vibrations in the extraordinary image are parallel, and those in the ordinary are perpendicular to the optic axis.

On these principles polarising and analysing instruments have been constructed by various combinations of wedges or prisms of Iceland spar, the details of which it is not necessary to describe in full. But the general problem, and object proposed, in all of them has been to cause such a separation of ordinary and extraordinary rays, that one set of rays may, by reflexion or other methods, be further diverted and afterwards thrown altogether out of the field of view. This done, we have a single beam of completely polarised light and a single image produced from it.

One such instrument, however, the Nicol's prism, on account of its great utility and its very extensive use, deserves description. A rhombohedron of Iceland spar double of its natural length is taken (see Fig. 10); and one of its terminal faces P, which naturally makes an angle of 71° with the blunt edges K, is cut off obliquely so as to give the new face, say P′ (not given in the figure), an inclination of 68° to the edges K. The whole block is then divided into two by a cut through the angle E in a direction at right angles to the new face P′; the faces of this cut are then carefully polished, and cemented together again in their original position with Canada balsam. Fig. 11 represents a section of such a prism made by a plane passing through the edges K (Fig. 10). A ray entering as a b is divided into two, viz., b c the ordinary, and b d the extraordinary. But the refractive index of the Canada balsam is 1·54, *i.e.* intermediate between that of the spar for the ordinary (1·65) and the extraordinary (1·48) rays respectively; and in virtue of this the ordinary ray undergoes total reflexion at the surface of the balsam, while the extraordinary passes through and emerges ultimately parallel to the incident ray. Fig. 12 shows an end view of a Nicol's prism, the shorter diagonal in the direction of vibration of the emergent polarised ray.

Two such instruments, when used together, are respectively called the "polariser" and the "analyser," on account of the purposes to which they are put. These, when placed in the path of a beam of light, give rise to the following phenomena, which are, in fact, merely a reproduction in a simplified form of what has gone before.

When polariser and analyser are placed in front of one another, with their shorter diagonals parallel, that is, when the vibrations in the image transmitted by the one are parallel to those in the image transmitted by the other, the light will be projected on the screen exactly as if only one instrument existed. If, however, one instrument, say the analyser, be turned round, the light will be seen to fade in the same way as in the case of the tourmalin plates; until, when it has been turned through a right angle, or as it is usually expressed, when the polariser and analyser are crossed, the light is totally extinguished.

In the complete apparatus or polariscope, we may incorporate any system of lenses, so that we may

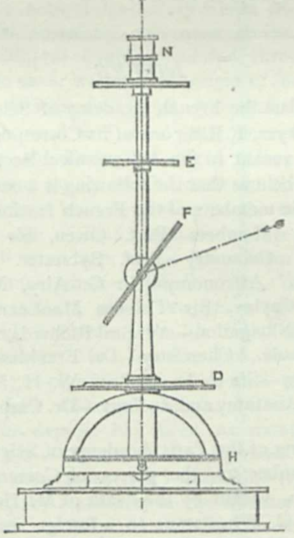

FIG. 13.

make use of either parallel or convergent light, and finally focus the image produced upon the screen or upon the retina. At present we shall speak only of the phenomena of colour produced by crystal plates in a parallel beam of polarised light—chromatic polarisation, as it is called, with parallel light.

Various forms of polariscopes have been devised, whereof the three described below may be regarded as the most important.

Fig. 13 is an elevation of one of them. When used in its simplest form, the frame F carries a plate of black glass which is capable of revolving about pivots in the uprights. The positions of the source of light and of the frame must be adjusted so that the plate will receive the incident light at the polarising angle, and reflect it in the direction of the eye-piece which contains a Nicol or other analyser. The objects to be examined are to be placed on the diaphragm E.

This instrument may be converted into another form, due to Norremberg, by placing a silvered mirror horizontally at H. The plate of black glass must be removed from the frame F, and a plate of transparent glass substituted for it, which must be so inclined that the light falling upon it shall be reflected at the polarising angle perpendicularly towards the horizontal mirror. The object may be placed on the diaphragm E as before. But it may also be placed on the diaphragm D below the polarising plate F, and in that case the eye will receive the polarised ray reflected from the mirror; and the polarised ray will have passed, before it reaches the eye, twice through the crystalline plate placed between the mirror and the polariser. The result is the same as if, in the ordinary apparatus, the polarised ray had passed through a plate of double the thickness. If the plate does not fill the entire field of view two images of the plate will be seen, the one larger, as viewed directly, the other smaller, as viewed after reflection from the horizontal mirror; the first will show the tint due to the actual thickness of the crystal, the other that due to a plate of the same crystal, but of double the thickness.

A further modification of this instrument will be described hereafter.

W. SPOTTISWOODE

(*To be continued.*)

GALILEO'S WORK IN ACOUSTICS

IN looking through the "Dialoghi delle Nuove Scienze" of Galileo, I came unexpectedly on a passage* containing two remarkable discoveries in acoustics, which I should have confidently referrred to a much later age. For the sake of such of your readers as may share the same erroneous impression, I hope you will allow me to give, in NATURE, a short account of these results.

The first is a perfectly accurate explanation of the phenomenon called "resonance." Every pendulum has a fixed period of oscillation peculiar to itself. Even when the "bob" is of considerable weight it is possible to set it swinging through a large arc by merely blowing against it with the mouth, provided the successive puffs are properly timed with reference to the pendulum's period of vibration. In the same way a single ringer can, by regular pulling, throw the heaviest bell into oscillations of such extent as to be capable of lifting half-a-dozen men who should hang on to its rope, off the ground all together. When a string of a musical instrument is struck, its vibrations set the air in its vicinity trembling, and the tremors thus set up spread themselves out through space. If they fall on a second wire in unison with the first, and therefore prepared to execute its vibrations in the same period, the effects of the successive impulses are accumulated, and the wire's oscillations can be distinctly seen to go on dilating until they have attained an extent equal to those of the wire originally struck.

Anyone who looks into the chapter on resonance in the "Tonempfindungen" will see that the account of the phenomenon given by the greatest living acoustician is, in principle, identical with that of Galileo.

