THURSDAY, APRIL 13, 1871

THE PROPOSED SCHOOL OF PHYSICAL SCIENCE AT NEWCASTLE-UPON-TYNE

THE proposal to found a College in Newcastle for the teaching of Physical Science needs from us more than a mere passing mention. The idea of such an Institution is not a new one, indeed it is only justice to the coal-owners, chemical manufacturers, and engineers of that busy centre of commercial enterprise, to say that they have long confessed to a sort of shame that youths, intended for responsible positions connected with the various industries on the banks of the Tyne, Wear, and Tees, have had to seek their scientific training in metropolitan or continental schools; whilst young men a shade lower in the social scale, with no disposition to undervalue such knowledge, have had to depend upon their own limited resources for its partial acquirement, with the alternative of remaining in entire ignorance. The feeling of soreness on this point had attained sufficient force fifteen years ago to induce the North of England Institute of Mining Engineers to take preliminary steps towards establishing a college for the teaching of practical science. Meetings were held, architects consulted, plans drawn, and eventually those interested in the project were informed that about 35,000*l*. would be wanted from them if they were really in earnest. The Duke of Northumberland (Duke Algernon) was applied to, and his response was characteristic; it amounted practically to this:—"Raise 30,000*l*. and I will make it 40,000*l*, but while you are about it, do the thing well." One would have thought that such an offer to so wealthy a body was equivalent to an order for the buildings to be advanced without delay. Unfortunately interests began to clash, individual promoters had pet ideas which they were unwilling to sacrifice, and there was no agreement as to the way the scheme should be carried out. The University of Durham, it was admitted on all sides, must have some share in the work, and no one could suggest a basis of connection that was mutually satisfactory, so by the end of the year 1855 the North of England had heard the last of the proposed "British College of Practical Mining and Manufacturing Science." It is perhaps no wonder if younger men, looking back at Duke Algernon's munificent offer, have accustomed themselves to think, "we would not have done as our fathers did."

One good result, however, had accrued from the failure. The necessity for scientific and technical education had been admitted, and public attention had been directed to the entire absence of local facilities for systematic teaching in those branches of theoretical knowledge most concerned in the industries of the North.

For a time the idea of an independent establishment in Newcastle seemed to be abandoned, and people were disposed to look to Durham University for a solution of the difficulty. The position of Durham was discussed, the revenue of its University talked of, and the relation of its expenditure to its educational results seriously debated—the outcome of all which was the appointment of a Commission to inquire into the administration of its various endowments. At this time the scientific instruction of the University amounted to twelve lectures annually from a Reader in Chemistry, some teaching from a Reader in Natural Philosophy, and a very few lectures from a Reader in Medicine. After the sittings of the Commission, the Senate took powers to establish a school of physical science in the faculty of Arts and to endow chairs therein, but as the stipends for these chairs were not forthcoming, their powers were never practically exercised. The readership in natural philosophy for some reason became vacant a few years afterwards, and as no fresh appointment was made, teaching in that department ceased even nominally to exist. We may be spared going into details as to the extent of the classes in the other two subjects; suffice it to say, that at the present time the physical science teaching supposed to be accomplished in Durham by the University cannot be regarded as anything more than the merest apology.

We have omitted any mention of Astronomy. Durham University has an Observatory and an Observer,—it has also a "Professor of Mathematics and Astronomy." We trust we do the present worthy occupant of the chair no injustice in supposing that his occupation has rested in the former rather than the latter branch of knowledge. With the Readership in Hebrew also on his hands, more than this could scarcely be expected.

Some knowledge of the history of previous movements, such as has been attempted in the above remarks, is needed if we would understand rightly the *status quo* at the commencement of the revived agitation.

It has been a matter of wonder to many that the northern coal owners and engineers, a body wealthy enough for almost any undertaking, and amongst whose faults cannot be reckoned want of regard to their own interests, even in that wide sense which embraces a care for the technical education of the rising generation, have remained passive during the long period which has elapsed since the failure of their first scheme; the more so as they appear to have in their "Institute" an organisation fitted to take the initiative in any public movement connected with theoretical or applied science. We are given to understand that one chief difficulty has been the want of house accommodation. The "Wood Memorial Hall," a building imposing in its design, if somewhat odd in its sculptural decorations, is expected to supply this deficiency, and its approaching completion indicates the opportunity for another effort. The new structure closely adjoins the buildings of the College of Medicine, the Natural History Society, and the Literary and Philosophical Society, suggesting lecture-room accommodation, a museum, and a library, ready to hand.

Meanwhile, a change seems to have been gradually taking place in the views held by those in authority at Durham; and when the Institute determined to invite all interested in the subject to a preliminary meeting a few weeks ago, it was with the conviction that a much more liberal response might be expected from the University than any hitherto accorded to proposals in which residence in Durham formed no part. As this first meeting appears to have been one for the expression of opinion only, and as this was elicited by the reading of a non-official letter from the Dean of Durham (*ex officio* Warden of the University) it is needless for us to dwell upon it further than to note the influential nature of the gathering, its unanimity as to the necessity for a thoroughly efficient school of physical science, and the determination that Newcastle was the only centre in which such an institution would have any chance of success.

At the adjourned meeting, the Dean of Durham and the Rev. Joseph Waite attended on behalf of the University, and as the proposals contained in the Dean's speech on that occasion seem to have been accepted as a general basis for the establishment of the College, we cannot do better than summarise them. They are roughly as follows :—

A College to be established in Newcastle for systematic teaching in Physical Science—literary subjects for the present to form no part of the curriculum.

Four Professorships to be constituted :—1. Pure and Applied Mathematics; 2. Chemistry; 3. Experimental Physics; 4. Mineralogy and Geology.

The curriculum of instruction to extend over two years; examinations to be held for degrees or diplomas in Physical Science, or other honorary distinctions subsequently determined upon.

Turning to the question of funds—the working expenses, including an adequate provision for the proposed chairs, were estimated at not less than 2,000*l*. per annum, in addition to the amount that might be received from students' fees.

Durham University offered to place in Newcastle two professors—one in Chemistry, the other in Experimental Physics—and to found ten scholarships, each of the value of 20*l*. per annum: five for first year, five for second year students. This offer was to be understood to extend to six years, but would be made in perpetuity if the results were such as to justify it. The government of the college to rest with a Newcastle board, upon which the University should have representatives. The Professors to be officers in the University, and degrees to be conferred in Durham; the examinations, on the other hand, to be conducted in Newcastle.

The one condition attached to the offer was that Newcastle should find a similar endowment of 1,000*l*. per annum, guaranteed for not less than six years.

The meeting appears to have been an eminently practical one, for more than half the required sum was subscribed in the room, and we learn that the amount named has since been considerably exceeded without any active canvass having been resorted to. The offer was naturally considered as accepted, and a Committee appointed to take steps for the carrying out of the scheme. The names of Sir W. G. Armstrong, the Rev. Dr. Lake, Mr. I. Lowthian Bell, Mr. Albany Hancock, and Mr. Newall, in connection with the executive, will carry assurance far beyond the northern counties that whatever is taken in hand will be efficiently accomplished.

The general design, sketched by the Dean of Durham, is so excellent that we are but little disposed to criticise its individual features, especially as the details which have been made public have not been put forward as representing foregone conclusions, so much as with the intention of supplying a basis for discussion.

If we read the scheme rightly, Durham is to provide two Professors and ten annual 20*l*. scholarships, and Newcastle to do likewise. Surely twenty scholarships in a newly-established college is an excessive allowance. Possibly this is not intended; at any rate such expenditure of funds would scarcely be entertained by the governing body without some reason not apparent to those less conversant with the requirements of the particular case.

Again, the selection of subjects as laid down by the Dean does not seem to be altogether happy. No scheme of scientific education in the present day can be regarded as satisfactory in which Biological Science is entirely ignored. It is true that the field of biology is too wide to be traversed in detail by a single lecturer or covered by a single course, and were the thing possible it would not be desirable. But it would be perfectly practicable for a Professor in Natural History to give in a short series of lectures much general information as to the organisation of the animal and vegetable kingdoms, and to select some special subject, either zoological or botanical, for more detailed exposition; and, as a means of training the observing powers, no portion of the curriculum would be so valuable. A college devoting its entire energies to one class of natural phenomena, to the exclusion of studies pertaining to natural objects and the phenomena of the organised world, can have no claim to be called a school of physical science in any wide or great sense.

Newcastle has already a position in respect to Natural History Science, and with an admirable Museum at hand, it would be a blot on the undertaking if its abundant local resources were not utilised.

THE UTILISATION OF NATURAL HISTORY MUSEUMS FOR SCIENTIFIC INSTRUCTION IN GERMANY

II.

THE German Museums of Natural History, founded for educational purposes, and connected with the various Universities, are by far the most important and influential. Those attached to the Universities of Berlin, Vienna, and Munich, are very large establishments, consisting of several sections which are independent of each other; and the aim pursued in each is to render the collections as complete as possible. Hence, although their chief purpose is to serve as schools of instruction for the students, they offer to the specialist abundant materials for original research, and have grown into attractive places of public resort. Those belonging to the smaller Universities are limited to instructive series of types; some, however, excel in one or more special branches. The teachers of the University are always the directors of the collections; thus the Professor of Zoology is the responsible head of the Zoological Museum, the Professor of Mineralogy of the Mineralogical, the Professor of Botany takes the charge of the Botanical Gardens, and so on. The appointments to the professorial chairs are not thrown open to competition; and the system of testimonials, humiliating alike to the candidate and his supporters, is unknown in German universities; men of repute for their knowledge and capability of teaching are chosen by the Senate, proposed to and appointed by the Government. We believe the Prussian Government has reserved to itself the right of appointment almost independent of the Senate, but, of course, is guided by the advice of men able to judge of the merits of the candidates proposed.

The lectures on the various branches of Natural History are either given in the Museum itself, or in a place adjacent. Each course occupies from 50 to 100 hours during a term of four months and a half. Some professors go with their students through a complete course of elementary instruction, whilst others leave this chiefly to private study, devoting the greater part of their time to inducting their pupils into the method of especial research. The attendance of students at the lectures is ensured by the circumstance that the Natural Sciences form part of the objects in which medical men, chemists, and teachers, are examined before they are allowed to enter upon the exercise of their calling. We are informed that, at a University with nearly 700 students (each remaining generally eight terms), some fifty would attend, within one term, the course of Natural Philosophy, or Botany; about twenty-five that of Zoology, or Comparative Anatomy; from fifteen to twenty that of Mineralogy, or Palæontology; and about thirty-five that of Geology. These were the numbers usually seen in the lecture-rooms, but there were, of course, other students who were prevented from attendance by various causes. The majority of those students who are desirous of receiving a perfect scientific education, and have the means for it, take advantage of the great variety of collections and instructors by prosecuting their studies at two or more Universities, finishing them at those places which offer the largest collections, and, in natural combination, the best instruction.

It may be mentioned here that the teaching of Science in German Universities is not entirely dependent on the public collections. Beside the staff of "ordinary" professors, there are younger men attached to the University, who have the right to teach, but can make only such use of the collections as the ordinary professor is disposed to grant. Most of them select, for their course of lectures, branches in the teaching of which they can dispense with the collections of the Museum—as, physiology of plants, histology and microscopy, history of development, general biology. This institution of "private docents," as they are called, is valuable not only to the students, but also to the body of instructors, inasmuch as it forms a preparatory school for men who intend to undertake the duties of an ordinary University teacher. The presence of an able and popular "private docent" has also not rarely had the beneficial effect of exciting to fresh exertions the ordinary professor, who had gradually lapsed into a course of stereotyped lectures. Nevertheless this institution can be regarded only as supplementary to the system of scientific education which is principally carried out in connection with the Museums.

We are not aware that there has ever been any lack of men combining an exact knowledge of some branch of Natural History with the aptitude for teaching it; nor have we ever heard of complaints that the duties of teaching seriously interfered with those of the curatorship; on the contrary, their union in one individual can have and has had only a beneficial effect. As teacher he knows best how to regulate the accessions and modify the arrangement of the collection, so as to meet the requirements of, and to be in accordance with, his system of teaching; and as curator he takes care that those parts which are not in direct connection with the lectures are not neglected, or that valuable specimens are not sacrificed for temporary purposes in the lecture-room or student's laboratory. Work in the Museum is as necessary for the training of the students as attendance in the lecture-room; and it is the duty of the teacher to devise suitable objects of research for his pupils. But if he had not the management of the collection, how could he be certain that the materials required are present, or will be made available? Would it be possible for him to superintend the student's work in a place where he is not the master? Were those duties assigned to two individuals, they would soon clash, to the injury of the service expected from the Institution.

The existence of numerous large or well-adapted collections, their utilisation for educational purposes, and the devotion of adequate time to instruction, are among the principal causes which have rendered the system of scientific education successful throughout Germany. But we must not forget that this success is due to the Universities only, and is limited to the classes receiving a University education. In the schools of lower degree, Science (with the exception of chemistry and natural philosophy) is only taught in the form of book-knowledge, in which the pupil takes but little interest, and therefore it has no great or lasting influence on the culture of his mind.

THE DESCENT OF MAN

The Descent of Man, and Selection in relation to Sex. By Charles Darwin, M.A., F.R.S., &c. In two volumes. Pp. 428, 475. (Murray, 1871.)

II.

THAT selection in relation to sex has been an important factor in the formation of the present breeds of animals was more than indicated in the "Origin of Species," and the theory has since been especially worked out by Professor Haeckel. It includes two distinct hypotheses. One is that in contests between males, the weakest would go to the wall, and thus either be killed outright, or at least debarred more or less completely from transmitting their characters to another generation. This may be regarded as a particular case of Natural Selection, and may be compared with the theory of protection by mimicry, suggested by Mr. Bates, and carried out by him and by Mr. Wallace. But though in the lists of Love the battle is often to the strong, even more frequently it is to the beautiful. This introduces a new process, of which the effects are not nearly so obvious as those of Natural Selection, either in its simplest form or in the more complicated cases of mimicry, and of sexual selection by battle. Many circumstances must combine in order that the most successful wooers shall have a larger and more vigorous progeny than the rest. In the first place, all hermaphrodite and all sessile animals may be excluded, and also those cases in which sexual differences depend on different habits of life. Mr. Darwin then shows that secondary sexual characters are eminently variable, and that males vary more than females from the standard of the species, a standard determined by the young, by allied forms, and sometimes by the character of the male himself when his peculiar functions are only periodical, or when they have been artificially prevented. Moreover it is the males who take the active part in pairing, and who not only fight for the possession of their mates, but display their colours, their voice, or whatever be their peculiar attractions, in order to gain the same end. This rule is confirmed by the exceptional case of the cassowary and a few other species in which the hens court the male birds, fight together in rivalry, and accordingly assume the brighter colours and more attractive shape usually worn by the male. Not only the parental and incubating instincts, but the usual moral qualities of the two sexes are in these cases reversed: "the females being savage, quarrelsome, and noisy, the males gentle and good." But it is further necessary to show that the females exert a choice among the males, and that the latter are polygamous, or arrive earlier at the place of pairing, as is the case with some birds, or else exceed in numbers, at least when both sexes are mature. On this point a series of observations is recorded relating chiefly to man, to domesticated mammals, and to insects. The rule as to transmission of male characters to both sexes appears to be that when variations appear late in life they are usually developed in the same sex only of the next generation, although they are, of course, transmitted in a latent condition through both; while, on the other hand, the differences which appear before maturity in the

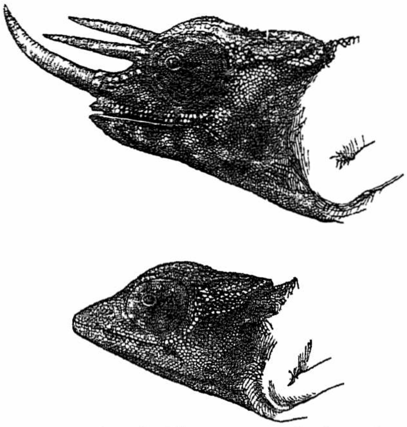

FIG 2.—*Chamæleon Owenii.* Upper figure, male; lower figure, female.

parent are equally developed in both sexes when transmitted to the offspring. The numerous apparent exceptions to these laws of inheritance and of sexual selection are examined with wonderful fairness and fertility in resource. I may particularly refer to the discussion of the ways in which the young and adults of both sexes differ among birds. The extreme intricacy of some of the questions considered is best shown by a postscript in which, with characteristic candour, the author corrects "a serious and unfortunate error" in the eighth chapter.

