THURSDAY, MAY 19, 1870

SCIENTIFIC EDUCATION

THAT the Government of this country is anxious to advance Science education is plainly manifest from what it has already done, in making large annual grants to institutions which it established, and which it maintains as its own. That it does not consider the present arrangements for this purpose as final or sufficient, is clear from the recent appointment of a Royal Commission to inquire into the whole question of Government aid to Science. The movement which resulted in the appointment of this Commission arose, as we have already explained, from a recommendation of the Council of the British Association for a formal inquiry into the existing state of Science education in this country; and the resolution stated: "That no such inquiry will be complete which does not include the action of the State in relation to scientific education, and the effects of that action upon independent educational institutions." Before the Commission meets, it seems desirable that those interested in advancing Science and Education generally, should seriously consider the different position in which Science now stands, as a means of education, to that which it formerly occupied. The time was, and not long ago, when Science was regarded as a thing by itself, having no connection with other branches of education, and useful mainly as a means for rendering men better machinists, better artisans, or discoverers of processes for the advancement of arts and manufactures. Many doubtless hold these opinions at present, and one concludes this to be the case from the very limited view which is expressed by the term "technical education" which is so generally used. Now, if it be desired to promote this view only, and to teach, Science alone, and not as a part of general education Government has established perhaps such schools as might meet the wants of the case, if it can be shown that they fulfil the expectations with which they were founded. But if the higher view, that Science is in its way as important a means of mental training as any other of the branches taught in our schools and universities, then some other method of extending Government assistance for its promotion must be adopted; and it is to this consideration we earnestly hope that inquiries will be directed. Since the first Report of the Science and Art Department, in 1854, sufficient time has been given to show whether the system then originated has answered its purpose. At page 2 of the Report, it is stated that its system will be "in the main self-supporting; while the advantages will be distributed over every part of the United Kingdom; and the assistance received from Parliament be applied for the general good of all." It is generally believed that the system is *not* self-supporting, but that every associate of the School of Mines costs the Government a considerable sum of money. There can be no question that the advantages of the system are very great, directed as it is, in the several branches, by men of the highest possible eminence; but it is urged that they are not to any great extent distributed over the whole country, but mainly collected for the benefit of the technical schools founded by Government, and this tendency to force the official plan of education upon the country is regarded by many connected with other educational establishments as unfair. In fact, there is a threatened crusade against the Government professors.

To such we would remark, that the quantity of Science taught is so small, that it is not wise to attempt in any way to reduce that quantity; but it is certainly to be wished that the Commission should carefully inquire whether this method is one calculated to extend a sound Science education over the whole country, and whether it is possible to judge of a person's fitness to teach, without practical examination in subjects which are eminently practical, and without some guarantee that he has received a sound general education.

The Report further says: "It is essential that the institution should be supported to a considerable extent by the fees of pupils." This, it is urged, is not the case with the London Government school (and still less with the sister College of Science in Dublin), where the fees are not sufficient to pay the working expenses, to say nothing of the salaries of professors, and the scholarships of £50 per annum each, which are held by so large a number of students. At page 9 of the Report, the same important subject is dwelt upon: "My lords concur in the views expressed by the Lords of the Committee of Trade, that every means should be used to render these institutions as much self-supporting as possible, and that, in the plans adopted, that object should always be borne in mind. My lords adopt this view, not only because they feel it incumbent upon them to confine the public expenditure to the lowest limit, but also because they entertain a belief that the utility of such institutions is great in proportion as they are self-supporting." It may not be generally known that large sums have been expended, and further large sums are to be expended, in building and fitting up laboratories, lecture-rooms, &c., at South Kensington. The present time, then, is a very fitting one for an inquiry as to the present wants and resources of the country in relation to the higher science teaching, and the means best calculated to utilize and develope them with due regard to efficiency and economy. If it can be shown that the School of Mines has really done more work than unendowed schools, in proportion to the sums spent upon it, let its sphere of action be enlarged—at South Kensington or elsewhere—and let its usefulness be increased. But it must always be remembered that it professes to give none other than a *special* training: that it in no way supplies the place of universities, colleges, and schools of general education. If, on inquiry, it is found that it has attained the object for which it was established, still that does not touch the recommendation of the Council of the British Association, which includes "the action of the State in relation to scientific education, and the effects of that action upon *independent educational* institutions." It certainly ought to be a subject of serious inquiry, whether or not such colleges as University College, London, which has for forty years trained and sent out into the world some of the most distinguished teachers of Science, which in fact originated the present system of scientific education in union with other branches of education; or King's College, which has in like manner contributed so largely to advance modern education; or Owens College, Manchester, whose students show so well the nature of the education they there receive by the honours and prizes they gain at the London University; or many other flourishing colleges—should have their hands strengthened by Government help. In these institutions a thoroughly sound education, in all branches, is given. They have hitherto depended entirely on voluntary support, but the time has come when larger aid is needed to meet the modern requirements. Scholarships given by Government as incentives to work, and as helps to the many industrious students whose means are limited; stipends to professors, in order that they may obtain teaching assistance of a high character, of which they stand sorely in need, for it is absolutely impossible for them to teach effectively the large classes who place themselves under their guidance; grants for apparatus, and enlarged accommodation for the extension of original research—these are subjects which must occupy the attention of any committee appointed to inquire into the existing state of education. It is now pretty generally admitted by scientific men that no exclusively scientific education can meet our present requirements. On the Continent it is felt that it is only in universities and schools where *all* branches of knowledge are taught, that a really scientific education can be given; and we are glad to find that this opinion has gained ground in this country, together with a conviction that Science studies in their turn render students more apt in the acquisition of other branches of knowledge.