The second point to which I wish to draw attention is an experiment involving the earliest direct determination of a vibration-ratio for a known musical interval. Galileo relates that he was one day engaged in scraping a brass plate with an iron chisel, in order to remove some spots from it, and noticed that the passage of the chisel across the plate was sometimes accompanied by a shrill whistling sound. On looking closely at the plate, he found that the chisel had left on its surface a long row of indentations parallel to each other and separated by exactly equal intervals. This occurred only when the sound was heard: if the chisel traversed the surface silently, not a trace of the markings remained. It was found that a rapid passage of the chisel gave rise to a more acute, a slower to a less acute, sound, and that, in the former case, the resulting indentations were closer together than they were in the latter. After repeated trials two sets of markings were obtained which corresponded to a pair of notes making

* Opere complete di Galileo Galilei. Vol. xiii. pp. 97–110. (Firenze.)

an exact fifth with each other; and, on counting the number of indentations contained in a given length of each series, it appeared that for 30 of the lower sound there were 45 of the higher, which numbers are in the exact proportion (2 : 3), which connects the lengths of two equally tense wires, giving that interval. Galileo, who had felt a tremor pass from the chisel to his hand at each experiment, inferred that what really determined a musical interval was the ratio of the numbers of vibrations performed in equal times by its constituent notes, and that that ratio was inversely as that of the lengths of the wires producing them. In order to bring out the crucial nature of his experiment, he goes on to remark, with extreme acuteness, that there was, prior to it, no reason for regarding the relations known to connect musical intervals with the *lengths* of wires as in any exclusive sense *representing* such intervals. With equal propriety might the ratio of the *tensions* under which two wires of equal lengths emitted sounds forming an interval be taken as its representative. In this case we should obtain the inverse square root of the ratio resulting from the former mode of comparison. Thus Galileo's experiment alone supplied decisive ground for concluding that the relations of *length* between similarly circumstanced wires, likewise governed those of *period* between corresponding aërial vibrations.

Prof. Tyndall, in referring to the above experiment, has described it as performed "by passing a knife over the edge of a piastre" ("Sound," 2nd ed., p. 51). This is an obvious mistake caused by incorrect translation. Galileo was scraping "una piastra d'ottone," *i.e.*, not "a piastre," but "a plate of brass." An excellent numismatist assures me that the *material* mentioned is alone decisive of the point, the piastre in Galileo's time being invariably made of *silver*. SEDLEY TAYLOR

THE HOOSAC TUNNEL

THE following facts respecting the Hoosac tunnel, in which the borings from east and west communicated on Nov. 28, may prove of interest. The mountain penetrated is part of the chain of mountains that skirts, at a distance of two or three hundred miles inland, the Atlantic coast of the United States; of which the Blue Ridge in Virginia, the Alleghanies in Pennsylvania, the Catskills and Adirondacks in New York, the Green Mountains in Vermont, and the White Mountains in New Hampshire, are prominent examples. Hoosac Mountain has two summits, the eastern being 2,210, and the western 2,508 ft. above tide-water.

The enterprise has been the subject of various undertakings by different contractors, and the greater part of the earlier work during the years from 1848 to 1863, in length but one-twelfth of the whole distance, was on a smaller scale than the subsequent plan adopted, and had to be much enlarged and strengthened. The present contract requires a clear width of bore of 24 ft. and a height of 20 ft.; the total length of the tunnel is 25,031 ft. A central shaft pierces it from above, at a distance of 12,837 ft. from the eastern, and 12,194 ft from the western portal. The shaft has a depth of 1,038 ft., and is of elliptical form, its major axis is 27 ft. being coincident with the line of the tunnel; its minor axis is 15 ft. The grade of the tunnel slopes up to the shaft from both ends, with a rise of $26\frac{4}{10}$ per mile. The shaft is not placed at the lowest point between the two summits of the mountains, as the exigencies of the work at the western extremity, and the presence of a stream of water at the point of lowest depression, made a site half a mile nearer the western portal preferable. The tunnel is 767 ft. above tide-water at its extremities. The temperature within averages 58° F.

The total excavation is about 1,000,000 tons of rock., requiring somewhat over 1,450,000 days' work. The boring was principally through mica schist, similar to that of the surface. The miners found it lying on the edge of the foliations and disposed to hang together after the blast. They compared the operation of working in it to pulling boards endwise from a pile of lumber. Rock of this character was found continuous until a point was reached within about 5,000 feet west of the central shaft. At that point the proportion of mica was diminished and the rock began to lose its foliated structure, becoming more homogeneous or granitic. In fact it might be characterised in general terms as granite with the ingredients differently proportioned at different localities, in some places feldspar, in some mica, and in others quartz predominating. This rock was harder to penetrate with the drills, but broke out more satisfactorily with the blast than the mica schist.

The chief trouble was occasioned by what received the name of "demoralised rock." This was rock saturated with water, which, exposed to air, disintegrated into mere mud, rendering the support of masonry absolutely necessary. The tunnel will not probably be ready for railway traffic before next July, as there is yet much work to be done, the total cost at that date, it is estimated, will not fall short of 12,500,000 dols.

NOTES

ON Monday last the French Academy of Sciences named Mr. J. Norman Lockyer, F.R.S., one of its Correspondents, to fill the place rendered vacant in the Astronomical Section by the death of Encke. We believe that the following is a complete list of the English scientific members of the French Institute at the present time:—Foreign Members—Prof. Owen, Sir C. Wheatstone. Correspondents: Geometry—Prof. Sylvester. Mechanics—Sir Wm. Fairbairn. Astronomy—Sir G. Airy, Mr. Hind, Prof. Adams, Prof. Cayley, Sir Thomas MacLear, Mr. Lockyer. Geography and Navigation—Admiral Richards, Dr. Livingstone. Physics—Dr. Joule. Chemistry—Dr. Frankland, Dr. Williamson. Mineralogy—Sir C. Lyell, Prof. W. H. Miller. Botany—Dr. Hooker. Anatomy and Zoology—Dr. Carpenter.

AT the meeting of the Paris Academy of Sciences, which took place on December 22, the places of Correspondents in the Physical Section, vacant by the death of M. Hansteen, and the election of Sir C. Wheatstone to a foreign associateship, were filled up by the election of MM. Angström and Billet.

HER MAJESTY'S Commissioners have resolved to commence, in connection with the series of international exhibitions, permanent collections which shall illustrate the ethnology and geography of the different portions of the British dominions, and ultimately form a great national museum of the empire upon which the sun never sets. They will be arranged for the present in the galleries of the Royal Albert Hall. Many portions of the empire are inhabited by aboriginal races, most of which are undergoing rapid changes, and some of which are disappearing altogether. These races are fast losing their primitive characteristics and distinguishing traits. The collections would embrace life-size and other figures representing the aboriginal inhabitants in their ordinary and gala costumes, models of their dwellings, samples of their domestic utensils, idols, weapons of war, boats and canoes, agricultural, musical, and manufacturing instruments and implements, samples of their industries, and in general all objects tending to show their present ethnological position and state of civilisation. It is proposed to receive for the Exhibition of 1874 any suitable collections, which will be grouped and classified hereafter in their strict ethnological and geographical relations. As, however, there is at present great public interest in the various tribes inhabiting the West Coast o·

Africa, including the Ashantees, with whom this country is at war, all objects relating to the Ashantees, Fantees, Dahomeys, Houssas, and the neighbouring tribes are especially desired. The Indian Empire, the Eastern Archipelago, and the islands of the southern hemisphere, are also able to afford abundant and valuable materials for the proposed museum, of which it is believed that the nucleus can be formed at once from materials in private collections. Her Majesty's Commissioners confidently appeal to the civil, military, and naval officers of the British service throughout the Queen's dominions to assist them in these collections. Her Majesty's Commissioners have secured the services of eminent gentlemen to advise them from time to time in giving effect to these intentions. It is requested that offers of gifts and loans of objects should be made known at once to the Secretary of Her Majesty's Commissioners, Upper Kensington Gore, London, S.W.