The remainder of the first and the greater portion of second volume are occupied by a survey of sexual variations throughout the animal kingdom. Passing rapidly over the other invertebrate classes, the author devotes two chapters to the secondary sexual characters of insects. The weapons, the ornaments, and the sounds peculiar to the males of this vast group of animals are briefly described, and the remarkable analogy between insects and birds which is seen in so many other particulars is traced here also. The brilliant colours of many caterpillars, which, of course, cannot be due to sexual selection, offer one of the many difficulties which are faced, and this is explained by the aid of what the author terms Mr. Wallace's "innate genius for solving difficulties," as being due to natural selection. The bright colours warn the enemies of the caterpillars that they are unfit for food, and so benefit the latter, "on nearly the same principle that certain poisons are coloured by druggists for the good of man." Many cases are probably further complicated by mimicry, savoury caterpillars assuming the colours of distasteful ones so as to share in their immunity, in the same way that a druggist might label his bottles of sweetmeats "poison," to keep them from the shop-boy.

In the frigid classes of the lower Vertebrata one would think that sexual selection would have little play; yet Mr. Darwin gives several instances among fishes, amphibians, and reptiles in which weapons or ornaments, peculiar to the males, appear to have been acquired by this means. (See Fig. 2.) But it is in the great class of birds that the most complete series of examples is found, and our advanced knowledge of the habits of this class renders it

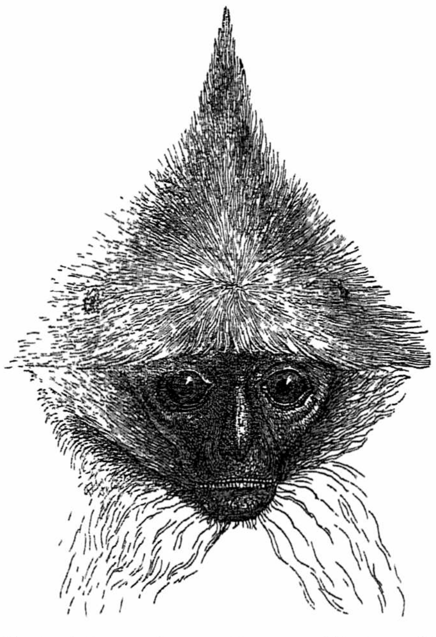

FIG. 3.—Head of *Semnopithecus rubicundus* This figure (from Prof. Gervais) is given to show the odd arrangement and development of the hair on the head.

the best possible field for the exposition of the whole theory. Again and again our author forestalls the evidence adduced in the chapters on sexual selection among birds, when tracing its first obscure operation among lower classes, and falls back on the same stronghold when explaining its less obvious working in the mammalia.

Among birds the rivalry of beauty has led to far more striking results than has the rivalry of strength. Foremost of these is the power of song, which, in accordance with the law of the least waste, is usually confined to birds of inconspicuous colours, while the combination of the harsh note with the magnificent plumage of the peacock is a familiar converse example. The object of the adornment of birds is conclusively proved by its being, as a rule, confined to males, and often to them only during the breeding season, as well as by the pains they take to exhibit their beauties to the hens. The difficulty is to show the precise way in which the results have been attained by gradual selection. In two remarkable instances, the wings of the Argus pheasant and the train of the peacock, Mr. Darwin succeeds in tracing the gradations in the same bird or the same family by which these wonderful and elaborate ornaments have been brought to their present perfection. The woodcuts which illustrate these gradations are unfortunately too numerous to be reproduced here; they are admirably drawn, and convey the impression of the feathers as nearly as is possible by the means employed. Indeed, we may here remark that throughout these volumes the original cuts, generally of details of structure, contrast very favourably with the figures of species taken from Brehm's "Thierleben," which are feebly drawn and ill-engraved.

Sexual selection has, of course, been continually checked and modified by the never-ceasing influence of natural selection, sometimes, as in the case of the horns of stags, being only somewhat diverted, but often directly opposed, as when it produces dangerously conspicuous colours, and dangerously cumbersome ornaments. In the case of birds, Mr. Darwin holds that the usual tendency of sexual selection being to produce variation in males, its transmission to hen birds has been checked by natural selection. Mr. Wallace, on the other hand, believes that both tendencies have generally operated together, in opposite directions, so as to make successive generations of males more and more conspicuous than the primitive type, and those of females less so. The fact that, as a rule, young birds resemble hens in their plumage, is a strong argument for the former opinion, since most naturalists admit that early characters are the most trustworthy guide to natural alliances, *i.e.*, to true genealogy. To explain the transmission in some cases of brilliant colours (acquired probably by sexual selection, and therefore properly a male character) to both sexes indiscriminately, Mr. Wallace has framed the ingenious hypothesis, that the females have been protected from the dull uniformity threatened by natural selection, by their very general habit of building covered nests. Our author looks at the facts in a reversed way, and supposes that in most cases these hen birds, having inherited bright colours from the males, were led to the habit of building covered nests for the sake of protection.

Among mammals sexual selection has chiefly operated by increasing the size and strength of the males, and furnishing them with weapons of offence;* but besides allurements to the senses of smell and hearing, this class offers not a few instances, especially among the Quadrumana, of brilliant colouring being developed as a secondary sexual character. Here also we have the most striking instances of the production of defensive organs by the same process, as in the manes of lions, the cheekpads of some of the *Suidæ*, and possibly the upper tusks of that ancient enigma, the barbirusa. Lastly, it is in the class of mammals that we meet with cases of what may be called primary sexual ornament, as in *Cercopithecus cynosurus*, which make one wonder, with a thankful wonder, why such apparently obvious results are not more common. We must, however, admit that such adornment is not more disgusting, nor that of which we copy a figure more ludicrous, than the personal decorations of savages. Sir Joshua Reynolds says that if a European in full dress and pigtail were to meet a Red Indian in his warpaint, the one who showed surprise or a disposition to laugh would be the barbarian.* But who could stand this test when meeting *Semnopithecus rubicundus* or *Pithecia satanas*?

* The very general transmission of such weapons to both sexes may, perhaps, be explained by the need females have of means to defend their young.

We must admit, notwithstanding such anomalies, that, on the whole, birds and other animals admire the same forms and colours which we admire, and this, perhaps, may be admitted as an additional argument in favour of their kinship with us. Some of the ugliest creatures (like the hippopotamus) appear to have been quite uninfluenced by sexual selection, while the magnificent plumes of pheasants and birds of paradise are undoubtedly due to its operation. That it has occasionally led to unpleasing results in birds and monkeys of aberrant taste, is no more strange than that all savages do not carve and colour as well as the New Zealanders, or that most Englishmen admire ugly buildings and vulgar pictures. The prevailing aspect of nature is beauty, and the prevailing taste of man is for beauty also. The *means* by which natural beauty has been attained are various. Natural selection is one, by which the healthiest, and therefore the most symmetrical forms survive the rest. Protective mimicry is another, by which fishes have assumed the bright colours of a coral garden and butterflies the delicate venation of leaves. Flowers again have in many cases obtained their gay petals and fantastic shapes from the advantage thus gained for fertilisation by insects. The successive steps which have led to the graceful forms and brilliant tints of shells, to the intricate symmetry of an echinus-spine or a nummulite, these are as yet untraced even in imagination.

But that many of the most striking ornaments of the higher animals, and almost all those which are peculiar to one sex, have been developed by means of sexual selection, is a conclusion which can no longer be distrusted. There remain doubtless many exceptions to be accounted for, many modifying influences to be discovered; but the existence of a new principle has been established which has helped to guide the organic world to its present condition. Side by side with the struggle for existence has gone on a rivalry for reproduction, and the survival of the fittest has been tempered by the success of the most attractive.

P. H. PYE SMITH

HELMHOLTZ'S TONEMPFINDUNGEN

Die Lehre von den Tonempfindungen, von H. Helmholtz. (Braunschweig: F. Vieweg. London: Williams and Norgate. 3rd edition. 1870.)

THIS work traces the connection between physical and physiological acoustics, on the one hand, and the general principles and practice of music, on the other. Professor Helmholtz's qualifications for taking up this subject are unique. In each branch of science involved in the inquiry he has a reputation at least equal to that of any specialist in that branch. In the combination of eminently original mathematical power and consummate

* Discourse delivered at the Royal Academy, December 10, 1776.

skill in physical and physiological research with the technical knowledge of a trained musician, he stands absolutely alone. It need therefore surprise no one that the volume before us, the first edition of which was published in 1862 as the fruit of eight years' work, has practically revolutionised the subject with which it deals. He begins by completely clearing up the nature of the *quality* (*timbre*) of musical sounds. He fixes his reader's attention on the *harmonics* which previous observers had recognised as accompanying a fundamental note. These, he shows, are no isolated phenomena, but invariable concomitants of nearly all musical sounds. In fact, what appears to be a simple note of any assigned instrument, is really a composite sound consisting of a number of different tones, all, however, members of a series connected together by a simple law. The *quality* of the sound depends on the relative intensities in which these *partial-tones* are present in the whole mass of sound (*Klang*) heard. Helmholtz illustrates his theory by determining the relative intensities of the audible partial-tones produced by the principal kinds of musical instruments, and also those corresponding to the different vowel-sounds of the human voice. He has also invented an apparatus by which the most important members of the complete series of partial tones corresponding to a fundamental tone can be sounded with any assigned relative intensities, and which is capable of producing a tolerably close imitation of many sounds differing widely from each other in quality. These investigations occupy the first part of the work.

In the second part the nature of the difference between consonance and dissonance is explained, and thus a problem which has baffled natural philosophers since the time of Pythagoras finally solved. Here, again, the key to the solution is a perfectly well known phenomenon, the real significance and scope of which it was reserved for Helmholtz to recognise. Intermittent noises called *beats* had been observed whenever two notes nearly, but not quite, in unison with each other, were sounded together. Helmholtz asks what becomes of these beats when they are so rapid that the ear can no longer distinguish them as separate sounds. It had been supposed since the time of Young that they coalesced into a third musical sound, and thus formed the *combination ones* discovered as early as 1740 by a German organist named Sorge, but more generally known as *Tartini's tones*. Helmholtz proves that Young's view is erroneous. The beats never coalesce into a musical sound, but when they cease to be individually distinguishable, produce the sensation which we call discord.

This fact, taken in connection with the composite character of musical sounds, leads at once to Helmholtz's theory of consonance and dissonance. When two notes of different pitch are sounded, we have two series of partial-tones co-existing. If no member of the one series produces *beats* with any member of the other, the interval between the fundamental tones of the two sounds is an absolute consonance. If, on the other hand, beats *are* so produced, the consonance ceases to be absolute, and may be classed as a good or an imperfect consonance, or pass into a dissonance, according to the amount of discord involved in the combination. Helmholtz goes through the ordinary scale, and classifies the different intervals according to the above theory, his results tallying perfectly with those of the best writers on harmony. For the case of the comparatively unimportant class of sounds which have no upper-tones, Helmholtz employs a different method, which need not be detailed here. It is interesting to observe that his theory not only confirms some of the ordinary rules of musical composition, but is able to deduce principles which, though actually adopted by great masters, Mozart for instance, have never been explicitly stated by any theoretical writer. The third and last part of the work discusses the construction of musical scales, and the relation of each to its key-note. In this investigation æsthetical considerations necessarily assume an importance which they could not claim in the two earlier purely scientific parts of the work. As, moreover, musical technicalities of much complexity abound throughout the inquiry, it is not possible to give a popular *résumé* of the general results obtained in the third part.

The above is the most meagre outline of the subjects treated in the "Tonempfindungen." Indeed it is absolutely hopeless, within any reasonable limits, to try to convey an idea of the thoroughness, the laborious accuracy, the wonderful many-sidedness which appear on every page of it. The author, though a great mathematician, is fortunately too great an experimentalist to allow the laws of nature to figure as mere examples of the integration of differential equations, or as but affording subject-matter for new mathematical conundrums. Each acoustical law is thoroughly explained in popular language, with the most attractive richness and variety of illustration, a method of treatment infinitely refreshing to a student who has hitherto experienced only the husks of our arid examination-ridden manuals. All details of calculation are relegated to an appendix, and, though mathematics has its due honour given it, as a science absolutely indispensable for *thorough independent mastery* of any branch of physics, the most effective practical discouragement is given to the pedantic notion that no valuable knowledge can be gained without it. We may well doubt, indeed, whether the long exclusive domination of theory has made anything beyond mathematical symbols really *understood*. Cambridge honour-men will know what we mean by saying that an average wrangler, if asked what a *wave* was, would probably unhesitatingly answer—

$$\text{“} a \sin \frac{2\pi}{\lambda} (vt - x), \text{”}$$

and refuse to produce any further explanation. We desire for works like the "Tonempfindungen" a triumph in this country over English books "adapted for writing out in examinations" as decisive as the victory of the German armies on the soil of France.

SEDLEY TAYLOR

OUR BOOK SHELF

A Monograph of the Alcedinidæ, or Family of Kingfishers. By R. B. Sharpe, F.L.S., &c. Librarian to the Zoological Society of London. 4to. (Published by the Author. 1868—1871.)