In Germany there is a strong feeling against the establishment of mere technical schools. It is maintained that boys should receive the same training up to a certain stage, and that they should afterwards enter for the special branch they design tofollow. Professor Köchly, of Heidelberg, Professor of Greek, proposes that there should be a thorough but limited instruction in classics, a more extended development of mathematics, a course of instruction in the natural sciences, and systematic instruction in modern languages. Professor Hofmann, who is well known in this country, considers that the best safeguard against the vulgarising of Science, when it is taught with too special a regard to its applications, is to be found in a sound general school training; and he believes that the old gymnasium system is of inestimable value. He asserts that in scores of instances he has seen youths who have come to the chemistry classes in the University of Berlin, with scarcely a knowledge of the meaning of the word chemistry, but who have been well trained in a gymnasium, in a short time completely surpass their fellows, who, in a school of another kind, have acquired considerable knowledge of the elements of chemistry. All the Polytechnic Schools of Germany are rapidly approaching the university type;—the teaching of the *principles* of Science, and not of the applications, is becoming more and more the main object.

LEONARDO DA VINCI AS A BOTANIST

FEW men have better earned the title of universal genius than Da Vinci. An ardent disciple of Nature, disdaining mere superficial knowledge, he went to the root of whatever he took up, and attained an intimate acquaintance especially with everything that bore on his beloved art of painting. And this art was understood by him in its widest sense. Not content with representing the mere outward appearance of Nature or of the human form, he considered it a part of his business as a painter to investigate the laws which produce those appearances or which govern that form in its healthy state. To the long list of his acquirements given in the catalogue of the Louvre collection, as painter, sculptor, architect, engineer, physicist, writer, and musician, may now be added that of botanist. In the first number of a new botanical journal, *Nuovo Giornale Botanico Italiano*, published at Florence, Sig. G. Uzielli has given some interesting extracts from a work by Da Vinci, from which he would appear to have anticipated the discovery of certain botanical laws generally attributed to writers of a later age. These extracts are taken from a section of his great treatise on painting, entitled "On Trees and Vegetation," which, however, is found only in one edition of that work, the Roman. The following are the points on which the originality of his observations deserves especial mention.

1. The laws of Phyllotaxis, or of the arrangement of leaves on the stem. Da Vinci appears to have been the first to observe that the order of growth of the leaves is uniform in the same species; and that their modes of arrangement can be divided into three principal forms—the opposite, the whorled or verticillate, and that usually denominated in text-books the alternate, but which should rather be called the spiral. He also pointed out that in the case of leaves growing in opposite pairs, they are generally arranged in a "decussate" manner, that is, each pair grows at right angles to the pairs immediately above and below it; that when leaves are verticillate, those in each whorl are seldom in a direct line with those in the whorls immediately above and beneath; and that a very common form of the spiral arrangement is that sometimes called "quincuncial," where the cycle is completed by five leaves, the sixth being in a direct line with the sixth above and beneath. Another observation of the great painter's is, that inasmuch as branches grow from buds generated in the axils of leaves, the arrangement of the branches on the trunk necessarily corresponds to that of the leaves on the stem.