IN reference to recent communications on the rate of stalagmitic deposit, Mr. Thomas K. Callard writes to say that he thinks the probability is that the rate of deposit in Kent's Cavern was not uniform, "for, when the thick forest (the habitat of the animals whose bones are found in the cave) left an accumulation of decayed vegetation on the soil, we had the natural laboratory where the rain would find the carbonic acid, to act as a solvent upon the calcareous earth, and as this acidulous liquid percolated through the soil and dripped into the cave, we have the origin of the stalagmite; but as, by the axe of man, the forest decreased, in that proportion the chemicals lessened, and as a consequence the deposit diminished. Besides the diminution of the solvent, every year that the operation was going on the material that composed the stalagmite must have been decreasing in the superjacent soil, so that the bicarbonate of lime which now takes two centuries to cover one-eighth of an inch, might have been, in days gone by, the work of much shorter time." Mr. W. Bruce Clarke writes that he visited, about ten years ago, a cavern near Buxton, commonly known as "Poole's Hole," and observed some stalagmite, probably $\frac{1}{8}$ in. in the back, had become deposited upon the gas-pipes, which were used to light the cave, and had been laid down six months before. At this rate, granting that the deposit had been six months in acquiring a thickness of $\frac{1}{8}$ in., 1 in. would be deposited in four years, a rate of deposit even more rapid than that (viz. $\frac{3}{4}$ in. in fifteen years) mentioned by Mr. Curry in the number of NATURE for December 18. It must be remembered, however, that though at one particular spot in "Poole's Hole," 1 in. of stalagmite might be deposited in four years, the same rate would probably not be maintained all over the cave.

THE Sub-Wealden Exploration has proved far more expensive than was at first anticipated, and additional funds will be required to complete the desired depth of 1,000 ft. A third sum of 1,000*l.* has now been promised, and this will form the basis for future operations. This amount includes 200 *l.* from the Duke of Devonshire, 100*l.* from Lord Leconfield, 50*l.* from the Earl of Ashburnham, 50*l.* from the Royal Society, and 25*l.* from the Duke of Norfolk. These sums will be collected as the work proceeds, and additional contributions are solicited. The importance attributed to the enterprise by Professor Phillips in the Geological Section, during the last meeting of the British Association at Bradford, is an additional proof, if any were needed, of the expediency of completing the investigation.

PROF. OWEN, who is suffering from a troublesome bronchial affection, is spending the winter in Egypt.

MR. J. ALLEN, of Clifton College, has been elected to the Natural Science Exhibition at St. John's College, Cambridge (50*l.* per annum tenable for three years). The examiners reported that the merits of Mr. Lodge were very nearly equal to those of the successful candidate. There were ten candidates.

THE Caspian Sea is extremely rich in various species of fish, many of these occurring in prodigious numbers. Indeed, according to Alexander Schultz, the yield is very much greater than that of the Great Bank of Newfoundland. Thus in one single district 15,000 sturgeon are frequently taken in a day, and when the fishing is interrupted for twenty-four hours the waters become almost choked by the abundance of fish, which are so numerous as to press each other out upon the shore. The total yield of the Caspian Sea for one year in fish and fish products has been estimated at 13,000,000 *pouds* (about 469,430,000 pounds avoirdupois), worth about 12,000,000 dols. There are several varieties of sturgeon among the fish taken, including the sterlet, as well as the carp and other cyprinoids, the salmon, the *Coregonus* (similar to the white-fish of the American lakes), several kinds of herring, &c. A peculiar phenomenon observed especially among the sturgeon is that of a kind of winter sleep. At the approach of cold weather they seek the deep portion of the rivers, and remain there in a state of torpor, during which they secrete a viscid matter which forms a coating over the entire body, called by the fishermen a *pelisse*. During this period they appear to eat nothing, their stomachs always being found entirely empty.

MR. DALL, of whose movements as a surveyor and explorer in the Aleutian Islands in behalf of the Coast Survey we have advised our readers from time to time, returned on the 8th Nov. to San Francisco, where he will spend the winter in preparing his report to Prof. Peirce. Part of his labours had special reference to the selection of a suitable locality for an intermediate land station for the proposed Pacific cable between the United States and Japan. Mr. Dall expects to return in the spring to finish his explorations on the islands.

AMONG recent discoveries of valuable minerals in Australia is that of iron in the form of magnetic iron, and brown hematite at Wallerawang, Victoria, in close proximity to limestone, fire-clay, coal, and a railway station.

THE Italian Scientific Commission, appointed to examine, from an anthropological point of view, the remains of the Italian poet Petrarch, and to publish the result of its observations at the centenary of the great poet, proceeded, we learn from *La Nature*, in the beginning of December to open the urn of red granite, amid a large gathering of people. The bones, instead of being contained in a coffin of wood or metal, were spread upon a simple plank, and were of an amber colour, moist, and partly mouldered. The cranium, of medium size, was intact, the frontal bone much developed. The jaws still contained many teeth, among which were a number of molars and incisors very well preserved. The orbits were very large. Nearly all the vertebræ and ribs were found. The bones of the pelvis were in good condition, as also the scapula, the humerus, and the other bones of the arms; the apophyses of the femurs were very prominent. There was discovered also a quantity of small bones which probably composed the hands and the feet. The vestments were reduced to a dark powder. From the size and length of the bones, we may conclude that Petrarch was a man of middle height and robust constitution.

AT one of the last sittings of the French Academy of Medicine, says *La Nature*, M. Devergie read a remarkable report on the prize of the Marquis d'Ourches, a prize of 25,000 francs, to be given to the man who should discover an infallible method of recognising certain death. The method must be so simple as to be at the command of the most illiterate and rude. Besides this prize, the testator instituted another of 5,000 francs for the discovery of a scientific method of arriving at the same result. The value of the prize of 25,000 francs has tempted people of all classes and all conditions; thus the Academy has received 102 memoirs, not counting those which arrived after the expiration of the time announced for their reception. Of these 102 memoirs, only 32 were judged worthy of serious examination. But no one has gained the famous prize of 25,000 francs, which therefore reverts to the testator's family. As to the prize of 5,000 francs, it will probably be divided among various competitors who have presented interesting memoirs.

AT the Annual Meeting of the Institution of Civil Engineers, held on December 23, it was stated that on the 30th November last, the number of members and associates was 1,994. On the subject of finance, it was stated that during the last fourteen years the savings had amounted to something like 2,000*l.* per annum, on the average. The receipts are now nearly 9,000*l.* per annum, while the ordinary expenditure was only 6,000*l.* per annum. What with trust funds, investments, and cash balance, the Institution has 30,233*l.* 8*s.* 6*d.* at its disposal. The library numbers 10,443 volumes.

WE would draw the attention of our London readers to the advertisement in this week's NATURE with regard to the Junior Philosophical Society, meeting at 6A, Victoria Street, S.W. We believe we have had occasion to speak of it before, as one whose object and method of work are commendable.