THIS work reflects the highest credit upon its author, and will establish his reputation as an Ornithologist. Very few monographs published in England are so entirely satisfactory as this one, for not only have the several parts appeared regularly during the last three years, but the concluding double number just issued contains a copious and well-written introductory chapter on classification, geographical distribution, and literature, which renders the book a model of what such a work should be. The Kingfishers, although represented in our country by only one species, are especially abundant in the Eastern Tropics, where they exhibit a great variety of form and the most exquisite beauty of plumage. A considerable number of them are inhabitants of the forests, and never frequent water, subsisting on insects, small crustacea and mollusca, and the larger species even on snakes, lizards, and other reptiles, which they capture by darting down upon them from a branch just as our own species pounces upon a fish. Mr. Sharpe has been fortunate in securing the services of a young Dutch artist, Mr. Keulemans, who has himself studied birds in the tropics, and seizes upon their various attitudes with the happiest fidelity. He also surrounds his figures with little bits of appropriate scenery, so that a considerable number of the 120 plates with which the book is illustrated are beautiful pictures, as well as admirable representations of the several species. We do not hesitate to say that many of these plates are equal to the very best that have appeared in any illustrated work of Natural History. The body of the work consists of coloured figures of every known species of kingfisher, with full synonymy, careful description, and record of whatever is known of its habits. In the introduction, the classification of the species is carefully considered, only those generic groups being retained which can be characterised by marked structural differences. The whole family is first divided into two sub-families: the Alcedinidæ, or true kingfishers, characterised by a compressed keeled bill; and the Daceloninæ, or king-hunters, which have a depressed bill rounded or furrowed above. These are subdivided into nineteen genera, in which are grouped the 125 species of kingfisher now known. The groups are all characterised by modifications of the bill, feet, or tail, and a plate exhibits these generic characters at one view. There is also a tabular key of the species in every genus and of the genera in each sub-family, and the reasons are given for rejecting numerous genera proposed by other authors on insufficient characters. The geographical distribution of the species is then discussed in the same careful manner, an exact account of the known range of every species being given, as well as tables showing at a glance the distribution of all the species of a genus or group of allied genera; after which the results of the examination are ably summed up. Kingfishers present us with some of the most curious anomalies of distribution to be found in the whole class of birds. There is no part of the world so rich in peculiar forms of bird-life as America, more especially the southern half of it, yet it is the poorest of all parts of the world in kingfishers, only eight species being found in the whole continent,—a continent with more rivers and more fish than any other! The single island of Celebes actually contains as many different kinds of kingfisher as all North and South America, while New Guinea contains more than twice as many. It is perhaps even a more extraordinary fact that there is no peculiar type of kingfisher in America, all the eight species belonging to one genus, and that genus found also in Europe, Asia, and Africa. In Africa we have three peculiar genera of kingfisher, and twenty-four peculiar species. In continental India there are only five peculiar species, and not one genus. The western Malay Islands (Indo-Malayan sub-region) have one peculiar genus, and eleven peculiar species; the Philippines, seven peculiar species; but the Australian region has no less than ten peculiar genera and fifty-nine peculiar species, or nearly half those of the whole world. The peculiarities of the island of Celebes are well shown by the kingfishers, for not only has it eight peculiar species and three peculiar genera, but one of the latter has affinities with an African genus. In discussing the general relations of this isolated group of birds to the rest of the order, and the mutual affinities of the genera, the conclusion is arrived at that they are most nearly allied to (although still very remote from) the hornbills; and their relations are expressed by a branching diagram, as well by a map of the genus on the plan of Professor Flower. A copious account of the literature of the family is also given, no less than 135 separate works being enumerated, with references to every species of kingfisher described or noticed in them. An elaborate paper on the anatomy of these birds by Dr. Murie, with a full index, completes this exceedingly valuable work, which will be equally acceptable to the naturalist for its detailed and accurate information, and to all who love nature for its beautiful and artistic illustrations.

ALFRED R. WALLACE

The Wind in his Circuits, with the Explanation of the Origin and Cause of Circular Storms and Equinoctial Gales. By Lieut R. H. Armit, R.N. (London: J. D. Potter, 1870.)

ACCORDING to Lieut. Armit "all the various phenomena which occur in Nature are accounted for by one theory forming one law, and the force which governs and regulates everything, even to imparting perpetual motion to the world, is Electricity" (p. 122). When the reader is informed of the author's opinion that the east wind is formed of compressed vapour or steam (p. 57), that lightning and thunder are caused by the Arctic current descending to fill any vacuum that may suddenly be found in the warm currents below it, the "grating" of the currents against each other causing friction and lightning, and the sudden shock of the impenetrable masses the thunder (p. 68); and that, by an attentive study of his theory, it will in future "be as easy to foretell and evade a storm and keep in a fair wind, as it is to drive over good roads and evade the bad ones, when you know the country you are driving through" (p. 126), he will understand that the book may be consulted out of curiosity, or for its psychological interest, but not for instruction in what concerns atmospherical phenomena and the laws which govern them.

LETTERS TO THE EDITOR

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

Pangenesis

ON the introduction of Mr. Charles G. Leland, the author of the famous "Breitman Ballads," who was present at the reading of Mr. Galton's paper on Pangenesis before the Royal Society on the 30th ult., I have seen Mr. Lewis Ware, a young American gentleman who has been studying science in Paris since 1868.

By him I am informed that M. Leconte (I presume the physiological chemist of that name) is accustomed to mention in his lectures that he had frequently transfused the blood of one kind of animal into the veins of another; but it does not appear, in reference to those experiments, that any subsequent effects were noticed, as regards the offspring of such animals.

M. Leconte, however, further relates that once, not by way of experiment, but in order to save life, endangered, it must be supposed, from the occurrence of previous hemorrhage, he transfused into the veins of a white man blood drawn from a negro, and that the subsequent offspring of this white man by a white mother were *swarthy* in complexion.

Now, I cannot find any *published* record of M. Leconte's operation and its singular consequences, and it is impossible at the present moment to reach him by letter. I desire therefore to give publicity to what *seems* to be a conclusive proof of the theory of "pangenesis," with the view of eliciting a confirmation or refutation of the statement from some one who may chance to read this note, and who may have the necessary opportunities and leisure for further inquiry into the particulars of so very remarkable an incident. It is obvious that the number of children so affected, and the coincidence or absence of other changes in the hair, the form of skull, &c., require to be investigated, and the credibility of the parents fully authenticated.

10, Savile Row, W., April 8 JOHN MARSHALL

The Spectra of Aurora and Corona

SO much attention has been drawn to the correspondence between the spectrum of the corona and that of the aurora, as to lead one to suppose that they were almost identical; or, at least, that the principal auroral line was also seen in the corona. But even this is not at all the case. As the readers of NATURE are aware, the light of the aurora is almost monochromatic, giving a spectrum of one bright line in the yellowish green (wave-length about 557), and three or four very faint bands, which are more refrangible. These last are only occasionally visible, and indeed, Angström, in 1869, had seen them but once, and that momentarily. It is with one of these faint bands that the 1,474 corona line (wave length 531·6) is said to coincide, and not with the bright line (wave length 557), which is entirely absent in the corona spectrum. Two more of the auroral bands are near to the F and G hydrogen lines, which are visible in the corona, but it is yet doubtful whether they coincide. It is not impossible that a faint H spectrum may be produced in the aurora by the moisture of the air, but I incline to attribute them to the low temperature air spectrum mentioned in my letter of February 7, and which has bands in nearly the same positions. From the extreme faintness of the auroral bands, it is of course impossible to measure their positions with great accuracy.

Under these circumstances it would seem rather premature to lay great weight on the supposed coincidence, and much careful work must be done both on gas spectra and on that of the aurora before we can say with any confidence that these lines are not due to gases already known to us under different circumstances of temperature and density.

I subjoin a table, giving the approximate wave lengths of the lines observed in the auroral and coronal spectra.

Lines of Corona and Prominences.		Lines of Aurora.		Observers.
Description	Wave length	Description	Wave length	
C Hydrogen	656			
		Bright line.	630 / 640*	H. R. Procter and others.
D Sodium	589			
D_3				
		Bright line.	556·7	Angström
			557	Winlock
			569†	Alvan Clarke, jun.
1474 line	531·6	band	531	Winlock
			532	Alvan Clarke, jun.
E	527			
		band	520	Winlock
b	517			
F Hydrogen	486	band	485	Alvan Clarke, jun.
		band	464	Winlock
G Hydrogen	435	band	434	Alvan Clarke, jun.

HENRY R. PROCTER

Royal College of Chemistry, March 28

* Seen on October 26 last year, but very rarely visible.

† Prof. Pickering considers this an error. My own measures give a wave length very slightly greater than those of Winlock and Angström.

The Aurora

THE splendid aurora which was visible here last night was probably seen in many other places, and from a comparison of data, perhaps the position of the luminous arch, which formed a conspicuous part of it as seen from here, may be made out.

At 10.30 it passed through the northern part of Corona, 12 Canum Venaticorum, and the head of Leo. At the time mentioned above, the whole of the light was a vivid green, but at about 10.40 red patches appeared, and at 10.45 rays shot up to a point situated about 4° S.S.W. of 12 Canum. The colour round this point was a most wonderfully dark blood red, and in many other parts of the heavens the same colour was seen, very different from the rosy light of last October.

About 11 clouds coming up covered the whole sky, and on their partially clearing away, the aurora was much decreased in brilliancy. The lurid red light reflected from the detached clouds which preceded the main body produced an exceedingly grand effect. The light was strong enough to read type of the size in which NATURE is printed.

On first observing the green parts with a spectroscope of one bisulphide prism, the only line distinctly visible was the green one; but by watching and opening the slit there came into view two bands at the more refrangible end, more sharply defined at the more refrangible side than at the other, and there also seemed to be a considerable continuous spectrum from the green line nearly to the least refrangible of the two bands.

In the red parts the red line was most brilliant, quite equal in intensity to the green one, and then even in the green light it was distinguishable with care and long watching.

York, April 10 T. H. WALLER

LAST evening, at about 9.50, my attention was called to a magnificent display of aurora borealis. A mass of light, composed of red and bluish-white streamers or rays, moved rapidly up from about W.S.W. to E.N.E., and the whole took the form of an arch overhanging for a short space of time the western horizon, while transverse waves of light, intensifying the lustre of the blue portions, and occasionally reaching almost to the zenith, rolled across the nebulous mass at intervals of about a second. Streamers projecting eastwards kept shooting out with great brilliancy, like sheet lightning, except that they were separated by a sharp line from the dark surrounding sky. Each flash made a fresh advance eastwards, like the skirmishers preceding an army, and a few bright crimson clouds alone kept nearly the same position throughout the display,—the finest of these was nearly in the S.W. At one time, when the flashes and waves had ceased, an umbrella-like radiation of red and white rays from the zenith attained great beauty. By five minutes past ten the sky had regained a more ordinary hue, but dull red clouds still remained, and in the west a white phosphorescence like early dawn. The night was calm and rather cold; the barometer 30·00 and steady. The wind had been gusty from E. in the afternoon. I had remarked during the daytime some very rare and beautiful modifications of cirrus and wave-cloud stretching from W.S.W. to E.N.E. (a direction coinciding with that of the aurora streamers), and crossed by bars at right angles to them at a lower elevation. The arrangement of these clouds showed that they were strongly acted on by electricity, as is generally, perhaps, the case with wave-cloud. May not vapours of this kind in a peculiar state produce the apparent polarisation of the sun's rays recorded by "J. W." in the *Times* of April 8? To-day, especially, between twelve and one o'clock, detached cumuli, driving rapidly from about E.S.E. and upper cirro-cumuli from E.N.E., have behaved in a manner quite unlike anything I have observed before. The only cirro-cumulus to be seen in the morning shot out branches in advancing and melted away between the branches, leaving a sort of skeleton of spine and ribs, which in their turn were dissipated. The cumulus motions were also unusual, for portions were suddenly arrested, remaining fixed, and then rose apparently and arranged themselves in bands more or less parallel until dissolved. The last phenomena only occurred, as far as I could see, below some whitish rays, extending across the sky from W.S.W. to E.N.E., parallel to the aurora streamers of last evening, and closely resembling the beams of light which often proceed from the sun when behind a cloud on a showery day. Either an aurora must be going on to-day, or the higher atmosphere is in a peculiar electrical state. The influence of these whitish bands on the clouds at a much lower level is at any rate remarkably powerful.

Wrexham, Denbighshire, April 10 F. R.

Solar Science at the pleasure of *Secret* Referees

IN the faithfully-recording columns of NATURE for March 30, at p. 434, is a much required abstract of Mr. Stone's important paper, recently communicated by him to the Royal Society, London, on the connection between terrestrial temperature and sun-spot phenomena. By comparing the curves of mean annual temperatures during the last thirty years (as observed, ready to his hand, by his indefatigable predecessor Sir Thomas Maclear) with another curve constructed on Wolf's observations of sun-spots, Mr. Stone has been enabled to deduce, almost immediately after arriving on his new scene of labour at the Cape of Good Hope, first, that there is an approximately decennial period of such temperature, and so similar to that of the sun-spots as to indicate more than a mere coincidence; and secondly, that the sun-spots are not to be looked on as the direct ages of thent temperature variation, but that either phenomenon results from some general change of solar energy.

As Mr. Stone expressly mentions "that he had not the slightest expectation, on first laying down the curves, of any sensible agreement resulting," I presume that he is not aware that upwards of a year ago I both sought the honour and experienced the grief of communicating to the self-same Royal Society of London an almost exactly similar research, resulting in almost the same solar conclusion; my foundation matter being the mean annual rock-temperatures observed in the Royal Observatory, Edinburgh, during thirty-three years (twenty-four of them under my own supervision) with the recorded sun-spot and other solar phenomena by Schwabe, Wolf, the Kew Observatory, and other authorities, during the same period.

And yet why was Mr. Stone *not* acquainted with this previous work of mine, communicated to the very same London Society, at a time too when he was still in London or very close to it?

The answer is probably, that it was the work of the *Secret* Committee of the Royal Society appointed by the Council to report on my paper. For the Committee's first proceeding was to keep the paper shut up with themselves for upwards of seven months; and their next, to condemn it before the Council on several counts, the two chief of which seemed to be—first, that I had inveighed without occasion, in a note on a certain page, *against* British units and standards of linear measure; and secondly, that I was not to be allowed to compare the Edinburgh mean annual temperatures with sun-spot observations.

Touching the first objection, I showed that there was no such note or sentiment throughout the whole paper; and with regard to the second, I felt scientifically constrained to declare, that I could not consent to be denied the right of comparing so long, accurate, and indeed hitherto unsurpassed, a series of earth-surface temperatures as those of the Edinburgh Observatory, with acknowledged solar phenomena; especially when confining myself to merely trying and exhibiting for annual means whether there was, or was not, any sensible correspondence in time and manner.

For this rebellious opposition to the despotic dictates of the *Secret* Committee, my paper was instantly extinguished by the Council of the Royal Society; and I was put to the further indignity of receiving an unpleasant letter from the secretary, on merely requesting to know the names of the gentlemen constituting the said Committee, whose identity in the flesh is therefore still a problem. But now, see how speedily the *Nemesis* of deeds of darkness has overtaken those who dabble in them; for the newly-appointed Astronomer Royal at the Cape of Good Hope, in charge of the British Observatory which stands next in importance to Greenwich, one of the Royal Society's own Fellows too, has, moved by some most mysterious impulse, made that very subject, just banned by the carefully concealed sages who speak from behind a curtain, the material of his first scientific communication from the Southern Hemisphere; and, with even a cruel degree of polite attention, he has sent that paper, filled with their own forbidden matter, to the Royal, rather than any other, Society in London, to read aloud before their members.

Yet this chief and leading society's secret Star-chamber, though exclaiming, perhaps, to the South African astronomer, "*Et tu, Brute,*" has not repented, at least in any generous or human manner; for they have left me both to find out from NATURE the whole character of Mr. Stone's paper just accepted by and read before them, and to form my own unaided conclusions.

Wherefore I cannot but wonder more than ever, and even with exceeding admiration, at what *any* Scientific Societies in the present day have got to do with that accursed thing in all national history represented by Secret Committees, secret members, secret judgments, *veiled* prophets, who may, and—as would most clearly be shown if the whole correspondence in this case were to be published—who do, blunder utterly in understanding a plain sentence of simple English, who likewise enact a mistaken rule to tie down some astronomers in their own business, prove themselves totally void of Christian charity and gentlemanly feeling, and all the time require the incense of passive obedience to their partial edicts and strange behests.

Is not this then a matter just as important as any that can occur in the interests of true science and unalloyed, for the Royal Commission now sitting on Scientific Education and the Advancement of Science to take account of! For, if that Commission fitly and fully represents the general government in these times of this free and enlightened land in which we live, it would seem to be one of their holiest duties to the nation at large, to see that a base political method of a past and exploded era of our history, after being driven with ignominy out of every other branch of government, be not allowed to linger in sequestered nooks and dark corners of State-supported or State-aided societies for scientific pursuits.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, March 31

Ocean Currents

MR. LAUGHTON thinks (see his letter in NATURE of April 6) that the ocean surface current, which flows into the Mediterranean by the Straits of Gibraltar, is due to the preponderance of west winds over the Atlantic. Were this so there ought to be a similar current flowing into the Baltic; but on the contrary, there is a surface-current flowing out of the Baltic.