In botanical works it is generally stated that Sir Thomas Browne, in his quaint little treatise "The Garden of Cyrus, or the Quincuncial Lozenge," published in 1658 (a work not mentioned in Pritzel's "Thesaurus Litteraturæ Botanicæ"), was the first to describe the spiral disposition of leaves, which was afterwards noticed contemporaneously by Grew and Malpighi. Bonnet,* however, in 1754 followed out the laws of phyllotaxis in a far more exact manner; and the subject has been still further elucidated by Goethe, Schimper, Braun, Steinheil, the brothers L. and E. Bravais, and Martins. To Da Vinci, however, who lived from 1452 to 1519, is clearly due the priority in the discovery of these laws; although, as might be expected, many of his observations show a crudeness and imperfection which have been corrected by more recent writers.

2. The manner in which, from the structure of the trunk of exogenous trees, their age can be determined. This fact, although now familiar to unscientific persons, appears to have been unknown to the ancients; since Theophrastus makes no mention of it, nor does Pliny, who

* Bonnet, Ch., Recherches sur l'usage des feuilles dans les plantes.

cites examples of trees which have been known for a great length of time. The discovery is usually attributed to Malpighi and Grew, who published their works, the former in 1675, the latter in 1682; it was, however, known earlier; for Montaigne, passing through Pisa in 1581, learnt the fact from a jeweller of that town, in terms which recall those used by Leonardo. I transcribe the description of Montaigne:—

"The workman, an ingenious man, and famous for the manufacture of beautiful mathematical instruments, informed me that every tree bears as many circles as the years it has lived, and he showed me this in all the specimens of wood which he had in his shop. And the part which is exposed to the north is firmer, and the rings closer and more dense than the rest. By this means he professes to be able to judge of any piece of wood that is brought to him, both the age of the tree, and in what situation it grew." *

The following are the words of Leonardo:—

"The southern part of the plant shows more vigour and youth than the northern. The rings of the branches of trees show how many years they have lived, and their greater or smaller size whether they were damper or drier. They also show the direction in which they were turned, because they are larger on the north side than the south; and for this reason the centre of the tree is nearer the bark on the south than on the north side."

From this it will be seen that both the observations on the age, and those on the eccentricity of the trunks of trees, attributed hitherto by De Candolle † and others to Malpighi, had been previously made by Leonardo da Vinci.

3. The growth of exogenous stems by the formation of new wood beneath the bark. This he describes in the following sentence:—

"The growth in the size of plants is produced by the sap, which is generated in the month of April between the outside coating (*camisia*) and the wood of the tree. At the same time this outside coating becomes converted into bark, and the bark acquires new crevices of the depth of the ordinary crevices."

It will be seen that, although the painter correctly indicated the portion of the trunk in which the increase takes place, he nevertheless failed to detect the cambium, and the important part which modern researches have shown that it plays in the formation of new wood.

For the above illustrations of the botanical knowledge of Da Vinci, we are mainly indebted to the article already named by Uzielli, who states that he might cite from the "Treatise on Painting" many other observations, generally correct, on the structure and development of plants, on the symmetry of their secondary axes, and on the influence which external agents have upon their growth. Uzielli remarks that it is strange that Venturi does not mention these botanical observations, he having had Leonardo's MSS. for a long time under his hand, not even referring to them in his "Essay on the physico-mathematical works of Leonardo da Vinci," where he claims for the painter the character of a great *savant*, and one of the founders of the experimental method. Amoretti, and all the other illustrators of his life and works, are also silent; and Libri, who wrote after the publication of the Roman edition of the work on Painting, mentions only that Leonardo records in it some botanical observations. Libri was, however, the first to publish the important experiments of Da Vinci relative to the action of poison on plants, discovered in the MSS.* preserved in the Library of the Institute at Paris, in which he also alludes to an ingenious process of drying plants, and reproducing their form easily on paper. Not only these MSS., but those also in the Ambrose Library at Milan, in the British Museum, and at Windsor, and those to be found in some private libraries, would doubtless repay a more careful research than has at present been bestowed upon them; and we would commend the subject to the attention of whoever takes up the thread of the life of Da Vinci, broken by the lamented death of Mr. B. B. Woodward.

Sir Charles Lyell † refers to Leonardo da Vinci as one of the first who applied sound reasoning to the facts of Geology, and who taught the organic origin of fossils. His botanical and geological theories are alike evidence of the spirit in which he applied all the powers of his mind to the observation of the phenomena that surrounded him, and which prompted him to counsel his pupils and readers invariably to have recourse to Nature rather than to the works of man, as their guide and the source of their inspiration.