THE January number of Petermann's *Geographisches Mittheilungen*, contains a contribution by Dr. Nachtigal giving valuable details concerning the various Pagan tributaries to the kingdom of Baghirmi. Dr. Meyer gives some statistics of the inhabitants of the Philippine Islands, whose number he estimates at 7,451,352. In the same number is a communication from Dr. Miklucho-Maclay, dated Batavia, October 25, 1873, in which he maintains that the Papuas and Negritos belong to the same race, notwithstanding that the former are dolichocephalic, and the latter brachycephalic.

THE principal article in Guido Cora's excellent Italian Geographical Journal *Cosmos*, is on "Recent Expeditions to New Guinea."

THE "Second Report of the Committee on Boulders appointed by the Royal Society of Edinburgh," contains much interesting information which will no doubt be ultimately of service to geologists.

WE have received the first number of *The Argonaut* (Hodder and Stoughton), a journal started by "a number of young fellows who are just entering on the bolder thoughts or the more active duties of manhood," for the purpose of discussing questions in which all earnest young men take an interest. It professes to be devoted to no party either in religion, politics, or philosophy. It is edited by Mr. George Gladstone, F.C.S., and this first number contains an Introduction by Dr. Gladstone, F.R.S. The contents are varied and mostly interesting.

THE Opening Address to the Geological Association, by the president, Mr. Henry Woodward, F.R.S., has been printed as a supplemental number of the Proceedings. The Address is a survey of what has been done in geology during the past twelve months.

"THE Glaciation of the Northern Part of the Lake District," is the title of a paper by Mr. J. Clifton Ward, reprinted from the *Quarterly Journal of the Geological Society*.

THE *Mémorial Diplomatique* states that the Italian Consul at the Piræus has informed his Government that M. Théodore Tubini, banker, at Athens, has obtained a concession for cutting a canal through the Isthmus of Corinth. The principal clauses of the concession are that the canal shall have a *minimum* depth of 8½ metres (27 ft.), and a width of 12 metres (39 ft.) at the bottom. Half-way through the canal is to be a dock of 30,000 square metres in extent, and of sufficient depth to receive the largest vessels. The canal is to be completed in six years. The concession is for 99 years, and a deposit of 12,000*l.* is to be paid immediately after the Greek Parliament has approved the concession. The estimated cost of the undertaking is 800,000*l.*

THE principal papers in No. 39 of the *Journal of the Scottish Meteorological Society*, are "The Report of the Committee appointed to investigate the Relation of the Herring Fishery to Meteorology," an abstract of which has been given in our report of the Society's meeting, and a valuable paper by the Rev. W. Clement Ley, "On the Mean Inclination of Winds towards the Lower Isobarics." The Journal contains, as usual, the admirably compiled quarterly Meteorological returns from the Society's numerous stations.

WE have received a reprint from the "Proceedings of the Geologists' Association" of Mr. Henry Hick's paper on the "Classification of the Cambrian and Silurian Rocks.

PART III. of vol. xxii. of the "Transactions of the North of England Institute of Mining and Mechanical Engineers" consists entirely of an elaborate and valuable paper on the geology of the Redesdale ironstone district, by Mr. G. A. Lebour, of the Geological Survey. It is accompanied by two useful maps of the district.

AN aerolite, *Iron* says, weighing about twelve pounds fell in the vicinity of Marysville, Cal., on the 24th of August, which was so hot that it could not be handled for some time. It came crashing through the tree tops with a bright flash, and was found buried eight feet in the ground.

THE additions to the Zoological Society's Gardens during the past week include an Asiatic Wild Ass (*Equus onager*) from S.W. Asia, presented by Capt. H. L. Nutt; an Anubis Baboon (*Cynocephalus anubis*) and a Patas Monkey (*Cercopithecus ruber*) from W. Africa, presented by Mr. A. E. Oakes; a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. F. E. Bradley; a Hybrid Duck (between ♂ *Aix sponsa* and ♀ *A. galericulata*), presented by Mr. J. C. Parr; a Yarrell's Curassow (*Crax yarrelli*) from S.E. Brazil, and a Coypu (*Myopotamus coypus*) from S. America, purchased.

SCIENCE IN KÖNIGSBERG

WE have before us the *Schriften der Königlichen Physikalisch-Okonomischen Gesellschaft zu Königsberg*, for 1871-72, in which is to be found a considerable amount of useful scientific observations, both of local and general interest. Dr. Berendt, who, along with some coadjutors, has been engaged in preparing a full geological map of Prussia, and in other geognostic researches, describes a specimen of immature amber brought from the sea-bottom on the Samland coast. Under a wrinked and brittle crust, the resinous substance was soft, transparent, and highly elastic. From some similarity of physical properties (not complete, however), Dr. Berendt inclines to identify it with a fossil resin found by Bergemann in brown coal of Lattorf, and described under the name of kranzit. The sp. gr. of the new substance is 0·934; it is insoluble in alkalies, spirit of wine, oil of turpentine, soluble in sulphuric acid; it begins to melt at 300°; in air it burns with a luminous sooty flame, giving a peculiar smell; it is free of sulphur, but contains a little nitrogen, like amber and some kinds of asphalte.

The same author has given much attention to the formation of amber in Prussia, and in an earlier number of the *Schriften* (1869, first part) will be found a very full investigation, by him, of the subject. In one of the present numbers he gives an account of preparations lately made for subterranean mining of the substance in Samland. Hitherto this method has not been adopted, and on two accounts chiefly; the nature of the superincumbent strata (which are generally sand and clay), and the high value of amber, which sufficiently repaid the other method. The Government, however, has lent some aid, and in July 1872 boring was commenced at the southern base of Carlsberg, where, at a depth of about forty-four metres, blue earth was found containing amber in abundance. This is about 5·7 m., or eighteen feet below the sea. The results were of a highly promising nature, and exceeded expectation.

The coast of Samland affords a good opportunity of studying the Algæ of the Baltic; and this forms the subject of a communication from M. Caspary. It is known that the water of the Baltic contains a much smaller proportion of salts than that of the North Sea or Atlantic. According to a recent analysis by Von Behr, the quantity was only 0·6766 per cent. To this fact, chiefly, and also to the fact of a colder climate, M. Caspary attributes the much smaller number of species of Algæ in the Baltic than on the English coast. He enumerates only twenty-five from the Prussian coast, whereas, at Falmouth, in Cornwall, 176 different species have been found. The water of the Atlantic contains about four per cent. of salt, or nearly seven times more than the Baltic water.

We further note, in the department of Botany, a paper in which Dr. von Klingraff describes the species and varieties of Sphagnum found in Prussia. In referring to the colouring of the leaves as a means of characterisation, he points out that the red and yellow colours almost always exclude each other. Red is found in only three species; *S. acutifolium, tenellum* and *cymbifolium*; and each of these has a purple-red variety. On the other hand, yellow is wanting in the first two, and the variety *congestum* of the third is the only known example in which the red and yellow co-exist in forms of the same species.