I am convinced that Dr. Carpenter is right in accounting for the currents at the entrances of both the Mediterranean and the Baltic by the differences in the degrees of saltness of different seas.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim

Sun Spots

SOME very remarkable maculæ appeared on the sun on March 28, $9^h\ 50^m$ A.M., which are of interest from the fan-like portion of the most westerly of the large spots having been much enlarged whilst under observation. The enlargement took place from the centre outwards, and occupied several seconds in its development.

W. H. WALENN

74, Brecknock Road, N.

The Echoes of the Royal Albert Hall

THE following observations may assist in reconciling some of the conflicting statements respecting the above subject, and explaining their curious discrepancies:—

The shape of the building is nearly elliptical; for the sake of description I will assume that it is a true ellipse. The middle of the platform, down which Her Majesty walked on the occasion of the opening ceremony, corresponded to the major axis of this ellipse, the seats in the arena were arranged in rows at right angles to the major axis, and thus the middle row of these seats was placed across the minor axis. I sat on one of the chairs of this middle row, that against the edge of the platform, and thus was in the nearest available place to the geometrical centre of the building, and therefore well situated for one set of acoustic observations. I listened very carefully, and made the following notes:—

An invisible military band was playing for some time before the arrival of the Queen. This music was freely heard without any perceptible echo, but the outlines of the sound (if I may use such an expression) were slightly shaded, there was just that want of crispness and definition of individual sound which would be advantageous to an ill-timed band, but somewhat damaging to the display of one that was playing staccato passages with perfect unity.

When the Prince of Wales read his address I heard every word repeated with perfect distinctness, the echo was pure and single, the two voices appeared like those of a prompter and a faithfully repeating speaker. The echo was remarkably well defined, and nearly as loud as the voice of the Prince.

When the Queen replied, her words were also repeated, but far less distinctly. This was a respectful whispering echo. When Santley sang a solo, there was no distinct echo, only a slight confusion of sound; but every note of Madame Sherrington's solo was most vexatiously mocked, but not so distinctly as the words of the Prince of Wales. A slight murmur accompanied the band, but it required a strain of attention to detect any definite echo.

The above is a description only of what I heard.

A friend who was sitting at the other end of one of the middle arena seats, *i.e.* near the boxes, or circumference of the ellipse, did not hear these echoes at all, and I have since learned that this was the case with others seated in boxes on either side of the hall.

The explanation of these facts is not difficult. On both sides of the organ, which occupied the south end or vertex of the ellipse, are unbroken curved wall spaces above the choir, covered with wooden panels or lining, a material well adapted for the reflection of sound. Beyond these bare spaces the boxes begin, and extend round the circumference till they reach the bare wall-space on the opposite side. There can be no regular reflection from the large area covered by the boxes when these are filled with people, but there must be such regular reflection very distinctly effected by the small bare portion of the curvature on each side of the organ.

If the curvature of this bare wooden wall-space were a true parabola, and a sound were emitted from the focus of the curve, it would be reflected in straight lines parallel to the axis, and only extending to a short distance on each side of it. With the actual curvature a close approximation to this should occur, the echo of the sound thus emitted would travel along the platform and extend a short distance beyond it, and thus be distinctly audible to the beefeaters arranged along the platform, and to those who like myself were sitting close to it.

When the Prince read his address, he stood very nearly in the south focus of the ellipse, a little the east side of it. In facing Her Majesty his voice was projected directly towards that portion of the panelled curve which should theoretically supply the parallel waves of sound to my side (the west) of the platform. Thus the distinctness with which I heard the echo of his voice is explained, and also the absence of echo in those parts of the hall farther distant from its major axis.

Her Majesty was near the focus, but not so near as the Prince of Wales. Santley was considerably to the west, and Madame Sherrington was on the east of the focus, but not so far removed as Santley. The quality and pitch of Madame Sherrington's voice would of course assist in rendering the echo more distinct. The band and chorus being distributed between the focus and vertex of the ellipse, fulfilled their theoretical requirements by having no regular echo, nothing beyond an indefinable rumble.

That the distinct echoes I heard came from the wooden lining was evident to the sense. I have often amused myself by experimenting upon mountain echoes, and when there is no redoubling have usually been able to detect the direction of their issue, and to find the rock surface producing them. The echoes of the voices of the Prince of Wales, Her Majesty, and Madame Sherrington, were remarkably free from any degree of redoubling, and evidently came from the direction of the south wall.

The remedy for this is obvious enough. This blank wall space must be covered with some kind of drapery, or broken up by ornament. Drapery will promote absorption of sound, an irregular ornamental surface will convert the regular reflection into scattering reflection.

I listened very carefully for any indications of echo from the roof, but could detect none, either the velarium was quite effective, or the echo, formerly attributed to the roof, came from the walls, or my position prevented me from hearing the roof echo. As I was not present at the first experimental concert before the velarium was put up, I will not venture any opinion on these points.

My apology for publishing these details is that the subject of the acoustics of this Hall is one of vast importance, both in reference to the Hall itself, and the intellectual progress of the inhabitants of all great cities. If large masses are to be taught orally, we must learn how to construct buildings in which the human voice may be audible to assembled thousands. The Royal Albert Hall presenting the grandest, and, I think, we may now say, the most successful experiment ever yet made in determining the possible limits of oral teaching, every contribution to a knowledge of its acoustic properties is of great value. I offer the above simply as such a contribution of observations made from one point—perhaps the most important point, and hope that it will be followed by other observations from other parts of the building. By combining these a correct knowledge of the whole subject may be obtained.

W. MATTIEU WILLIAMS

Gum Dammar

In a valuable article in the current number of the "Quarterly Journal of Microscopical Science" the Radcliffe Travelling Fellow alludes to the general favour with which Prof. Stricker and other eminent German workers, regard Gum Dammar as a substitute for Canada Balsam as a medium for the preservation and preparation of histological specimens. Mr. Mosely further points out an unfortunate mistranslation in the Sydenham Society's English edition of Stricker's work, in which *Dammar firniss* is translated Canada Balsam, and regrets that good Dammar firniss (*Anglice* dammar varnish) cannot be obtained in England, though the gum itself is sufficiently common. It so happens that I have made use of various home-made preparations of Dammar in preference to balsam for some time past. I have found that it not only is a substitute for the latter "torment to beginners," but that it possesses many advantages over balsam, *e.g.* it is easier to use, sets more rapidly, and is above all clearer, more perfectly transparent, and more dense. Perhaps many of your microscopical readers will be glad to learn that a very good "dammar varnish" is made and sent out in a suitable form by Mr. Walter White, of Monmouth, to whom I am indebted for my knowledge of some valuable formulæ for its preparation.

Hull H. POCKLINGTON

THE IRON AND STEEL INSTITUTE

In NATURE for March 30, we called attention to the annual meeting of the above society, which had just commenced in London. The new President, Mr. Henry Bessemer, delivered his opening address on the afternoon of Tuesday, when there was a large and influential attendance of the members from Scotland, South Wales, the North of England, South Staffordshire, Yorkshire, and other districts connected with the industries represented by this Institute. There were also several gentlemen present representing Continental and American works. Various matters of considerable practical importance were introduced to the notice of those present by Mr. Bessemer, and it is understood that the attentino of the Council will shortly be directed to carrying out, as far as possible, the suggestions contained in the address. Perhaps the most important subject mentioned was the proposal for a new series of tests to ascertain accurately the relative strengths of iron and steel. Many of the data upon which engineers and manufacturers have now to depend are comparatively old, and refer to classes of iron that are not made so extensively as they were at the time the experiments were instituted. New classes of iron have risen into importance during the last few years, and steel has become a very valuable article for engineering construction, so much so that it is desirable the materials now available for use should be thoroughly tested, in order that their properties may be fully understood by engineers and ironmasters. The proceedings at the meeting on Wednesday and Thursday were of a varied and interesting character. The committee appointed to investigate the subject of distribution of iron ores in Great Britain, presented their preliminary report, in which they stated that they had received from gentlemen connected with the trade special communications upon the matter. They gave a *résumé* of the production of iron ore in the various districts, and in many cases they intimated that the mineral statistics published by the Mining Record Office did not accurately represent the quantity of material raised. Taking a general view of the production of iron ore in the United Kingdom, they remarked that attention is now being mainly directed to the development of those districts that yield the cheaper classes of ore, such as Northamptonshire, Lincolnshire, and Cleveland, and to those localities where deposits of hæmatite are obtainable. The great demand for the latter ores is stimulating research in every direction where there is a probability of this mineral being found, but the circumstances under which it was deposited are at present so imperfectly understood that it is impossible to estimate with any precision where these researches are likely to prove successful. The Committee was re-appointed, and we understand that it is their intention to proceed with the preparation of a more thoroughly comprehensive report upon the subject of their investigations, and that this will be presented at an early meeting of the Institute.

The Committee appointed to report upon the question of mechanical puddling stated that they had given considerable attention to the subject of their investigation. They had paid visits to the principal forges where furnaces for mechanical puddling were in operation, and they gave a detailed list of such works. With respect to the Continent, they reported that Mr. Menelaus had kindly undertaken to obtain from France a set of the apparatus used at La Haynge, to put the same in operation at Dowlais, and to ask the Committee to see it at work in due course. Had it not been for the Continental war this machine would long ago have been at work, but it was detained in transit, and has not yet arrived in England. The Committee intimated that they were making arrangements for obtaining the services of a practical engineer, and of a gentleman acquainted with puddling, to visit the different works, and thoroughly to investigate the merits of the various machines in existence. The Committee proposed afterwards to verify the statistics given in by this gentleman.

The subjects which these Commissions are investigating are of great interest and importance to the trade, and it is to be hoped that the gentlemen entrusted with the inquiries will be able to prosecute them to a satisfactory issue. The paper by Mr. F. Kohn on the production of alloys of iron and manganese gave rise to a discussion, in which it was asserted that the manufacture of spiegeleisen had at length become an established fact in connection with the iron trade of this country, the Ebbw Vale Company having recently succeeded in extracting that material from the spathic iron ores of the Brendon Hills. Considering that this company have devoted a long time to the solution of this important question, it is satisfactory to find that they have been fortunate in this matter. The results obtained by the Terre Noire Company in the production of a soft steel are very remarkable, as Sir W. Fairbairn testifies that in ductility this steel stands in the ratio of ·219 per unit of length to ·092 of the Bessemer steel manufactured at Barrow from hæmatite ore. The steel in question was made by the use of ferromanganese made by Mr. Henderson's process, and containing an average of 23 to 25 per cent. of metallic manganese. The pig iron is run directly from the blast furnace to the converters without mixing with other kinds of iron, and the rich ferromanganese is used instead of the ordinary spiegeleisen.

Mr. Walker read a communication on modern appliances for reversing rolling mills, which introduced a notice of the principal arrangements now adopted for securing reversing action in rolling iron and steel. This is a matter of great importance, and has engaged the attention of engineers for some time past. The principal systems are—First, by reversing motion of the ordinary locomotive type; and, secondly, by friction clutches. The latter plan was most particularly described. It was stated that the polls can be reversed at any speed, and the mills fitted up on this method are remarkably effective. Mr. Ferrie contributed a paper upon an improved form of blast furnace recently introduced into Scotland. This differs from the furnace in ordinary use by the addition of about 20ft. at the top, which is divided into four compartments, and the raw coal charged in at the top is coked in its passage down the vertical chambers. The practical results of the working of this furnace over a considerable period has been a saving of at least one ton of coal for each ton of iron produced. In the discussion it was maintained that the advantage derived by Mr. Ferrie from the alteration of his furnace were mainly due to increased height; but it was also advanced that with raw coal for fuel it would not be practicable as a rule to make furnaces 80ft. high work satisfactorily. Mr. Ferrie appears to have demonstrated that high furnaces using raw coal can be made to give as good results as are obtained in the more modern districts. Mr. Tate read a paper giving a very clear account of the distribution, extent, and value of the iron ores of Antrim, which are now coming into notice, and will doubtless very soon be extensively employed in the west coast and elsewhere in the manufacture of hæmatite iron. Mr. D. Forbes also read a paper on iron ore, his subject being a brief description of the central mining district of Sweden. He called attention to the immense deposits of iron ores of great purity that will soon be opened up by the construction of a railway which will give direct access to the North Sea, and will thus render it feasible to import the Swedish ores into this country. The discussion on the Sherman process was interesting, but showed pretty clearly that the practical men who had taken the matter up, and had investigated it thoroughly, had not been able to arrive at any satisfactory results from it. Considering the nature of the chemical substances applied in the treatment of the iron by this process, it was only natural that such negative results should be obtained.

We must not omit to mention the lecture by Prof. Roscoe on Wednesday evening on spectrum analysis in its relation to the manufacture of iron and steel. There was not very much to state with respect to recent discoveries in the application of spectrum analysis to the production of steel, but it was important that the trade should know exactly what they might, and what they might not, expect from this delicate method of chemical investigation. Prof. Roscoe, in a very able and lucid manner, laid before the members of the Institute all that is at present known about the subject. One discovery by Mr. Snelus is likely to lead to good results. He has found that by the aid of the spectroscope he can predict the exact length of time that a "blow" will last in the Bessemer converter, and he hopes to be able eventually to stop the operation at a time when a definite amount of carbon may be left in the molten iron, and thus the quantity of speigeleisen required to produce steel of a given quality will be reduced.

The proceedings, on the whole, were of a thoroughly satisfactory character, and, considering the short time the Institute has been in existence, it seems highly probable that it will eventually occupy a position of much influence and importance.

NOTES

HIS EXCELLENCY the Lord Lieutenant of Ireland has been pleased to appoint Dr. R. O. Cunningham to the Professorship of Natural History in the Queen's College, Belfast. The newly-appointed Professor is well-known as an enthusiastic naturalist. The pleasant post of Professor to the most successful of the Queen's Colleges in Ireland is one that we are glad to see filled by the appointment of so estimable a man.

WE rejoice to be able to announce that the following Scholarships have been established by Gonville and Caius College, Cambridge, and hope it will not be long before all the other Colleges follow so good an example:—A Scholarship in Natural Science, tenable for four years from Lady-day, 1871, and of value from 60*l.* to 20*l.*, according to the candidate's proficiency, will be awarded at this College in June next. The successful candidate will require to enter his name at this College forthwith, and to begin residence in October. There will be three distinct examinations, in any one (but in one only) of which the student may compete—namely, in (1) Chemistry and Experimental Physics; (2) Zoology, with Comparative Anatomy and Physiology; (3) Botany, with Vegetable Anatomy and Physiology. The examinations will be held on the 2nd of June. Candidates must send in their names, stating which subject they elect to be examined in, to Dr. Drosier, Gonville and Caius College, Cambridge, on or before the 15th of May, enclosing a certificate of good conduct from a graduate of one of the British Universities.

THE vacancy in the curatorship of the Leeds Philosophical and Literary Society has been filled by the appointment of Mr. Louis C. Miall, curator to the Bradford Philosophical Society. Mr. Miall is already favourably known in Leeds, through the very interesting and successful lectures on Geology which he delivered at the Philosophical Hall last year, and he is at present engaged in the delivery of a course of lectures on Botany at the same place. He is the author of various papers and publications on Botany and Geology, more especially as affecting the West Riding. Mr. Miall's candidature was strongly supported by Profs. Owen, Huxley, and Rolleston; and the Leeds Philosophical Society may be congratulated on his appointment.

WE are unable this week to give any report of scientific proceedings in Paris: during the civil conflict every scientific movement is paralysed. The sittings of the Academy are suspended; but should the siege be prolonged, they may probably be resumed at Versailles, although some of its members are detained in Paris by the Commune as hostages.