ALFRED W. BENNETT

* Journal of Travels in Italy, by M. Montaigne.

† Organographie végétale, vol. I. p. 324. Paris, 1827.

* MSS. of Leonardo da Vinci, vol. N, fos. 11 and 71.

† Principles of Geology, 10th ed. vol. I. p. 31.

THE RACES OF INDIA

Memoirs on the History, Folk-lore, and Distribution oj the Races of the N.W. Provinces of India. By the late Sir Henry M. Elliot. Edited by J. Beames. (2 vols. Trübner and Co.)

THE above work dates from the time of the old East India Company, bearing ample witness anew to that glorious fertility of genius produced in the full flow of an activity directed seemingly to the development of a purely mercantile policy of the most practical kind—the utilising of a distant continent for the enrichment of a handful of merchants sitting at home at their ease. Such, at least, was the repute enjoyed by the Honourable Court of Directors in their day, and it required no less a change than the transfer of power to as methodical a form of government as that which rules India nowadays to make us see matters in their true light, and bless the memory of John Company. This remark is made, of course, from a scientific point of view, for in every other respect, doubtless, India has at large been the gainer. The Company had served its term, and had to give way to a more central power in the interest of the empire generally. One cannot help contrasting, however, the times that are gone by, when upon the horizon shone such stars of first magnitude in science and literature as Sir Charles Wilkins, Sir William Jones, Gilchrist, Lumsden, Colebrooke, Wilson, Ballantyne, Charles Philip Brown, Roer, Sprenger, with the days that be, when examination tests of the severest kind are in the ascendant, but followed, alas! by no apparent results as far as growth of scientific knowledge is concerned, whatever advantage the service generally may be found to derive from them. Men there are, no doubt, who in the proper spirit, and with no less self-devotion, have continued the work of the past. Such names as Cowell, Nassau Lees, Buehler, Burnell, need only be mentioned to give us hope in the future. But what encouragement have their efforts met with? Unsupported as they are by any government aid, will not such efforts go sadly to waste? We do not mean to insinuate that the State should constitute itself a "Bureau de Surintendance," for the better direction and advancement of science and learning. It may be all very well in its way if the "Ministère de l'Instruction Publique" appoints a "Commission pour l'exploration scientifique de l'Algérie," but in a country of parliamentary government, where most things are left to individual initiative, such a state of things is supposed to be anomalous. A great deal might meanwhile be achieved if the range of knowledge required of an Indian civil servant were narrowed, and if he were plied more amply with knowledge of more immediate use for his future career. Instead of being obliged, as now, to occupy himself *de omnibus rebus et quibusdam aliis*, let his attention be directed to such knowledge as will more immediately concern him, and which, if properly followed up, could not but add greatly to our acquaintance with India. Practically speaking, indeed, such a course seems to be not only advisable, but absolutely necessary. That our authority throughout that region is diminishing according as our military power is less displayed, it would be useless to deny. The greater, consequently, seems the necessity for drawing closer the bonds of union, by employing ourselves more fully with the concerns of the people—not in the carping spirit too often assumed by missionaries, but with the unprejudiced mind of scholars. Occasion has been given to these remarks by the perusal of Sir Henry Elliot's book on Indian races, which, although cast in a form anything but grateful to the ordinary student, teems with most interesting information, not to be met with elsewhere in so condensed a form or backed up by such reliable authority. The work resulted from an order issued by the then Government to the Sudder Board of Revenue, N.W.P., bearing date 14th Dec., 1842, and directing them to compile a glossary of Indian terms in accordance with a comprehensive scheme which comprised not only terms relating to the revenue, but also to matters mythological, and to geographical nomenclature. The plan being but insufficiently carried out by his subordinates, Sir Henry of his own accord took it upon himself, in 1844, to complete the parts submitted to the Government, and reaching down to the letter J, without waiting for the completion of the whole—which, indeed, never seems to have been published—limiting his attention mainly to "tribes, customs, fiscal and agricultural terms." He not only added a great many new headings, but enriched the whole with contributions from his own vast store of historical knowledge, compiled from Mohammedan sources, principally from the "Ayin-i-Akbari," the work of the well-known Minister of the Emperor Akbar, who was the founder of a new era in Indian administration. So far as it goes, it is the nearest approach to an encyclopædia of modern Hindooism we can think of. But to contend that it is anything more than a most convenient book of reference in *practised* and *skilful* hands, would be going beyond the mark. In spite of the more practical arrangement adopted by the present editor, one must have struggled for some time with the difficulties which haphazard transcription of native words into English has put in one's way, in order to know where to find what is sought for, or to identify it if one has come across it by chance. This is the first attempt at a rational way of transcription; but, just because it is the first, it is not yet so consistently carried out as might be wished.