Among the various organic remains found in amber, those of molluscs are peculiarly rare. It might have been expected that the liquid resinous matter would more readily surprise such animals than running or flying insects (which are abundant), while the shell, after death of its tenant, would offer a longer resistance to destruction than an unprotected body. It would be rash to conclude that the amber forest contained as few molluscs as our present exclusively pine forests; and botanists have shown that other trees than those of the pine species must have been present. In these mixed forests there were doubtless numerous molluscs, and we are led to suppose that the resin-producing trees were carefully avoided by them. Such is the view given by M. Künow, who describes two snail shells found in amber, and probably belonging, he thinks, to the genus *Helix*. Only three previous notices of similar discoveries has he met with; and among the 13,000 organic remains of amber in the Society's collection, there is no piece of the kind in question.

Dr. Buchholz furnishes an account of the Hansa Arctic Expedition, and many interesting particulars as to the forms of life observed in the North Polar regions.

The anatomical collection in the University at Königsberg contains three bear skulls found in the province. These are described at some length by M. Müller. They differ much in size and form, and it is striking that such different individuals of the same species should have lived so near one another (the places of discovery not having been more than 20 miles apart). A few similar bear skulls have been found in this country and in Ireland, and are described by Owen under the name of fen-bears.

It has been commonly believed that living trees struck by lightning are frequently consumed. In a paper on the effects of lightning on trees and telegraph posts, M. Caspary shows this is a mistake, and that the case is extremely rare. He cites 93 authenticated cases of trees having been struck; the species were as follows (and here also some common notions are disproved):—1 *Populus alba*, 2 *Pirus communis*, 2 *Ulmus*, 3 *Pinus picea* L., 3 *Betula verrucosa*, 3 *Fraxinus excelsior*, 12 *Pinus sylvestris*, 12 *Picea vulgaris* Link., 14 *Populus monilifera*, 15 *Quercus pedunculata*, 20 *Populus italica*. Several valuable experiments and results are detailed in this paper, of which, however, accounts may be found in English serials.

Another important paper in physics treats of the arrangements at a station for measuring ground temperatures in Königsberg, and the correction of the thermometers there employed. It is by Dr. Ernst Dohrn.

Archæology claims a considerable share of the Society's attention; and there is one paper by Dr. Berendt, which specially deserves our notice. It enters very fully into the question of certain curious "face urns" which have been found in the region about Dantzic, &c. The forms of these articles are calculated to throw a good deal of light on the physiognomical features and the manners of the people that used them.

Königsberg now numbers over 100,000 inhabitants, and the sewage question becomes urgent. Dr. Müller calls the attention of the Society to what is being done in other cities and countries, by way of improvement in this direction.

WELLINGTON N.Z. PHILOSOPHICAL SOCIETY

THE President, Dr. Hector, delivered his annual address before a meeting of members on Aug. 6, 1873. Dr. Hector in his opening remarks paid a tribute to the memory of Dr. Fred. John Knox, who had during a life-time contributed greatly to the science of comparative anatomy. Dr. Knox was an undoubted authority on all matters relating to the Cetacea, having made it his chief study. As one of the oldest members of the New Zealand Society he contributed largely and valuably to its transactions and the museum, which latter is specially indebted to him for the numerous contributions of anatomical preparations. The society, during its six years' existence, has gone on steadily increasing its members, who now number 142. Referring to vol. v. of the Transactions, Dr. Hector stated it contained forty-eight original papers, some of which possess a value from their originality of research which cannot fail to make the Transactions in future times important for reference.

Mr. T. Locke Travers' paper on the Life and Times of Te Raupara is a valuable page in the history of New Zealand, as the career of a man like Te Raupara is not merely of interest from its association with the early history of the colonisation of these islands, but affords a subject for study in connection with the more general historical question of the rapidity with which changes can be effected in uncivilised races, and the aptitude which they show in acquiring the arts, both peaceful and warlike, from colonists or conquerors as the case may be. Mr. Travers' contribution, valuable though it is, is but a small portion of the material relating to the Maori race which would find a fitting place in the Transactions of the Institute. The Maoris present a peculiarity of a mental type, the reason for which is not yet fully explained; as a race they show evidence of greater mental vigour than might have been expected in a people possessing no written knowledge. The facility with which they acquire our written language, and the delight which they take in exercising it, in reducing to writing their ancient *waiatas* (songs) and traditions is of itself a remarkable evidence of their vigour of mind. It does not appear, however, a reliable course in the collection of these songs to employ the Maori narrators to reduce them to writing, as it must be a process of translation of a most complex kind, and must lead to loss of accuracy both in matters of fact and in form of expression. A most interesting feature in the Maori language is the minute detail with which natural objects have been discriminated and named. He contrasted this with the North American Indians, who have only names for objects of immediate and practical utility in their affairs of every-day life. The Maoris, on the contrary, appear to have possessed a pure love of exercising their discriminating faculty; every tree or shrub, useful or useless, nearly every fish of large size or insignificant, and even many insects and lower forms of life that would remain unnoticed by most Europeans unless specially trained to the observation of such objects, have all their special names to the Maoris. The frequent reference made in their songs and traditions to these natural objects, invests them with a richness of imagery that adapts them for the poetical expression of sentiments and emotions that could only have been feebly if at all developed to the minds of the originators and narrators of those legends.

One of the most important events connected with this subject is the publication of the poem "Ranolf and Amohia," to the talented author of which all who love natural history must feel grateful for the abundant allusions which he has made to the characteristic features of the fauna and flora of the country, and the care which he has exercised in making his descriptions accurate. When a poet qualifies himself to appreciate the precise relations of the objects that enter into the scenes he depicts he will find that it is not necessary to sacrifice either facility or grace of expression in order to obtain the impressiveness which arises from strict accuracy. From this point of view Mr. Domett's poetical descriptions of the natural history of the new country cannot fail to aid in linking the sympathy of literature and fancy with the study of Science, and do good service to those objects which the society has most in view. The president also eulogised the efforts of a member of the Institute, Mr. G. H. Wilson, whose graceful and vigorous pen has been devoted to the rendering of those legends which relate to events that occurred in past time in the immediate neighbourhood of Wellington. The President referred to the papers of Messrs. Mantell and Taylor as bearing out his (Dr. Hector's) view of the recent date of the extinction of the moa. The discovery of a large bird of the *Anser* family, but which could not fly adds another remarkable feature to New Zealand's extinct ornithology. Chief among the additions which have been made to the zoological literature of the colony during the past year is Dr. Buller's great work on the Birds of New Zealand, which is to be rendered more complete by the publication of additional plates. The President expressed a hope that a second edition might be called for in order to give Dr. Buller an opportunity of bringing up the information to a still later date. The enumeration of our whales and dolphins communicated to the Society by Dr. Hector has already called forth critical remarks from the veteran zoologist, Dr. J. E. Gray, of the British Museum. The President expressed his opinion that the fur seals frequenting the South Island all belong to one species, *Arctocephalus cinereus*, although skulls of a second species (*A. lobatus*) are found in caves and Maori ovens. Captain Hutton's valuable addition to the list of fishes was also referred to, as also the successful introduction of salmon during the past year. Dr. Hector expressed an opinion in favour of introducing ova not only of salmon but of trout, white fish, and other species, that inhabit the inland waters of British Columbia. The catalogues of the Marine Mollusca, and the Star Fish of our coasts, prepared by Captain Hutton, will be found invaluable by collectors, but the most interesting contribution to the Zoology of New Zealand is Captain H.'s essay on the Geographical Relations of the Fauna, which to a great extent bears out the hypothesis advanced by Dr. Hector in a previous address, that the peculiar insular characters of the forms of life in New Zealand have been present from a very remote period.