WE are sorry to learn that the Government of Nova Scotia, in resorting to the retrenchment system, has withdrawn the small annual grant heretofore made to the Institute of Natural Science, the only scientific society that colony possesses; and, moreover, one which for the past eight years has struggled to maintain a position creditable to itself and the country in which it is established. Surely the trouble and expense of publishing, setting aside the gratuitous mental labour of those members who have furnished the interesting papers which together form the eight annual parts, comprising two volumes of over 1,000 pages, should have been considered by the authorities of the colony before they acted in such an illiberal spirit. We trust, nevertheless, to see the Institute still progress in its career of usefulness.

WE have great pleasure in announcing that Mr. Julian Goldsmid, M.P. for Rochester, who is a Master of Arts in the University of London, has just made his University a handsome present of 1,000*l.*, to be paid in annual instalments distributed over ten years, towards the formation of a good classical library in the new building. The Senate have accepted the offer, with a hearty acknowledgment of its generosity; and a committee has already been appointed to begin the agreeable task of forming a classical library. We trust Mr. Goldsmid's generosity may be infectious. The *Spectator* suggests whether it is possible to secure for the University the late Prof. De Morgan's unique Mathematical Library, which probably contains the most curious collection of books on the history of mathematics to be found in England. The value of this collection is besides greatly enhanced by Mr. De Morgan's own numerous and characteristic annotations. Whether the library is to be disposed of or not, we do not at present know; but if it could be obtained, there would be a special fitness in securing it for the University of London, which would then have a really good start towards the formation of a fine classical and scientific library.

MR. ELWES, of University College, London, and Mr. Jude, of King's College, London, have been elected to Natural Science Scholarships at Christ's College, Cambridge, of the respective values of 70*l.* and 50*l.* per annum.

WE have to record another instance of American munificence towards Science. Vassar College has received a donation of 50,000 dollars to found a natural history professorship.

WE have received the first number of the 4th volume of "Sirius," edited by Dr. R. Falb, which promises to keep its old reputation as an excellent astronomical journal. It is accompanied by an admirable map of the stars of the northern hemisphere down to the 4th magnitude, the variable and double stars being indicated at a glance.

SEVENTY years ago some domestic rabbits were introduced upon Sable Island, a small sandy islet lying about a hundred miles off the Nova Scotia coast, and being left alone and not crossed in breeding, they have entered their feral state in liveries of beautiful silver grey, with white collars, intimating some remote affinities with bygone races.

AT the Natural History Society of Ireland, held on Wednesday, April 5th, R. P. Williams in the chair, Dr. A. W. Foot read a paper on "Irish Diptera." The list contained those species taken by him during the previous summer, and embraced sixty-five species belonging to thirty-nine genera. Mr. W. Andrews read a paper on the species of the genus Hymenophyllum met with in New Zealand. Some pretty sketches of scenery in New Zealand were exhibited by the author, who also laid on a table a number of illustrative dried specimens which had been communicated to him by friends in America.

ON December 1 there was an earthquake at Tinnevelly in the Madras Presidency; and on the following day a slight earthquake was felt at Darjeeling, an English town in the Himalayas.

ON the 9th February there was a very strong shock of earthquake at Illapel in Chile. On the 11th February a strong shock of earthquake was felt at Valparaiso in Chile about 4 A.M. It is worthy of note that both these earthquakes occurred simultaneously with freshets from the mountains.

ON Twelfth Day an Indian woman of Cuzco in Peru, forty-five years of age, gave birth to a triplet of boys, one of whom survived. As this happened strangely enough on the day of the Three Kings, it excited the superstitions of the natives. The surviving boy was named Gaspar, after one of the kings.

COAL of excellent quality is said to have been discovered near the rich silver mines of Caracoles in Bolivia, about twelve miles from Calama.

IN a recent number of the *Scientific American* are short descriptions and drawings of two useful inventions:—a Washing Shield, consisting of a corrugated shield or armour which protects the arm and at the same time forms an effective surface for rubbing the clothes; and an Anti-snoring device, consisting of a leather band placed over the head and chin, which effectually closes the mouth during sleep.

FROM the Thirteenth Annual Report of the East Kent Natural History Society we learn that that body is "in much the same condition as at the end of the preceding year." The library has been largely augmented; there has been but one excursion; several lectures have been given; and fortnightly evening meetings have been established. The Committee appointed to report upon the flora of the district seems to have made but little progress. The Rev. J. Mitchinson, D.C.L., is the President; and Mr. George Gulliver, F.R.S., Secretary.

THE Malvern Naturalists' Field Club has issued in a neat volume its Transactions for 1853-70. It contains a large number of papers mainly illustrative of the natural history of the district, including catalogues of local birds, mollusca, lepidoptera, and fungi, with sketches of the geology of the Malvern Hills, and observations on the meteorology of Malvern. There is also an interesting sketch of the proceedings of the Society from its commencement in 1853, to the close of 1868, by the Rev. W. J. Symonds, F.G.S., President; and a long paper on "The Forest and Chace of Malvern: its Ancient and Present State; with Notices of the most remarkable old Trees remaining within its Confines," by Mr. Edwin Lees. This is illustrated by several well-executed engravings of some of the trees referred to; but we can commend neither the illustrations nor the matter of the same author's paper "On the Forms and Persistency of Arboreal Fungi." The volume, however, on the whole, is likely to be useful to the members of the club, and is a creditable production.

THE more general use of buffaloes for the purpose of moving timber in some of the forests of India has been recommended by the conservators of those forests which are situate on comparatively level or uneven ground as being more practicable and economical than elephants. It is found that there is great difficulty in some parts in obtaining sufficient fodder for the elephants, one of the consequences of which is that their health suffers, and this, when taken with the high price paid for them, causes considerable loss. Owing to the size and weight of many of the logs, however, which often lie in difficult positions, a few elephants are necessary; but in those forests where low trucks and carts can be used, it is said that a few pairs of buffaloes will do more work, and can be kept with less risk than elephants.

THERE is a plant in New Granada which, if our ink-makers could only grow in sufficient quantity in this country, would be a fortune to them. The plant in question (*Coriaria thymifolia*) is commonly known as the ink plant, and it is simply the juice that is used without any preparation. Its properties seem, according to a tradition in the country, to have been discovered during the Spanish administration. A number of written documents destined for the mother country were embarked in a vessel, and transmitted round the Cape, the voyage was unusually tempestuous, and the documents got wetted with salt water, those written with common ink became nearly illegible, whereas those written with "chanchi" (the name of the juice) remained unaltered. A decree was therefore issued that all government communications should in future be written with the vegetable juice. The ink is of a reddish colour when freshly written, becoming perfectly black after a few hours, and it has the recommendation of not corroding a steel pen so readily as ordinary ink.

A NEW *Wellingtonia gigantea*, or "big tree," forty feet and four inches in diameter, has been discovered lately near Visalia, in Southern California. This is thicker by seven feet than any other that has yet been found. A section of one of the "big trees" is now exhibited in Cincinnati, which is seventy-six feet in circumference and fourteen feet high; and, standing on the floor of the hall, it gives one a perfectly clear idea of the enormous size of the tree from which it was taken. The section was cut last year in the Mariposa grove, about two hundred and fifty miles south-east of San Francisco, and far up the western slope of the Sierra Nevada mountains. It was divided and hauled a hundred and forty miles to Stockton, on three waggons by seventeen yoke of cattle.

UNDER the title of "British Pharmacology" Mr. W. W. Stoddart is publishing in the *Pharmaceutical Journal* some interesting papers upon some of the British plants which are employed in medicine. Speaking of the presence of allyl in the horseradish, he says, "It is a very singular fact that the cruciferous plants produce compounds of sulphur and allyl that are so well known in the genus Allium, plants so dissimilar in habit and construction as to be in both exogenous and endogenous divisions of the vegetable kingdom. In every part of the world the garlic flavour seems to be a favourite. The Israelites of old regretted the loss of their leeks and onions. The Englishman likes the addition of a shallot, mustard, or horse-radish to his beefsteak. The Spaniard selects the onion, and the Asiatic assafœtida. Even the Brazilian has chosen the petiveria and sequieria, both of which have an alliaceous flavour. The whole of these owe their smell and taste to allyl, which in the onion tribe exists as a sulphide."

A DEPOSIT of alum of considerable magnitude has been found in the Kulhu Valley, in Madras. It was first found by shepherds. As a rule, the headmen of villages prefer even now not to disclose mineral discoveries.

MR. BLANFORD, of the Indian Geological Department, has been specially appointed to proceed to Damagoodiam in the Central Provinces to examine and report on the coal discovered by Colonel Henry.

FAVOURABLE reports of the Cinchona cultivation in the West Indies continue to be received. We learn that in the Jamaica plantations the trees are seeding plentifully, and that about 100,000 seeds of *C. calisaya* are now ripening. There are also 40,000 seedling plants of *C. succirubra* raised from Jamaica seed. One hundred acres of land over and above the hundred acres already established, have lately been prepared for planting in the coming spring, and there appears every prospect of a few hundred more acres being soon prepared to be put under similar cultivation.

FROM Asia Minor we get no scientific records of weather, but in their absence some information of a meteorological character is useful. The winter in Smyrna has been very mild, accompanied with heavy rains, but apricots had shown fruit. On the 29th the rainy season culminated in a flood of the river Metes, inundating the city of Smyrna in a way not known for more than half a century, while the great river Hermus also overflowed. Soon after the weather changed to a sharp frost, which will cause destruction among orange and fruit trees. It will be observed the weather is the reverse of ours.

THE Government of Madras has appointed four scientific gentlemen to annalyse the water of that Presidency.

DR. HERMAN CREDNER, of Leipzig, in a forthcoming number of Petermann's *Mittheilungen*, presents a valuable report upon the geology and mineralogy of the Alleghany system of the United States, accompanied by a detailed map of the region.

NEWSPAPERS do indeed bring intelligence to men of Science, but they bring error to the vulgar. We had made a note from an Indian paper of a hen which had hatched a chicken perfectly resembling a young kid, and created consternation in a whole kingdom concerned to know what misfortunes are portended. We are the more inclined to notice this valuable contribution to natural science, because now we find in a Smyrna paper, *La Réforme*, intelligence that the island of Crete is now busied with the fact, "well authenticated," that a woman in the village of Melikos has been brought to bed of two monsters having the form of serpents. Although they only lived two hours, so that the medical men of the island could not, if they had the requisite capacity, make any observations, the "fact" may cost the unlucky Turkish Government another insurrection. Cock-and-bull stories may sometimes be dismissed with contempt, but want of instruction in natural science may in this country and some others be of more serious moment; for ignorance is seldom bliss, but one of the great promoters of evil. Knowledge of natural science may prevent national discouragement in some cases, and in others stifle the spread of conspiracy and rebellion. The Aurora Borealis has in the east been connected with the Menzikoff note and been commented on by it.

A HANDSOME consignment of silkworms' eggs has arrived at Sydney with the appliances of a "magnanarie" from Japan, which may prove the foundation of a branch of Industry in New South Wales that shall vie with the production of wool and excel that of sugar. The Acclimatisation and Agricultural Societies have been directing their attention to the subject, and some of the best varieties of silkworm have been acclimatised by Mr. Charles Brady. In June last the Acclimatisation Society wrote to Sir Henry Parkes at Yokohama for specimens of the finest varieties of worms, with specimens of silk, cocoons, &c., and a complete set of sericultural implements. With kind alacrity he set to work at once to oblige the society, and so far interested the ex-Minister of the Interior, Prince Daté, on the subject as to receive from him gratuitously nearly all that was wanted.

A LONG and interesting letter by Mr. T. J. Monk, on the Breeding and Preservation of the Woodcock in East Sussex, appears in the *Field* of Feb. 25. The writer gives an account of the occurrence of this bird in seven districts of East Sussex, comprising twenty-one parishes, in all of which woodcocks have nested, and are nesting in greater or less numbers every year. On an average, Mr. Monk considers that from a hundred and fifty to two hundred nests might be found in these districts in most years; and states his opinion that, if never shot at after Feb. 1, and if the coverts were kept as quiet and undisturbed as possible during the breeding season, we might hope for a still further increase in the number of young birds.

EXAMPLES OF THE PERFORMANCE OF THE ELECTRO-MAGNETIC ENGINE*

SOME experiments and conclusions I arrived at a quarter of a century ago having been recently criticised, I have thought it might be useful to place the subject of work in connexion with electro-magnetism in a different and I hope clearer form than that in which I have hitherto placed it. The numbers given below are derived from recent experiments.

Suppose an electro-magnetic engine to be furnished with fixed permanent steel magnets, and a bar of iron made to revolve between the poles of the steel magnets by reversing the current in its coil of wire. Such an arrangement is perhaps the most efficient, as it is the most simple form of the apparatus. In considering it, we will first suppose the battery to consist of 5 large Daniell's cells in series, so large that their resistance may be neglected. We will also suppose that the coil of wire on the revolving bar is made of a copper wire 389 feet long, and $\frac{13}{16}$ of an inch diameter, or offering a resistance to one BA unit. Then, on connecting the terminals of this wire with the battery, and keeping the engine still, the current through the wire will be such as, with a horizontal force of earth's magnetism 3·678, would be able to deflect the small needle of a galvanometer furnished with a single circle of one foot diameter, to the angle of 54°23′. Also this current going through the above wire for one hour will evolve heat that could raise 110·66 lbs. of water 1°, a quantity equal to 85430 ft. lbs. of work. In the meantime the zinc consumed in the battery will be 535·25 grains. Hence the work due to each grain of zinc is 159·6 ft. lbs., and heat ·20674 of a unit.

I. In the condition of the engine being kept still we have therefore, current being 1·396, as shown by a deflection of 54° 23′,

1. Heat evolved per hour by the wire 110·66 units.
2. Consumpuion of zinc per hour 535·25 grains.
3. Heat due to 535·25 grains, 110·66 units.
4. Therefore the work per hour will be (110·66 − 110·66) 772=0.
5. And the work per grain of zinc will be $\frac{0}{535 \cdot 25} = 0$.

II. If the engine be now started and kept by a proper load to a velocity which reduces the current to ⅔, or ·9307, indicated by deflection 42° 57′, we shall have

1. Heat evolved per hour by the wire $110{\cdot}66 \times \left\{\frac{2}{3}\right\} =$ 49·18 units.
2. Consumption of zinc per hour $535{\cdot}25 \times \frac{2}{3} = 356{\cdot}83$ grains.
3. Heat due to 356·83 grains, $110{\cdot}66 \times \frac{2}{3} = 73{\cdot}77$ units.
4. Therefore the work per hour will be (73·77 − 49·18) 772 = 18983 ft. lbs.
5. And the work per grain of zinc will be $\frac{18983}{356{\cdot}83} = 53{\cdot}2$ or ⅓ of the maximum.

III. If the load be lesssened until the current is reduced to ½ of the original amount, or to ·698, we shall have

1. Heat evolved per hour by the wire $110{\cdot}66 \times \left(\frac{1}{2}\right)^2 =$ 27·665 units.
2. Consumption of zinc per hour $535{\cdot}25 \times \frac{1}{2} = 267{\cdot}62$ grains.
3. Heat due to 267·62 grains $110{\cdot}66 \times \frac{1}{2} = 55{\cdot}33$.
4. Therefore the work per hour will be (55·33 − 27·665) 772 = 21357.
5. And the work per grain of zinc will be $\frac{21357}{267{\cdot}62} = 79{\cdot}8$ or ½ of the maximum duty.