To the editor, for whom we have the greatest respect, and who, by his "Outlines of Indian Philology," has shown how earnestly he goes to work in such matters, we in no wise wish to be unfair. The short space of two months, however, allotted to him for editorial work, was far too short to allow him to think of such a fundamental change as that of digesting the whole of the additional matter, and making it conformable with the rest. To do this would involve immense labour, much more, at all events, than one is called upon to bestow when merely editing another man's work. This leads to another point of the utmost importance for our scientific knowledge of India, the bewildering confusion regarding geographical and other names in their English garb. We have been long in the habit of laughing at philologists pouring showers of abuse on each other on the question whether a certain letter in English transcription ought to have its dot over or under the line. But if we do not adopt a little of their pedantry, we shall see no end of confusion in scientific terminology. Since the days of Gilchrist, in 1802, when he made an appeal to European scholars to adopt a uniform system of transcription, no visible improvement has yet generally taken place. If we should not see the urgent necessity of such a change, he gave us the counterfeit of the Hindustani people spelling and pronouncing *udbikut* for advocate, *usishtun* for assistant, *kotmasool* for court-martial, etc. Nevertheless we go on spelling native names in all manners of ways. No two gazetteers, not even of India proper, agree in their orthography, and we may even say, not one gazetteer is consistent with itself. Look at the index to Allen's map of India, which, after all, is still one of the best. We often find there, under different letters of the alphabet, two places, at only a few minutes' distance from each other, which, if it had not been for the strange disguise in which different surveyors chose to put it from the way in which the name struck their ear, would never have been put down as two, but would at once have led to a more accurate measurement of longitude and latitude. The only way to rectify these errors is now afforded, by comparing those maps in Hindustani and Devanagari character, which are issued from the Surveyor-General's offices at Agra and Allahabad, with our English maps, and rectifying the latter in a systematical manner. We are no better off if we turn to botany and the pharmacopœia. Mr. Watson's index, which was lately compiled with a view of collecting the material, swarms with the most glaring mistakes, which, it is true, will do no harm to the learned in these matters, but it is just for them that such books are *not* published. They are intended for those who, in our busy days, have no leisure to settle all this detail for themselves.

To turn back to our book. Of the hundreds of geographical names contained in it, there are perhaps not ten which one would find in this form on our maps of India. But after more or less experimenting, you would not only find every one of them on the maps, but also in some volume of the latest edition of "Thornton's Gazetteer," and perhaps in the volume in which you least expect to find it. To make the book useful for the general public, therefore, a careful index of all the possible spellings, and reference to the correct one, ought to have been annexed to it. Another English index arranged according to subject matter, such as for instance the one to "Rich's Dictionary of Roman and Greek Antiquities," is still a great desideratum, even after the new distribution in four chapters by Mr. Beames. To give only two or three instances out of many: How is the ordinary reader to know that Bareilly (II., 143) is the same as Barelî (141), and that the latter is the correct form? or that the Jadubans (I., 3) are the same as the Yadbansî's (350), and that Kayat, Kayath, Kayeth, Kaisth and Kaith, as they are spelt in different parts of the book, are the same, namely, Káyastha, and that the name is not composed, as stated, on I., 305, from *kai* and *stittei*? And how, without an alphabetical table of contents, are you to know that contributions to Persian and Slang lexicography are hidden away in pages 178 of the second, and 160 of the first volume?

All this does not, however, detract from the value of the work, which we consider, with the author, as "a basis and starting point" very well worth imitating for all the civilians who go out to India. If every secretary of a Sudder Board of Revenue in India were presented with a copy of this work, and if an injunction were made that either he himself or one of his assistants who is well qualified for the task should from time to time send in reports of what he sees and hears after the pattern of the present book, we might, without outlay to the Government, soon see the book completed to the letter Z, and the same thing done for other presidencies too. But the case occurring, we must beg one thing, that the right man be put in the right place, and that we are to have no more of that gentleman's reports who tries to pass off the names of five great districts and of five great languages for so many "great families." (I. 342). We fancy we see him in our mind's eye sitting down to a task utterly ungenial to him, and after a strenuous effort to huddle it through, only heaping blunder upon blunder. Such discoveries shake our faith in the reliability of his other statements in cases where we have no means to test them by facts established elsewhere, and resting on sufficient authority by themselves.