The President referred to the expected visit of the *Challenger* on a scientific exploration of the Southern Seas, and expressed a hope that it would add largely to our knowledge on this interesting subject. Referring to the great Southern Continent, which is full of interest with its active volcanoes amidst perpetual snows, he stated it was likely that the ensuing year will add greatly to our knowledge of that land, which is only 1,200 miles distant from New Zealand, on whose climate it probably exerts a marked influence. This little known land possesses large supplies of guano, and according to Sir James Ross, has a large and undisturbed whaling ground near it, in which whales of several different species abound. The President criticised Captain Hutton's paper on the Glacial period of New Zealand, and confirmed his dissent from the theory of a submergence of the New Zealand area on a grand scale during the post-pliocene or post-glacial period, and stated that unless palæontological evidence of recent date can be obtained from strata occupying valleys that were eroded during the last extension of the glaciers he must still adhere to his formerly expressed opinion, that the geological period previous to that which may be termed the recent period in New Zealand was characterised by a prolonged though perhaps not excessive elevation; and that especially in the South Island there is in consequence a marked absence of marine drifts and tills. The President commended the study of the subject of our soils, surface drifts, and beach rocks to the members of the Society. He also differed from Capt. Hutton, who underrates, he thought, the erosive power of existing glaciers, and referred to the recent changes reported to have taken place in the outline of the summit of Mount Cook, owing to a great avalanche having slipped from the ridge, leaving a conspicuous gap in the formerly even tent-like form of the apex.

After referring to the Geological reports for the progress made during the past year in the survey of the country, the President stated that descriptive catalogues of fossils from the tertiary formations, as also an illustrated work on the fossil plants from the different coal-bearing formations are nearly ready for publication. The development of the wonderful reptilian fauna in the upper secondary rocks will afford subject for several communications at the meetings of the Society during the present session. Already at least seven distinct forms belonging to the genera Plesiosaurus, &c., have been worked out from the blocks of matrix collected at the Amuri Bluff (Marlborough) and at the Waipara, and the description of these gigantic Saurians will be sure to excite great interest in the study of geological structure by exciting discussion at home, and indirectly to attract attention to the mineral and other resources of the colony. Mr. Skey's contributions were also favourably reviewed by the President, who concluded by thanking the members for the courtesy and support which he had received. He then vacated the Chair in favour of Dr. Knight, the President for the present year.

SCIENTIFIC SERIALS

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, November 1873.—In order to give warning of approaching storms, an important determination is that of "barometric gradient" between two places, found by ascertaining the difference of atmospheric pressure, and dividing by the distance. But as the places may be at unequal heights above the sea level, the influence of this inequality on the barometric state must first be eliminated. This may be done by either of two methods; reduction to the sea level (the more common way), or determining the divergence of the observed barometric state from the average for several years. At the recent meeting of the International Congress of Meteorology at Vienna, the question came up, which method was preferable; and it was decided, that for stations not more than 300 metres above the sea, the method of reduction had advantages over the other. Dr. Hann here compares the two methods, and presents the grounds of the Congress's decision. Austria adopts, this year, the method recommended, in place of the other.—The paper is followed by one giving a sketch of the organisation for meteorological observations in France, under the direction of M. Le Verrier.—We further note some observations by M. Caloria, of Mailand (communicated to the Istituto Lombardo), comparing the number of sun-spots with the temperature and rainfall during the period 1763–1872. The tables indicate pretty clearly an increase of heat with decrease of spots; though anomalies occur. In rainfall the connection is less marked. Among the other notes will be found information as to the climate of the Philippines, statistics of earthquakes in Austria, meteorites, &c.

Bibliothèque Universelle et Revue Suisse for November 1873, commences with a paper by M. Rahn on the Origin of the Renaissance in Italy. He considers the essential character of the art of that period to have been, that the works produced were no longer the product of a collective activity, but the creation of such and such a master. He also shows from the Palais Pitti at Florence, and other edifices (as compared with the Gothic style), how the sense of harmony in proportion was developed.—M. I. Piccard communicates the second part of a paper entitled "Poisons and Counter Poisons," giving here a clear popular account of the three different methods of remedy in cases of poisoning—mechanical elimination of the unabsorbed poison, neutralising of the poison by substances forming with it a harmless compound, and symptomatic treatment, dealing with the effects produced.—Mdlle. Anneville, criticising the public instruction in the United States, thinks history and literature, and æsthetical studies, are too much ignored.—M. Glardon has a review of some English works on Patagonia. The remaining papers do not specially call for notice here.

Bulletin de L'Académie Royale de Belgique, Nos. 9 and 10. This issue contains some interesting observations by Dr. Nuel, of Utrecht, on the electrical phenomena of the heart. Electrodes being applied, one to the apex, the other to the lateral face of an intact, fresh heart, beating regularly, there is, *in diastole*, a small current from the former to the latter, increasing with distance between the points. If the heart is exposed to air, however, the current is soon reversed. Any wounded part is negative to every other point on the surface. The circuit being closed between an intact surface and a transverse section, there is a considerable current from the former to the latter (greater than in ordinary muscles); this diminishes rapidly, but increases again somewhat, when a contraction has been excited. As to the phenomena *during contraction*, the weak current at the surface of the intact and fresh heart does not change; but if a strong current is obtained from lesion, this is weakened or reversed during systole. The negative variation precedes contraction; it reaches a maximum at commencement of systole, and lasts to the end of the contraction. The same author has experimented on the influence of the vagus nerve on the heart; and finds that stimulation affects the auricular contraction differently from the ventricular, implying the presence of different nervous elements. The nerve also contains some fibres which excite, instead of retarding, the heart's movements. In an investigation of the orbits of comets, M. Houzeau shows that the greater axes have a decided tendency to place themselves parallel to the double heliocentric meridian 102° 20′ and 282° 20′, and this longitude differs little from that of the point in space, towards which the solar system is found to be moving.—M. Plateau describes a parasite of the Belgian Cheiroptera. There is a short account, by M. Quetelet, of the proceedings of the recent international Congress of Meteorology held at Vienna; and

M. Van Rysselberghe's "universal meteorographic system" (which we lately noticed), is here described in full, with illustrations, and deserves the attention of meteorologists.