IV. If the load be still further reduced and velocity increased so as to bring down the current to ⅓ of what it was when the engine was still, or to ·4653, shown by a deflection of the galvanometer of 24° 57, we shall have

1. Heat evolved per hour by the wire $110{\cdot}66 \times \left(\frac{1}{3}\right)^2 =$ 12·294 units.
2. Consumption of zinc per hour $535{\cdot}25 \times \frac{1}{3} = 178{\cdot}42$ grains.
3. Heat due to 178·42 grains $110{\cdot}66 \times \frac{1}{3} = 36{\cdot}89$ units.
4. Therefore the work per hour will be (36·89 − 12·294) 772 = 18988 ft. lbs.
5. And the work per grain of zinc will be $\frac{18988}{178{\cdot}42} = 106{\cdot}4$ or ⅔ of the maximum duty.

V. Remove the load still further until the velocity increases so much that the current is brought down to $\frac{1}{100}$ of its quantity when the engine is still. Then we shall have

1. Heat evolved per hour by the wire $110{\cdot}66 \times \left(\frac{1}{100}\right)^2$ = ·011066 of a unit.
2. Consumption of zinc per hour $535{\cdot}25 \times \frac{1}{100} = 5{\cdot}3525$ grains.
3. Heat due to 5·3525 grains of zinc $110{\cdot}66 \times \frac{1}{100} = 1{\cdot}1066$ units.
4. Therefore the work per hour will (1·1066 − ·011066)772 = 845·73 ft. lbs.
5. And the work per grain of zinc will be $\frac{845{\cdot}73}{5{\cdot}352} = 158$ or $\frac{99}{100}$ of the maximum duty.

When the velocity increases so that the current vanishes the duty=159·6.

I. Let us now improve the engine by giving it a coil of 4 times the conductivity, which will be done by using a copper wire 389 feet long and ⅛ of an inch diameter, the same battery being used as before. Then when the engine is kept still, we shall have a current 1·396 × 4 = 5·584, shown by a deflection of 79° 51′. Then we shall have

1. Heat evolved per hour by the wire $110{\cdot}65 \times \frac{4^2}{4} =$ 442·64 units.
2. Consumption of zinc per hour 535·25×4=2141 grains.
3. Heat due to 2141 grains 442·64 units.
4. Therefore the work per hour will be (442·64 − 442·64) 772=0.
5. And the work per grain of zinc will be $\frac{0}{2141} = 0$

II. Start the engine with such a load as shall reduce the current to ⅔, or to 3·7227 (74° 58′), then we shall have

1. Heat evolved per hour by the wire $442{\cdot}64 \times \left(\frac{2}{3}\right)^2 =$ 196·73 units.
2. Consumption of zinc per hour $2141 \times \frac{2}{3} = 1427{\cdot}3$ grains.
3. Heat due to 1427·3 grains $442{\cdot}64 \times \frac{2}{3} = 295{\cdot}09$ units.
4. Therefore the work per hour will be (295·09 − 196·73) 772 = 75934.

* From the Proceedings of the Manchester Literary and Philosophical Society.

5. And the work per grain of zinc will be $\frac{75934}{1427\cdot3} = 53\cdot2$ or $\frac{1}{3}$ of the maximum duty.

III. Lessen the load so that the velocity of the engine is increased until the current is reduced to one half its original amount, or 2·792 shown on the galvanometer by a deflection of 70° 18′. Then we shall have

1. Heat evolved per hour by the wire $442.64 \times \left(\frac{1}{2}\right)^2 =$ 110·66 units.
2. Consumption of zinc per hour $2141 \times \frac{1}{2} = 1070\cdot5$ grains.
3. Heat due to 1070·5 grains, $442\cdot64 \times \frac{1}{2} = 221\cdot32$ units.
4. Therefore the work per hour will be $(221\cdot32 - 110\cdot66)\ 772 = 85430$ ft. lbs.
5. And the work per grain of zinc will be $\frac{85429}{1070\cdot5} = 79\cdot8$ or $\frac{1}{2}$ the maximum duty.

IV. Let the load be further reduced until the velocity reduces the current to $\frac{1}{3}$, or to 1·8613 shown by a deflection of 61° 45′. Then we shall have

1. Heat evolved per hour by the wire $442\cdot64 \times \left(\frac{1}{3}\right)^2 =$ 49·182 units.
2. Consumption of zinc per hour $2141 \times \frac{1}{3} = 713\cdot66$ grains.
3. Heat due to 713·66 grains of zinc $442\cdot64 \times \frac{1}{3} = 147\cdot55$ units.
4. Therefore the work per hour will be $(147\ 55 - 49\cdot182)\ 772 = 75940$ ft. lbs.
5. And the work per grain of zinc will be $\frac{75940}{713\cdot66} = 106\cdot4$ or $\frac{2}{3}$ of the maximum duty.

V. Let the load be still further reduced until, with the increased velocity, the current becomes reduced to $\frac{1}{100}$, or to ·05584 showing a deflection of 3° 12′. Then we shall have

1. Heat evolved per hour by the wire $442\cdot64 \times \left(\frac{1}{100}\right)^2$ = ·044264 of a unit.
2. Consumption of zinc per hour $2141 \times \frac{1}{100} = 21\cdot41$ grains.
3. Heat due to 21·41 grains of zinc $442\cdot64 \times \frac{1}{100} = 4\cdot4264$ units.
4. Therefore the work per hour will be $(4\cdot4264 - \cdot04426)\ 772 = 3383$ ft. lbs.
5. And the work per grain of zinc will be $\frac{3383}{21\cdot41} = 158$ or $\frac{99}{100}$ of the maximum duty.

Now suppose that we still further improve our engine by making the stationary magnets twice as powerful. In this case all the figures will remain exactly the same as before, the only difference being that the engine will only require to go at half the velocity in order to reduce the current to the same fraction of its first quantity. The attraction will be doubled, but the velocity being halved no change will take place in the amount of work given out.

In all cases the maximum amount of work per hour is obtained when the engine is going at such a velocity as reduces the current to one half of its amount when the engine is held stationary; and in this case the duty per grain of zinc is one half of the theoretical maximum.

The same principles apply equally well when, instead of employing the machine as an engine evolving work, we do work on it by forcibly reversing the direction of its motion. Suppose for instance we urge it with this reverse velocity until the quantity of current is quadrupled, or becomes 22·386 indicated by a deflection 87° 26′. Then we shall have

1. Heat evolved per hour by the wire $442\cdot64 \times 4^2 =$ 7082·2 units.
2. Consumption of zinc per hour $2141 \times 4 = 8564$ grains.
3. Heat due to 8564 grains of zinc $442\cdot64 \times 4 = 1770\cdot56$ units.
4. Therefore the work per hour will be $(1770\cdot56 - 7082\cdot2)\ 772 = -4100432$ ft. lbs.
5. And the work per grain of zinc will be $\frac{-4100432}{8564}$ $= -478\cdot8$ or -3 times the maximum working duty.

The principal reason why there has been greater scope for the improvenmt of the steam engine than for the electro-magnetic engine arises from the circumstance that in the formula $\frac{a-b}{a}$, applied to the steam engine by Thomson, in which a and b are the highest and lowest temperatures, these values are limited by practical difficulties. For a cannot easily be taken above $459° + 374°$ $= 833°$ from absolute zero, since that temperature gives 12·425 atmospheres of pressure, nor can b be readily taken at less than the atmospheric temperature or $449° + 60° = 519°$. Also there is much difficulty in preventing the escape of heat; whereas the insulation of electricity presents no difficulty.

I had arrived at the theory of the electro-magnetic engine in 1840, in which year I published a paper in the 4th Vol. of Sturgeon's Annals, demonstrating that there is "no variation in economy, whatever the arrangement of the conducting metal, or whatever the size of the battery." The experiments of that paper indicate 36 ft. lbs. as the maximum duty for a grain of zinc in a Wollaston battery. Multiplying this by 4 to bring it to the intensity of a Daniell's battery, we obtain 144 foot lbs. Here, as in the experiments in the paper on Mechanical Powers of Electro-Magnetism, Steam, and Horses, the actual duty is less than the theoretic; which is owing partly to the pulsatory nature of the current, and partly also to induced currents giving out heat in the substance of the iron cores of the electro-magnets; although these last were obviated as far as possible by using annealed tubes with slits down their sides.

J. P. JOULE

OBJECT TEACHING AND SCIENCE IN AMERICA

THE following article, reprinted from the *Scientific American*, will give some idea of the spirit in which the teaching of science is being pursued in the United States:—

"The public are beginning to be awakened to the fact that technical education is *the* education they require, being in accordance with the conditions of modern civilisation; and it is admitted that such technical education must be based upon a foundation of natural knowledge. The principles of the natural sciences must then, for the future, form an essential part of popular education; the only questions are, how far and in what manner are these sciences to be introduced? Whatever is to be the amount taught, educators are agreed that the first steps in natural science, or, in other words, in systematising natural knowledge, are to be taken as early as possible. Early impressions are the deepest, and every child before its school days is already an untrained student of nature. The foundations of technical education should, therefore, be laid in the primary school; but whether commenced thus early or not, the method will always be the same. The child must be encouraged and guided in its natural habits of observing, and it must be led to systematise its observations, connecting them together by a chain of reasoning into groups of related ideas. This method is simply that known as "object teaching;" and you may as well try to fly without wings, or to teach geography without maps or globes, as to teach natural science without objects and diagrams. There is not a teacher, nowadays, but has heard of this object teaching; there are hundreds who have tried to utilise it; there are "colleges" in which it is professedly taught as a system; and yet there seems to be no method applied to the inculcation of natural science more misunderstood than this, and no teaching in our schools, at present, more utterly destitute of good results. Ninety-nine out of a hundred who talk so glibly of object teaching forget that it is merely a method—a method that has for its end to inculcate knowledge; that this knowledge to be inculcated is the essential part of the lesson; and that a *thorough acquaintance with the subject must precede any application of this mere method of instruction.* To stand up and give a lesson upon a cat, without knowing the first principles of natural history, is simply to go through a farcical parody; and authorities who have no better conception of the purposes of object teaching than this, set the cart before the horse; or, rather they never hitch on their should-be-useful animal at all, but ride off upon this hobby, leaving the load of knowledge it was meant to draw standing in the ruts—where it has been standing, as Prof. Huxley admirably puts it, ever since the days of ancient Rome.

"It has been recently advocated that every public school should be supplied with a collection of objects to illustrate the fundamental facts of natural science. By all means let it be so; but let the first use to which these are put be to instruct the teachers themselves in what they will have to teach. Let them learn what there is in each object of educational value, and what are its worthless characters; let them recognise that no object is complete in itself, but is merely a part of a vast whole, and that their office is to lead the child to recognise its most important relations to other objects. In building up the edifice of knowledge, they must not use every rough stone indiscriminately, but they must teach the little builders to chip off the useless angles of selected pieces, and so shape them that every stone shall, at its proper time, fit into its proper place. If this be not done, the most instructive objects in the world will not raise its single line of substantial structure, but will rest upon the minds of the pupils as an unarranged heap of meaningless facts—facts which will not even be long remembered; and it is as well that they should not be, because utterly useless, being unconsolidated by any cement of reason.

"We fear that no better end is attained by, or can be hoped for from, object-teaching in our public schools, until, as we have said, the teachers themselves are thoroughly educated in the principles of natural science. To accomplish this, however, the ear of these who rule the teachers must be gained; and we raise the question whether the representatives of science should not have a voice in the management of our public school system? As object-teaching is a mere handmaid of science, is of use only to give scientific habits of thought, and to convey a knowledge of scientific facts, and is worthless without science, the public should see that its introduction into our schools be carried on under the advice of scientific experts, who shall direct what is best to be taught, and advise with the adepts in teaching how such knowledge may best be imparted. As a journal having the interests of science and education at heart, desiring to see science soundly popularised, and the masses made acquainted with its technical value, we make this suggestion, and furthermore ask: Is there any man of scientific attainments in the present Board of Education? Is there any scientific authortiy upon its general staff? And how many teachers favourably known to and having the confidence of the really scientific portion of the community are engaged in giving scientific instruction in our public sehools?"

*TRANSMISSION THROUGH PNEUMATIC TUBES**

THE writer having been employed in designing the extension of a pneumatic despatch line in which some heavy gradients were unavoidable, and it became necessary to ascertain by calculation the steepest gradient that could be employed so as to obtain a sufficient carrying capacity in the new section of the line under given conditions of engine power and of length. Almost every text-book and paper on the velocity of gases in pipes gave a different formula, and the author therefore found it necessary to attempt to construct a convenient expression for the speeds of carriers of given weight and friction, under various conditions of pressure, gradients, and dimensions of tube. The problem of a successful pneumatic system is simply this: To make a given quantity of air expand from one pressure to another in such a way as return a fair equivalent of the work expended in compressing it. It is obviously impossible to regain the full equivalent of the work, because the compression is attended with the liberation of heat, which is dissipated and practically lost. Therefore, in designing a pneumatic system, the first thing is to contrive means of compressing the air as economically as possible; and, in the second place, to get back the available mechanical effect stored up in the compressed air, irrespectively of the work employed in compressing and examining it. The writer considers that small pneumatic tubes may be worked more profitably than large ones. The great convenience of and practical facilities for working small letter-carrying tubes have been amply proved by the extensive systems already laid down in Paris, Berlin, London, and in other towns, as adjuncts to the telegraph services. Tubes of somewhat larger diameter would undoubtedly work satisfactorily. Even still larger tubes, if of moderate lengths, might also be found useful for a variety of special applications. But the author does not believe that a pneumatic line working through a long tunnel could, for passenger traffic, ever compete in point of economy with locomotive railways. A pneumatic railway is essentially a rope-railway. Its rope is elastic, it is true, but it is not light. Every yard run of it, in a tunnel large enough to carry passengers, would weigh more than ¼ cwt. And it is a rope, too, which has to be moved against considerable friction, and in being compressed and moved wastes power by its liberation of heat. In a pneumatic tunnel, such as that proposed between England and France, in order to move a goods train of 250 tons through at the rate of twenty-five miles an hour, it would be necessary to employ simultaneously a pressure of 1½lb. per square inch at one end, and a vacuum of 1½lb. per square inch at the other. The mechanical effect obtained with these combined—pressure and vacuum—would be consumed as follows:—

In accelerating the air . .	29	millions of foot pounds.
In accelerating the train .	12	
By friction of the air . .	5721	
By friction of the train .	330	

The resistance of the air, therefore, upon the walls of the tunnel would alone amount to 93 per cent. of the total mechanical effect employable for the transmission; while the really useful work would be only about 5½ per cent. of it. And to compress and exhaust the air to supply these items of expenditure of mechanical effect, engines would have to exert over 2,000 horse power at each end during the transmission, even on the supposition that the blowing machinery returned an equivalent of mechanical effect such as has never yet been obtained. This would not be an economical way of burning coals.

ROBERT SABINE

* Abstract of a paper read at the Liverpool Meeting of the British Association.

SCIENTIFIC SERIALS

Silliman's Journal, January, 1871. The opening article in this number is by Prof. J. D. Dana, "On the Quaternary or Post-tertiary of the New Haven Region," in which he proves from numerous observations that the glacial era in this district was an era of glaciers and not of icebergs, many evidences of glacier action being visible in the form of broad furrows from eight to ten inches in depth, and extending for long distances on beds of trap and granite.—The second paper is by Prof. W. A. Norton, "On the Corona seen in Total Eclipses of the Sun." The author attributes this phenomena to a solar aurora, but the observations on the recent eclipse will probably induce him to modify his opinions; his arguments being based on the observations made during previous eclipses, when the corona was not made such a special object of investigation. He lays great stress on the long streamers as indications of auroral action, though it now appears that these streamers are not so decidedly of solar origin as was supposed.—In a letter to Dr. W. Gibbs, Mr. O. N. Rood gives a short account of some experiments to determine the duration of lightning flashes. A cardboard disc, with fifteen narrow and radial apertures, was caused to rotate very rapidly on a pin. Occasionally, during a flash, the slits in the cardboard were seen distinctly as if the disc were stationary, but more usually they were distinctly elongated. From the observations made it would seem that the duration of the flashes was about $\frac{1}{500}$ of a second. The accuracy of this result may perhaps be rendered doubtful from the fact that both Becquerel and Faraday have noticed that gases are rendered slightly phosphorescent by electrical discharges.—Dr. A. M. Mayer contributes an article "On the physical condition of a closed circuit contiguous to a permanent and constant Voltaic current; or, on the electrotonic state." The author commences by giving extracts from Faraday's investigations, in which he uses the term electro-tonic state to indicate the condition of a wire in which an electric wave has been induced by the proximity of a conductor through which a constant current was passing. He has endeavoured to obtain some clue of the condition of such a closed circuit by passing through it another electric wave of a constant intensity, and which he ingeniously generated by slipping a flat spiral from the end of a permanent magnet, as described in the number of this journal for November last. Currents thus obtained are found, by means of a delicate reflecting galvanometer, to be practically of the same intensity; for on repeating the experiment several times this produced deflections differing from one another to an extent not greater than 20". In this manner it was determined that a definite electric current, traversing a metallic circuit in proximity to another traversed by a powerful voltaic current, has the same intensity, whether passed in the same direction as the latter or in a direction opposed to it. The author thinks, however, that a diminution in the velocity of the current ensues, and he intends to continue his experiments in order to settle this question.—This paper is followed by an abstract of the "Programme for the Observation of Stars of the Ninth Magnitude, undertaken by the German Astronomical Society; an analysis of gahnite from Mine Hill, Franklin Furnace, New Jersey, by G. J. Brush; and an account of the Observations of the Meteors of November 13 and 14, 1870."—The next article is by Prof. J. Le Conte, "On some Phenomena of Binocular Vision," in continuation of some previous papers. For examining the effects produced on observing objects with both eyes, the author employs a white plane about twenty inches long and of any convenient width. A notch is cut at one end of the board to enable the operator to place the plane just below the level of the eyes, the notch fitting on the bridge of the nose. By sticking pins on different parts of the board and drawing lines between the pins and the eyes, the phenomena of vision can be investigated. The author points out that when things are looked at with both eyes, the eyes themselves seem to double, two of them combining to form a binocular eye in the middle which looks out between two noses, while the other two are on either side beyond the noses. This article is well worth perusal.—The next paper is by Sidney I. Smith, "On a Fossil Insect from the Carboniferous Formation of Indiana," and is illustrated by a woodcut representing a wing 2·54 inches long and 0·85 broad, found in the grit quarry near Paoli, Orange County, Indiana, in cutting the stone for making whetstones.—Observations on the Earthquake of October 20th in North-eastern America have been collected by Mr. A. C. Twining. The area of disturbance extended from New Brunswick in the East to the State of Iowa in the West, and from the lakes of the River St. Lawrence in the North to Cincinnati and Richmond, Va., in the opposite direction. The shock travelled from about E. 6° N. to about W. 6° S. at the rate of 160 miles in a minute.—The concluding article is by Professor A. E. Verrill, "On some imperfectly known and new Asceidians from New England."

Silliman's Journal, February, 1871. This number opens with a paper by Dr. A. M. Mayer, "On Observations on the Variation of the Magnetic Declination in connection with the Aurora of October 14, 1870, with Remarks on the physical connection between changes in area of disturbed solar surface and magnetic perturbations." The aurora was first noticed at 6.30 P.M. on October 14, and the magnetic observations commenced at 6.35 P.M. and were continued till 10 P.M. The mean declination being represented by 0°, at 6.35 P.M. the declination was 5'·70 W. and at 6.56 P.M. 18'·37 W. The magnet then rapidly moved towards the E., and at 7.46 the declination was 21'·94 E. The motion now became westerly, and at 7.57½ P.M. the reading was 32'·19 W. There was next a rapid easterly movement till 8.5½ P.M., when the reading was 10·42 E., deep rough streamers flashing up in the N.N.W. There was another deviation to 4'·55 W. at 8.10 P.M., after which the needle passed to the east of the neutral line, and, after several oscillations, reached the maximum easterly deviation of 22'·52 E. at 9.10 P.M. The author makes daily observations of the spots on the sun, and remarks on the connection existing between their appearance and magnetic disturbances. He points out the necessity of establishing several stations, where daily photographs of the sun may be taken.—The next communication is the first part of a series of "Notes on Granite Rocks," by T. Sterry Hurst, LL.D., F.R.S. This paper is continued in the numbers of the Journal for March, and its extraction may perhaps be more conveniently deferred until the whole of it has appeared.—Mr. E. D. Cope contributes a short note on "Siredon Metamorphoses."—This is followed by a note by Professor G. B. Andrews, "On Lower Carboniferous Limestones in Ohio," and the conclusion of Professor Verrill's "Descriptions of Ascidians from New England."—This number also contains a "Memoir of Professor Graham, by Professor J. N. Cooke, and a "Description of the Auroral belt of October 24-25, as observed at New Haven.

SOCIETIES AND ACADEMIES

LONDON

Royal Institution of Great Britain, April 3.—Mr. Warren De la Rue, F.R.S., vice-president, in the chair. Mr. William Cubitt, Mr. William Gould, Mr. Robert Hannah, Mr. John Henry Mackenzie, Rev. John Macnaught, M.A., Mr. Joseph Reynolds Masters, Mr. George Borwick Robertson, F.C.S., and Mr. George Wilson, were elected members of the Royal Institution. The special thanks of the members were returned for the following donation to "The Fund for the Promotion of Experimental Researches:"—Mr. T. Williams Helps (6th donation), 10*l*.

Entomological Society, April 3. Mr. A. R. Wallace, president, in the chair.—The Secretary exhibited drawings of Chinese Lepidoptera, beautifully executed by Mr. Holdsworth, of Shanghai.—Mr. F. Smith exhibited several examples of gynandromorphous Aculeata Hymenoptera, including *Anthophora acervorum*, *Andrena nitida*, *Nomada baccata*, and *Apis mellifica*, the latter combining the characters of male and workers. Mr. Lewis referred to the damage occasioned to books by *Lepisma saccharina*, which fed upon the paste of the bindings, and caused them to fall to pieces. Mr. Lewis also read a paper on the arrangement of British Lepidoptera, as adopted by various authors and compilers of catalogues, and he deprecated very strongly the constant changes in arrangement and nomenclature that are being made, the writers in many cases failing to give any reasons for such changes.

Anthropological Institute, April 3.—Sir John Lubbock, Bart., president, in the chair. Messrs. F. W. Rudler and Archibald Hamilton were elected members. Mr. Boyd Dawkins, read a paper "On the results obtained by the Settle Cave Exploration Committee." Victoria Cave, near Settle, in Yorkshire, is situated half-way up a cliff 200 feet high, and consists of a series of large chambers and passages, and has from time to time furnished to its explorer, Mr. Jackson, a remarkable collection of ornaments and implements of bronze, iron, and bone, along with pottery and broken remains of various animals, viz., red-deer, roebuck, pig, horse, sheep, goat, badger, fox, and dog. Fragments of Samian ware and coins of Trajan prove that the stratum in which they were discovered was accumulated subsequently to the Roman invasion. The numerous articles and bones were described in full detail. The author concluded that the cave was first inhabited by a barbarous Neolithic family, and, lastly, after a long interval, by Roman provincials, or possibly their descendants fleeing away from the arms of an invader. —A paper by Dr. Barnard Davis, F.R.S., was read, "On some recent Anatomical Writings bearing upon Anthropology, by Prof. Luigi Calori, of Bologna;" principally on the magnificent memoir of that anatomist, "Del Cervello, nei due tipi Brachicefalo e Dolicocefalo Italiani," lately published. That work is divided into four parts:—1. On the figure of the Brain in the two types. 2. The cerebral convolutions; their various aspect and their variety or anomalies. 3. On the weight of the brain in the two Italian types, brachycephalic and dolichocephalic. 4. On the extension of the cerebral superficies in the two Italian types. The second article goes into a thorough examination of the cerebral convolutions and the varieties they present.—Mr. A. L. Lewis contributes a paper "On the builders of the Megalithic Monuments of Britain." A special general meeting of the members of the Institute was held previously for the purpose of adopting the regulations proposed by the Council. Trustees of the Institute were elected, viz., Sir John Lubbock, Bart., president; J. W. Flower, treasurer; and the Rev. Dunbar J. Heath, M.A.

Zoological Society, April 4.—Mr. R. Hudson in the chair. Mr. W. Saville Kent read a paper on some new or little known Madrepores contained in the collection of the British Museum, amongst which were new species of the genera *Acanthocyathus*, *Flabellum*, *Stylaster*, and *Allopora*.—A communication was read from Surgeon Francis Day containing a series of notes on some of the rarer and less-known of the Siluroid fishes of India.—A communication was read from Mr. G. Stewardson Brady containing a review of the known *Cypridinidæ* of the European seas, together with a description of a new species of the genus *Philomedes*, proposed to be called *Ph. folinii*.—A communication was read from Dr. J. E. Gray containing additional notes on *Rhinoclemmys mexicana*, a Mexican Tortoise recently described by him in the Society's "Proceedings."—A second communication from Dr. Gray contained some additional notes on the genera *Eupleres* and *Galidia*, and a note on *Lemur ruber*, founded on specimens of these animals lately procured in Madagascar by Mr. Crossley.

Linnean Society, April 6.—Mr. G. Bentham, president, in the chair. The president read a paper on the styles and stigmas of Proteaceæ. In plants belonging to this order, the anthers mostly discharge their pollen before the expansion of the flower, as is also the case in Compositæ. In this latter order self-fertilisation is prevented by the fact that the stigmas are on the under face of the style branches which remain hermetically closed until after the opening of the flower. In Proteaceæ, on the other hand, the style is undivided, and the stigmatic surface is exposed even in the bud; and the contrivances to screen it from the action of the pollen of its own flower are very various. The observations have been made, with but few exceptions, on dried plants, and require confirming or rectifying by those who have the opportunity of examining the living plants. The anthers generally form, as in Compositæ, a closed tube surrounding the stigma, which is, however, usually if not always immature at the time of the extension of the pollen. That self-fertilisation seldom if ever takes place is shown by the fact that in no genus is the style more completely smothered with pollen than in *Banksia*, while there is none in which fecundated fruit is rarer. In *Petrophila* the stigmatic surface consists of the minute tip of the style, which is, however, completely protected while in the bud from the action of the pollen by the perianth segments. In one section of *Persoonia* the style is completely turned away from the anthers, and the stigmatic point is buried in a pouch prepared to receive it. The anther immediately over this pouch is sometimes destitute of pollen. In *Banksia* and *Grevillea* there appears to be no protection against self-fertilisation except the immaturity of the stigma. In *Conospermum* and *Synaphea* one anther in each flower has two perfect cells, separated by a connective; in the two lateral stamens there is one perfect and one abortive cell; and in the fourth there are two abortive cells, the cells are open cups; the perfect one of each lateral anther applied face to face with the adjoining cell of the double anther forms with it a closed globe in the bud, opening as the flower expands so as to let fall the pollen, the style projects far beyond with the stigmatic surface bent towards the upper perianth segment in the bud. In *Conospermum*, where the upper anther has two perfect cells, and the lowest is abortive, the style recurves elastically as the flower opens, so as to direct the stigma towards the abortive anther; in *Synaphea*, where the upper anther is abortive and the lowest perfect, the stigma is retained in its primitive position over the abortive anther by a strapshaped appendage proceeding from the rudiment of that anther and firmly attached to the lower margin of the stigmatic disc.—"On the Generic Nomenclature of Lepidoptera." By J. D. Crotch.

Chemical Society, March 30.—Prof. Williamson, F.R.S., president, in the chair. The president delivered the following address:—"Gentlemen, I feel much pleasure in congratulating you on the rapidly increasing prosperity of our society, and the enlargement which has taken place in its sphere of usefulness. For on the one hand the number of our fellows continues to show a most satisfactory increase, and on the other hand your Council has made arrangements for carrying out the system of monthly reports, which has been for some time in contemplation. It was hoped that the Chemical Society of Paris might, from the first, co-operate with us in the preparation of these monthly reports, but circumstances beyond their control have prevented the sister society from joining us in the beginning of this year. Deeming it undesirable to delay the commencement of the reports, your Council still look forward to the future co-operation of the Paris Society in their preparation. You are aware that the present available income of the society was not considered to be sufficient to defray the additional expense of writing and printing these reports, and I have the pleasure of informing you that contributions to the extent of 1,175*l*. have been promised by members of your body towards supplying the defect during the first five years of the appearance of the reports. The British Association has moreover granted us the sum of 100*l*. for this year in aid of the undertaking. We hope that in five years the funds of the society may have sufficiently increased to enable us to pay the whole expense of the reports, and that their publication will be valued by the members of our society, and promote the advancement of our science wherever the English language is read."

EDINBURGH

Royal Physical Society, March 22.—Mr. W. C. Peach, President, in the chair. Note on Carbon, showing ligneous Structure in Coal (with illustrative diagrams). By Professor Duns.—Mr. A. Taylor exhibited some undescribed Fossils from the Gilmerton Coalfield.—Remarks on some Japanese Skulls. By Dr. John Kennedy.—On Successive Glacial Periods, caused by Changes in Physical Geography. By Mr. Andrew Taylor.—Mr. C. W. Peach exhibited and described a few Zoophytes and Algæ, gathered on the shores by Port Phillip, near Melbourne.—Mr. Peach had to enter on a new field, and unfortunately had no works either on Australian Zoophytes or Algæ, beyond Busk's excellent catalogue of the Zoophytes contained in the British Museum, and part of a paper of Professor Wyville Thomson on some from Australia. He therefore regretted that his paper would come before them in an imperfect state. He first noticed several species of *Catenicella*—large masses of all were exhibited, as well as small portions on black paper prepared for the microscope—showing how luxuriantly these delicate animals built up their lovely homes. This genus is found plentifully on the shores of Africa, New Zealand, and Australia, but not in British seas, evidently being confined to warmer climates. He also introduced to the members several species of *Salicornaria*, *Cellilaria*, *Menipea*, *Scrupocellaria*, *Ætua*, *Bicellaria*, *Retepora*, *Flustra*, *Lepralia*, *Cresia*, *Crisidia*, *Serialaria*—altogether more than twenty species.

GLASGOW

Geological Society, February 2.—Mr. J. Young, V.P., in the chair.—Mr. Robert Craig read a paper "On the Boulders found in Cuttings on the Beith Branch Railway." The line of railway referred to runs nearly south-east from Beith. The striations upon the glaciated rock-surfaces of the district have a general bearing of nearly N.E. to S.W.; the line accordingly at its western terminus crosses them almost at right angles. The cuttings run nearly parallel to the southern termination of the range of trap hills which extends from Gleniffer to Beith, and at the distance of little more than a mile from it. The Carboniferous strata crop out along the southern boundary of this trap range, and consequently about a mile to the north of the railway. In the trap range four well-marked varieties of porphyrite occur, which, with the easily-distinguished beds of the Carboniferous limestone, gave the geologist an opportunity of classifying the boulders and tracing them to their source with an exactitude not always attainable. Mr. Craig then read a table giving the percentage of the different kinds of boulders found in eight cuttings proceeding eastward from Beith, and showed that the changes which were observable in them always corresponded with the rocks to the north-east of the cuttings. This strictly local character of the boulder-clay he thought was strong proof that it was due to land-ice—that, in fact, it had been taken up and deposited as the glacial "foot-board moraine." Droppings of sea-ice would have consisted much more largely of rocks from a distance. A small percentage of travelled rocks undoubtedly occurred in the boulder-clay of the district; and this, it must be noted, in all parts of the deposit—at bottom, middle, and top. These erratics he supposed to have been dropped from time to time through fissures and crevasses of the ice during its progress. From some sections in which he had followed the direction of the ice-stream, he found there was a change in the boulder-clay every three to five miles, less or more according to the roughness or evenness of the ground. He recommended a more minute examination and comparison of the boulder-clays of different localities than had yet been effected.