SOCIETIES AND ACADEMIES

EDINBURGH

Royal Society, Dec. 22, 1873.—Sir W. Thomson, president, in the chair. At the request of the Council, Dr. Andrews gave an address on ozone. After giving a full *résumé* of the history of the discovery of the more important properties and relations of ozone, Dr. Andrews showed a number of beautiful experiments. Especially remarkable among these was a class-illustration of the contraction of oxygen by the silent electrical discharge. By the use of a new form of apparatus a diminution of volume was obtained, exceeding any hitherto recorded. Among the more remarkable of the new experiments shown was one quite recently made by the lecturer, proving that coarsely pounded glass, shaken in a vessel containing electrolytic oxygen, rapidly destroys the ozone reactions. This experiment forms a new link between a purely mechanical action and a chemical change, closer than any hitherto observed. The chairman, thanking the lecturer in the name of the Society, pointed out how very large a portion of all that we know about ozone is due entirely to the exquisite researches of Dr. Andrews.

Royal Physical Society, Dec. 17, 1873.—Dr. James M'Bain, R.N., president, in the chair.—The communications read were the following :—On a deposit of magnetic iron ore on the shores of Bute, by James Middleton, M.B. (with exhibition of specimens.) It seems that some time ago Mr. Cameron, of Rothesay, had noticed some remarkable kind of black sand on the beach at Bogany Point, at the entrance to Rothesay Bay. Being interested in it, he carried home a specimen, dried it, and made an examination of it, the result being that he found the sand to consist of almost pure magnetic iron-ore. Bogany Point is not the only part of Bute where it has been found, as it occurs at Kilmichael in the Kyles of Bute. An interesting circumstance, probably connected with this deposit, is that captains of small coasters in the neighbourhood say that they have noticed a divergence of the compass near the point where the principal deposit lies.—Experiments regarding the rate of deposition of sediment from fresh and salt water, by David Robertson, F.G.S. A simple way to illustrate the experiment of the precipitation in fresh and sea water is to take two small glass jars of equal size. Fill the two about four-fifths full, the one with sea and the other with fresh water ; then fill both up with clay dissolved in fresh water—say about the consistence of cream—and stir both well up. Set the jars side by side to settle, and in a very short time the precipitation in the jar containing the sea-water will be seen to be going on rapidly, while in the jar with the fresh water little or no change will be observable. From these results, we can easily understand that whatever changes may have taken place relatively to land and sea from other causes, it does not appear that deposits from fresh water currents can be carried far seaward.—Note on the deposition of mud from various solutions, by Joseph Sommerville.

MANCHESTER

Literary and Philosophical Society, Dec. 16, 1873.—E. W. Binney, F.R.S., vice-president, in the chair.—"Method of Construction of a New Barometer," by Dr. J. P. Joule, F.R.S., president. The condition of the instrument placed on March 18 in the Society's Hall proves that it is possible to use sulphuric acid on the top of the mercurial column without chemical action taking place. I have therefore proceeded to prepare other tubes with a view to test, by practical work, the merits of the new contrivance. A tube of about $\frac{3}{16}$ inch bore is selected. It is first cleaned by drawing a knotted string through it. It is then bent to the siphon shape ; and near the longer end it is drawn to a capillary tube. It is then washed with nitric acid ; afterwards with sulphuric acid. The sulphuric acid is then drained off. Mercury is then poured into the short limb. The end of the longer limb is then attached to my mercurial exhauster. On working this the mercury rises in the tube, and, being replenished by pouring it into the short limb, soon arrives at the height due to the atmospheric pressure. It carries with it the acid left adhering to its sides, so that after a few hours half, or, what is better, one third of an inch of acid stands above the mercury. Small bubbles of air are seen to arise ; but by leaving the tube in connection with the exhauster for a day or two these finally cease. Mercury is then poured into the short limb until that in the longer rises nearly to the capillary part of the tube. This is then sealed and detached from the exhauster. Mercury is then removed from the shorter limb until it stands in the long one at a convenient height. Sulphuric acid is then introduced into the short limb until it forms a column equal to that in the longer limb. A small tube is finally attached to the short limb, and dipping a little way into a small bottle containing a small quantity of sulphuric acid, prevents the access of moist air into the short limb. The tube thus completed possesses the following advantages :—1st. There is the utmost facility in the movement of the column, so that the most minute changes of pressure are at once registered without any dragging. 2nd. The depression produced by capillary action is reduced to one half, so that the siphon arrangement can be satisfactorily used as affording an accurate neutralisation of capillary action.—Mr. Baxendell read a letter from Prof. C. Piazzi Smyth, F.R.S., Astronomer Royal of Scotland, referring to Prof. Reynolds's experiments on exploding glass tubes, and confirmatory of the conclusions of the immense force exerted by water when suddenly converted into steam, as when lightning rends a tree.

VIENNA

Imperial Academy of Sciences, Oct. 9, 1873.—Prof. Krasan made two contributions in plant physiology ; one of them as to what degree of heat wheat-seeds can bear without losing the power of germination. It is much higher than had been thought. They could bear a boiling heat for some hours, desiccation being effected by very gradual rise of temperature, and the use of chloride of calcium (65° for one hour was the limit previously supposed).—A second paper treated of the germination of tubers and bulbs of some early-spring plants.—Prof Lindemann communicated a paper on the behaviour of acrylic acid towards hydrogen liberated from acid solution, and towards agents of oxidation. He finds that acrylic acid at 100° C., with zinc and sulphuric acid, readily passes into ordinary propionic acid ; and that, in oxidation, it furnishes no acetic acid. He thinks acrolein and acrylic acid cannot be constituted similarly to true aldehydes and fatty acids.

October 16.—Prof. Heller, who had been requested to study the Tunicata of the Adriatic, gave a paper on the vascular system of these animals, and especially Ascidians. The walls of the heart (which is a long cylindrical bag, with a thin pericardium), show fine striated muscular fibres, not parallel, but forming a network. The two vascular trunks immediately proceeding from the heart have a similar wall-structure, and contract along with it. The vessels supplying the outer coat in Ascidians always appear as double vessels, joined together only at the end of the last ramification ; in one vessel the blood flows outwards, in the other inwards. The blood in Ascidians is often coloured ; sometimes greenish yellow, sometimes brownish ; while in some species (as *A. intestinalis*), it is quite colourless.—Dr. Von Reuss communicated the first part of a monograph of the fossil bryozoa of miocene Tertiary strata in Austro-Hungary.—Prof. Ritter read a paper on the path of Winnecke's Comet (III. 1819).—Prof. Böhm described experiments which proved the injurious action of ordinary gas on plants. For example, of ten plants (Fuchsia and Salvia), in pots, in which gas was constantly being conducted to the roots, seven died in four months. It was also shown that the gas does not in the first instance kill plants, but that it poisons the ground. Dr. Böhm recommends Von Jürgen's method of preserving plants from gas in the ground, which is, to place the pipes in wider pipes communicating with the outside air, and in which a draught is produced.

October 23.—M. Stefan gave the result of experiments on evaporation, made chiefly with ether. The rapidity of evaporation of a liquid in a tube is inversely proportional to the distance of the liquid surface from the open end of the tube ; it is independent of the diameter, and increases with the temperature. If a pipe, closed at one end, open at the other, is dipped with the latter in ether, bubbles are developed, and the times in which successive equal numbers of bubbles appear, are (initially) in the proportion of the odd numbers. If the tube contains hydrogen instead of air, the same number of bubbles appears in a four times shorter period. Thus evaporation in hydrogen is four times quicker than in air. If a pipe, with open stop-cock, is dipped in ether, and the cock then closed, the surface of liquid within the tube sinks under that without, and the depths to which it sinks in given times are as the fourth roots of the times.—Dr. Peyritsch communicated a memoir on Laboulbenia, describing a new species of the parasitic fungus, also the mode of development.

I. R. Geological Institute, Oct. 30, 1873.—Prof. Dr. A. Alth sent the first part of a monograph on the palæozoic rocks of Fadolia and "its organic remains," which will be published in the transactions of the Institute. This first part of Dr. Alth's memoir contains the geological description of the oldest formations of Padolia which, covered by large masses of cretaceous and tertiary deposits, and nearly horizontally stratified, appear only in the deep creeks along the beds of the rivers. The lowest rudimentary beds, resting immediately upon granite are sandstones which alternate with violet Argyle-slates, and are almost deprived of fossils. They contain the known concretionary globes of phosphorite. The next layer consists out of bituminous limestone with many fossils which belong to the Wenlock series; it is covered by grey marly slates which contain Brachiopods and Crinoids, and rarer Trilobites and Orthoceratites. The highest Silurian beds are green or grey shists alternating with crystalline limestones, which correspond to the Ludlow-series and contain, besides other fossils, very interesting remains of fishes. The Silurian strata are covered by red sandstone of Devonian age, and these immediately by the cretaceous strata. Of the fossil remains are described in the first part of the memoir, the fishes, chiefly Cephalaspidæ but partly also Placadermata (M. Cay) and the Crustaceæ, as Trilobites and Ostracadæ. They are figured on five plates.—Dr. O. Leny describes a fossiliferous bed belonging to the upper Neocomian limestone (Spatangenkalk) near Klein, in Vorarlberg. It consists chiefly of well-preserved oyster-shells and contains, besides, many different forms of Brachiopods, which certainly lived here in company with the oysters. This observation furnishes a new proof that the ancient Brachiopods were not confined to the deep sea like the modern representatives of this class, but inhabited the shores, also, together with the oysters; analogous observations had been made formerly by Th. Fuchs in the tertiary deposits of the Vienna basin, and by Dr. Majsisovics in the Muschelkalk of the Rhaetic.—Dr. C. Doelter examined last summer the environs of the Gurgl-valley in the Oetzthal Alps. He sends a notice about the different crystalline rocks which form this region.

GÖTTINGEN

Royal Society of Sciences, Sept. 3, 1873.—Chemical papers were communicated, on a base from nitrobenzanilid (Hübner and Retschy), on the xylidine from coal tar (Hübner and Struck), on the combination of nitrile with aldehydes (Hübner and Jacobsen).

November 12.—Dr. Hermann Ethé made a lengthy communication on the oldest period in new Persian poetry, criticising works of the poet Rûdagê, some of whose songs he translates.

BOSTON, U.S.

Natural History Society, Oct. 15, 1873.—Mr. S. H. Scudder described some kittens which he had seen at Plymouth, N.H., supposed to be a cross between the rabbit and the cat. The animals had a short rabbit-like tail, long haunches, and the gait of a rabbit, but in other respects were cat-like. Mr. Scudder could not believe the possibility of a cross between animals so far apart in the natural system, and asked for information from those present.—Dr. T. M. Brewer read a paper on the specific characters of the hermit thrushes, and also read extracts on their habits from the forthcoming work on "Birds of North America," by Prof. Baird, Mr. Ridgeway, and himself.—Dr. T. Sterry Hunt gave some account of the crystalline rocks of the Blue Ridge and their decomposed condition, as seen by him at various points in the region to the south-west of Lynchburg, Va. They are principally gneisses with hornblendic and micaceous schists, like those of the Montalban or White Mountain series, and are completely decomposed to a depth of 50 ft. or more from the surface, being changed into an unctuous reddish brick-clay, in the midst of which the interbedded layers of quartz are seen retaining their original positions, and showing the highly-inclined attitude of the strata. The nature of these chemical changes of the gneissic and hornblendic rocks consisted essentially in the removal, in the form of soluble carbonates, of the alkalies, lime, and magnesia of the silicated minerals and the hydration of the residues. The great antiquity of this chemical decomposition of the rocks was next alluded to. It was, in his opinion, effected at a time when a highly carbonated atmosphere and a climate very different from our own prevailed.

PARIS

Academy of Sciences, Dec. 22, 1873.—M. de Quatrefages, president, in the chair.—The following papers were read:—Note on the report of the last meeting by M. Pasteur. The author called attention to the tone of M. Trecul's paper, which he considered was too personal; he briefly re-asserted his statements with regard to the origin of Mycoderma, &c.—M. Trecul replied and adduced in support of his own views as opposed to those of M. Pasteur, the experiments of Wyman, H. Hoffman, and Bastian. After a brief reply from M. Pasteur the subject was dropped.—On loss of magnetism, by M. J. Jamin. The paper dealt with the loss of increasing magnetism, as exhibited on cooling, suffered by a steel bar subjected to increasing temperatures.—Researches on the stability and reciprocal transformations of the oxidised compounds of nitrogen, by M. Berthelot.—On the results of the experiments made by the commission on vine sickness of the department of Herault, by M. H. Marès.—On a skeleton of *Paleotherium Magnum*, found in the Vitry-sur-Seine gypsum quarries.—On the anharmonic relation of four points of a plane.—Note on magnetism (6th part), by J. M. Gaugain.—On the phenomena of gaseous thermo-diffusion in leaves and on the circulatory movements which result from the chlorophyllian respiration, by M. A. Merget.—On the action of incandescent bodies in the transmission of electricity, by M. E. Douliot.—On an eruption of mud from the volcano of Nisyros, by M. Gorceix.—On the limit of the ice in the Arctic Ocean, by M. Ch. Grad.—On the form of the *Phylloxera*, a comparative study of the young, from leaves and branches, of hybernating and of sexed insects, by M. Max-Cornu.—An essay on the geographical distribution of the primitive populations of the departments of the Seine-et-Marne and Moselle.—On bilinear polynomes, by M. C. Jordan.—On the physical constitution of the sun, an answer to M. Faye's criticisms, by M. E. Vicaire.—Note on a process for the measurement of the relative intensity of the constituent elements of different luminous sources, by M. H. Trannin—On the chemical composition of certain vegetable parenchyma, by M. Maudet.—New researches on the preparation of Kermes mineral, and on the action of alkaline carbonates and alkaline earthy bases on sulphide of antimony, by M. A. Terreil.

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ERRATUM.—Vol. ix. p. 124, 1st col. l. 6, for "South Villa," read "Campden Hill, Kensington."