March 2.—Mr. John Young, vice-president, in the chair. Mr. E. A. Wünsch read a paper on a section of the northern shore of Arran, giving an account of some transported blocks of limestones which he had observed there during the previous summer. After describing the remarkable succession of deposits which had made that part of Arran classic ground for the geologist, he referred more particularly to a characteristic bed of limestone found near the Salt Pans, on the north-eastern shore of the island. This limestone is of a deep red colour, and is full of the shells of *Productæ*—especially *Producta latissima*—together with fragments of *Encrinites* and other organisms. The bed is very regularly jointed, and breaks up into beautiful cubical masses.—Mr. James Thomson read a paper on the occurrence of *Stigmaria stellata* (Eichwald) in the lower Carboniferous series, at Wildshaw, in the Upper Ward of Lanarkshire. He described the position of the strata in which these plant-remains had been found—in beds of fire-clay and indurated sandstone, capping those thin bands of limestone which characterise the lower members of the Carboniferous series in Scotland. The section presented at Wildshaw was as under:—6 ft. calcareous shale; 3 ft. hard light greyish sandstone; 2 ft. fire-clay, containing portions of *Stigmaria*; 3 ft. highly indurated sandstone, or chertzite, into which the *Stigmaria* roots passed; 11 ft. thin banded limestone, with partings of calcareous shale interstratified. Mr. Thomson mentioned that remains of this variety of *Stigmaria* were of comparatively rare occurrence in the Scottish coal fields—he had only found them in two other localities, and always in the same geological horizon. He pointed out that *Stigmaria* were now generally admitted to be the roots of the *Sigillaria*, but in this case he found them associated and in contact with what some authorities had called *Norea taxina* (?). The specimens on the table presented very distinct stellate markings which had surrounded the rootlets at the base of attachment.

BERLIN

Royal Prussian Academy of Science, August 11, 1870.—A paper was read by Dr. Hugo Kroeker, on the law of the exhaustion of muscles.—Prof. W. Peters communicated descriptions of some new reptiles and Batrachia, including *Hemidactylus muriceus* from Guinea, *Cercosaura glabella* from Brazil, forming the type of a new subgenus *Urosaura*, *Tropidolepisma striolatum*, from N.E. Australia, *Geophis annulatus* from South America (?) *Uriechis lineatus* from Guinea, forming the type of a new subgenus *Metopophis*, *Scaphiophis albopunctatus* from Guinea, the type of a new genus allied to *Zamenis*, and *Hoplocephalus frenatus* from N.E. Australia. The Batrachia described include the types of two new genera, namely, *Entomoglossus pustulatus* and *Cophomantis punctillata*, both from Brazil; the other species are *Rana longirostris* from Guinea, *Cystignathus diplolistris*, *Hylodes Henselii*, and *H. rugulosus* from Brazil, *Arthroleptis dispar* from Prince's Island, and *Phyllobates verruculatus* from Mexico. Figures of most of the species accompany the paper. Prof. Braun presented a most elaborate memoir on the genera *Marsilia* and *Pilularia*, containing a tabular synopsis, and full synonymic and distributional revision of the species.

October 10.—The only scientific papers read were two on subjects connected with the higher mathematics, by MM. Kennmer and Schwarz.

November 3.—Prof. Gustav Rose communicated some notes on the fall of a meteorite at Murzuk, in Fezzan.

November 27.—Prof. Dove presented a paper on the annual distribution of rain in central Europe.

December 1.—M. Kummer read a memoir on a peculiarity of the unities of the complex numbers obtained from the roots of the equation $\alpha^{\lambda} = 1$; and M. Kronecker appended to this paper a further note on a part of the subject treated by M. Kummer.

December 5.—Prof. Reichert read a continuation of his memoir on the Skeleton of the Vertebrata, relating principally to the Myxinoidæ, Leptocephalidæ, and Cartilaginous Ganoids, *Protopterus anguilliformis* and the *Chimæræ*.

December 15.—Prof. Roth read a paper on the Theory of Metamorphism and the production of the crystalline slates.—A memoir on the principal tangential curves of the Kummerian surface of the fourth degree, with sixteen nodal points, by Dr. F. Klein and Dr. S. Lie, was communicated by Prof. Kummer.

December 22.—Prof. W. Peters communicated a monographic revision of the Chiropterous genera *Nycteris* and *Atalapha*. The author reunites to the genus *Nycteris*, originally established by Geoffroy Saint Hilaire, the groups *Nycterops* and *Petalia*, which have been separated as distinct genera by Dr. Gray; he also remarks that many unnecessary species have been established in it. He describes and gives the synonymy of 9 species and figures the typical form (*N. Hispida*) and the lower dentition of all of them. Two new species are described, namely *N. angolensis* and *N. damarensis*. The species of the genus *Atalapha*, which figure in the works of various authors under the genera *Scotophilus*, *Lasiurus*, and *Nycticejus*, are very difficult to discriminate satisfactorily; Prof. Peters recognises 11, of which 3 are described as new, namely, *A. Frantzii*, *A pallescens*, and *A egregia*. All the species are American, and the type is *A noveboracensis*.

January 9 and 12, 1871.—M. Kronecker read two mathematical papers, of which no details are given.

January 19.—Prof. Ehrenberg communicated a review of the investigations made since 1847 on the abundant organic life borne invisibly by the atmosphere, as a supplement to his former memoirs on trade-wind, dust, and blood-rain. Since 1847 no less than 186 cases of the occurrence of these phenomena have been observed, and 42 samples have been submitted by the author to examination. He considers that the results of these investigations bear out his former conclusions.—In connection with this Prof. Dove communicated some observations on the "Föhn" observed at Trogen on the 13th February, 1870

VIENNA

Imperial Academy of Sciences, January 12.—Prof. Hlasiwetz communicated a memoir by Dr. E. von Sommaruga on naphthylpurpuric acid and its derivatives. This acid is produced from dinitronaphthole, by the action of cyanide of potassium; it is incapable of its being isolated from its salts. When the latter are prepared in aqueous solution, a blue compound is formed simultaneously. This was first observed by Hlasiwetz, and the author named it indophane. In alcoholic solutions it is not produced.

January 19.—Prof. L. Pfaunden presented a memoir on the elementary deduction of the fundamental equation of the dynamical gas theory; and Prof. A. Lieben communicated the result of an investigation made by himself in conjunction with M. Rossi, upon formaldhyde and its conversion into methylic-alcohol. The author found that the product of the dry distillation of formiate of lime (formaldehyde) was converted into methylic alcohol by nascent hydrogen.

February 3.—A paper on the barytes of the ferriferous Lower Silurian and Carboniferous of Bohemia, and on baryte in general, by M. R. Helmhacker, and one on the increase of curvature of an oblique section of a surface, by D. K. Exner were read.—Mr. Karl Fritsch presented a comparison of the time of the flowering of the plants of North America and Europe, from which it appears that the lines of simultaneous flowering lie 5°—10° further south in America than in Europe. Elevation seems to have comparatively little influence.—A note from M. Max Schaffner was read, describing a method of obtaining thallium on a large scale from the dust produced during the roasting of iron pyrites.—Prof. Brücke communicated a new method of separating dextrine and glycogen from animal fluids and tissues.—Prof. Stefan presented a memoir on the influence of heat on the refraction of light in solid bodies, containing a series of determinations of the refraction of rock-salt, sylvine (perchloride of potassium), alum, fluorspar, and glass, at temperatures of 12°—94° C. (53°·6—201°·2 F.). The refractive power of the first four bodies decreases uniformly, and for all parts of the spectrum, with the increase of temperature; the refractive power of glass increases with the temperature, and the increase becomes greater in passing from the red to the violet end of the spectrum. The alterations calculated for the line *D*, and an elevation of temperature of 100° C are:—

Rock-salt	−0·00373
Sylvine	−0·00345
Alum	−0·00134
Fluorspar	−0·00123
Glass	+0·00023

M. K. von Littrow communicated a memoir by M. L. Schulhof, on the determination of the orbit of the planet (108) Hecuba.—Prof. Hlasiwetz briefly communicated the results of a nearly complete investigation of Liebig's Extract of Meat made in his laboratory by Dr. J. Weidler. This extract is found to contain a previously unknown nitrogenous compound, having the formula

$C_7 H_8 N_4 O_3$, and therefore most intimately allied to theobromine and caffeine.—M. Tschermak presented a paper containing observations on a meteoric iron from the desert of Atacama in Chili. It is a large shield-shaped mass, weighing 103 pounds, and when broken not only shows the usual figures after treatment with acid, but even before the application of acid thin lamellæ of triolite are recognisable, inserted parallel to the hexahedral surfaces and interrupting the octahedral texture. A similar phenomenon is presented by a meteoric iron from Jewell Hill, Madison County, North Carolina.

February 9.—A memoir by Prof. Linnemann, entitled "A Contribution to the further knowledge of Pinakone," was read, and its author claimed the priority in the discovery that formaldehyde is produced by the dry distillation of formiate of lime, and that from it methylic alcohol and other compounds may be obtained. A memoir on the employment of an electrometer for the stroboscopic determination of the elevation of notes, by M. A. von Obermayer, was read.—A paper by Prof. A. Weiss, on the structure and nature of the Diatomaceæ, was communicated. The author stated that the silica of the Diatomacean frustule polarises light, that the Diatomaceæ are composed of innumerable, minute, but perfectly individualised, cells, and that it is to these that the markings of the silicious shells are due.—Dr. E. Klein presented a memoir on the median germ lamella, and its relation to the development of the first blood-vessels and blood corpuscles in the embryo of the fowl, and communicated a paper on the finer nerves of the vaginal mucous membrane, by Dr. A. Chrschtschonovitsch of Kasan.—Dr. A. Schrauf presented a second series of his mineralogical observations, in which he noticed certain forms of crystals of gypsum, crystals of argentite, the properties and paragenetic relations of the Azorean azorite and pyrrhite, a new mineral from Leadhills, to which he gave the name of eosite, and the characters of vanadite, dechenite, and descloizite.—Dr. S. Stern read a memoir on the theory of the resonance of solid bodies, with reference to the accompanying vibration of the air; and Prof. Reuss presented the first of a series of memoirs by Dr. Manzoni, on Mediterranean Bryozoa. In this the author notices sixteen species (one *Hippothoa*, one *Membranipora*, and fourteen *Lepraliæ*).

February 16.—A memoir by Dr. U. R. von Jepharovich, on diaphorite and freieslebenite was read. The author stated that two species, one monoclinic, the other rhombic, have been included under the name of freieslebenite. Their composition is identical, but they differ in density. For the rhombic species he proposes the name of diaphorite.—A memoir was also read on the theory of gases by Prof. L. Boltzmann.—Prof. Reuss communicated a memoir on some fossil star-fishes from the Rhenish grauwacke, by Dr. S. Simonowitsch. Four new species were described, namely, *Asterias acuminatus*, *Aspidosoma petaloides*, and two species forming a new genus, *Xenaster*, *X. margaritatus* and *simplex*.—Prof. von Oppolzer reported upon the calculations undertaken by him for the re-discovery of the lost planet (62) Erato.—Prof. F. Simony made some remarks on the Lacustrine erosion of shore-rocks belonging to various limestone formations.

I. R. Geological Institution, March 28.—Theodor Petersen read a paper on "Cœruleolactin." By this name he designates a new phosphatic mineral, which has been found in the mine of Rindsberg, near Katzenellenbogen (Nassau), in a layer of brown iron ore. It must be placed between Kolaite and Wawellite. The specific gravity is 2·59, the hardness 5.—Variscite. This mineral described by Breithaupt from Plauin had never been analysed. Petersen determined its sp. gr. to be 2·408.—Diabase from Nassau. Exact inquiries have proved that diabase very often contains small quantities of metallic compounds, and is probably the original source of different strata of ores. The felspar in diabase is usually oligoclase, and not as had been generally supposed labradorite.—F. Karrer and Th. Fuchs on the "Relations between the different strata of the marine deposits of the Miocene Vienna Basin." From many new sections which they obtained along the aqueduct now in construction between Vienna and Gloggnitz, the authors endeavour to show that the clay of Baden and that of Geinfahrn, the sandstones of Pœtzleinsdorf, the limestones (leithakalk), &c., are not deposits of different geological ages, as had hitherto been generally supposed, but represent different facies of the same age, and like the zones of living organisms in the seas of our day, pass into each other without any exact limit.—M. F. Posepny spoke of the penetration of Klastic masses through eruptive or sedimentary rocks. The so-called Glam in the Transylvanian mining districts is an evident example of this phenomenon, and may be compared with the dowkies in N.W. England, and the Gangthonschiefer in the mines of the Harz. An exact study of the phenomenon showed that it originated from very different causes. Sometimes the klastic masses were formed by mechanical friction, in other cases they have been successively deposited by water, sometimes they are masses of mud and pebbles, which penetrated in open veins or cavities of the rock.

BOOKS RECEIVED

ENGLISH.—British Insects; their Form, Structure, and Habits: E. F. Staveley (L Reeve and Co.).—On Intelligence: H Paine, translated by T. D. Haye, part I. (L. Reeve and Co.)—The Bijou Gazetteer of the World: W. H. Rosser (Warne and Co.)

AMERICAN AND FOREIGN.—A Synopsis of the Family Unionidæ: Dr. Isaac Lea. New York—(Through Williams and Norgate)—Lehrbuch der Spärischen Astronomie: Dr. F. Brunnow—Mémoires de la Société de Physique et d'Histoire Naturelle de Genève, tome XX.

DIARY

THURSDAY, APRIL 13.

MATHEMATICAL SOCIETY, at 8.—On Diagrams of the Stresses in Warren and Lattice Girders: Prof. Crofton, F.R.S.—On Quartic Surfaces: Prof. Cayley, F.R S.

FRIDAY, APRIL 14.

ASTRONOMICAL SOCIETY, at 8.
QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, APRIL 15.

ROYAL SCHOOL OF MINES, at 8.—Geology: Dr. Cobbold.

MONDAY, APRIL 17.

ANTHROPOLOGICAL INSTITUTE, at 8.—The Position of the Australian Languages: Dr. W. H J. Bleek.—Comparative Table of the Australian Languages: Rev. G. Taplin.—Mental Characteristics of Primitive Man as exhibited in the Aborigines of Australia: Mr. Wake.

TUESDAY, APRIL 18.

STATISTICAL SOCIETY, at 7 45.
ZOOLOGICAL SOCIETY, at 9.—On the Dodo, Part II.;—Notes on the Articulated Skeleton of the Dodo (*Didus ineptus*) in the British Museum.—On Japanese recent Brachiopoda: Mr. Thomas Davidson.
ROYAL INSTITUTION, at 3.—On the Geology of Devonshire, especially of the New Red Sandstone: William Pengelly, F.R.S.

WEDNESDAY, APRIL 19.

METEOROLOGICAL SOCIETY, at 7.—On Deep-sea Thermometers: Staff-Commander John E. Davis, R N.
SOCIETY OF ARTS, at 8.—On the Economical Construction of Workmen's Dwellings: Dr. J. H. Hallard.

THURSDAY, APRIL 20.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
CHEMICAL SOCIETY, at 8.
LINNEAN SOCIETY, at 8.
ROYAL INSTITUTION, at 3.—On Sound: Prof. Tyndall.

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