OUR BOOK SHELF

A Catalogue of British Neuroptera. Compiled by Robert McLachlan, F.L.S. The Ephemeridæ by the Rev. A. E. Eaton, B.A. Published by the Entomological Society of London. 8vo. (London: Longmans. 1870.)

ENTOMOLOGISTS will give a cordial welcome to this first instalment of the catalogue of British insects, the preparation and publication of which has been taken up with such commendable zeal by our Entomological Society. The subjects coming under the domain of entomology are so infinitely numerous, and the literature of the science has increased so enormously of late years, that for any one man to attempt to grapple with it specifically would be almost an act of insanity; and the authorities of the Entomological Society have therefore very wisely entrusted the preparation of different parts of their projected catalogue to those British entomologists who have most successfully studied particular groups. Mr. McLachlan as a zealous student of the Neuroptera is so well known both in this country and on the Continent, that no one else could well have been selected for this part of the task, and he has associated with himself, in the preparation of the list of Ephemeridæ (the well-known May-flies of the angler) a gentleman who, if his published writings are less numerous than those of his colleague, has certainly shown in them that he possesses in a high degree the qualities necessary for the investigation of a rather difficult group of insects.

The order Neuroptera, as understood in this catalogue, possesses the same signification that was originally given to it by Linnæus—that is to say, it embraces, besides the true Neuroptera with a complete metamorphosis, those forms, such as the dragon-flies, May-flies, and some others, which, from their imperfect transformation and certain structural characters, have of late years frequently been placed with the Orthoptera, under the name of "Pseudo-Neuroptera." Under this subordinal or tribual name they figure in this catalogue, and in the present state of our knowledge of the classification of these forms of insects, this is perhaps as good a place for them as any. We have still much to learn as to the affinities of these creatures before any satisfactory arrangement of the families and higher groups can be made, and long and persevering labours, probably in the genealogical direction indicated by Darwinian views, will be necessary before we can clearly understand their true relations, which, however, are the more interesting, as it is undoubtedly in this neighbourhood that we have to seek for the primitive type or types of the whole world of insects. Towards such a happy consummation as the final settlement of so knotty a question as the true classification of the insects comprised under the orders Orthoptera and Neuroptera, such conscientious work as has been put into this catalogue by its authors must greatly contribute.

There is one other point on which we may congratulate the Entomological Society, namely, their adoption of an order of Entomological pariahs, if we may so speak, for the *début* of their catalogue. In Entomology, perhaps more than in any other department of Natural History, fashion rules the day, and the great majority of its votaries devote their whole attention either to Lepidoptera or to Beetles. The fact that one of the most neglected groups of insects has been taken for the commencement of this catalogue of British insects, is, we hope, a sign that the order of publication will continue to be in the inverse ratio of the popularity of the subjects, as we feel convinced that there are many who with any tolerable guidance would be only too glad to acquire some knowledge of the forms of insect-life which lie outside the limits of their present studies.

Ost Afrika: Erinnerungen und Miscellen aus dem abyssinnischen Feldzüge. Von Dr. J. Bechtinger. (Wien. 1870.)

DR. BECHTINGER furnishes an account in a light sketchy style of his experience in the Abyssinian campaign as an acting assistant surgeon. The contents of this work are of a very miscellaneous nature, and are not particularly well arranged, comprising scraps of information respecting the diseases of the troops, the treatment adopted for the *Filaria medinensis*, the Yemen ulcer, the character and habits of the Abyssinians, and the incidents of the journey. The descriptions of the scenery are few and short, and there are scarcely any observations of scientific value. We scarcely know whether the book is intended for the general or the professional reader. For the former it contains too much medicine and surgery; for the latter it is almost worthless, and we think the author need not have been so particular in reserving the right of translation and reproduction.

LETTERS TO THE EDITOR

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

Strange Noises heard at Sea off Grey Town

I AM glad to see that the vexed question of the noise heard from under the sea in various parts of the Atlantic and Pacific has been re-opened by a gentleman so accurate and so little disposed to credulity as Mr. Dennehy. The fact that this noise has been heard at Grey Town only on board the iron steamers, not on board the wooden ones, is striking. Doubtless if any musical vibration was communicated to the water from below, such vibration would be passed on more freely to an iron ship than to a wooden one. But I can bring instances of a noise which seems identical with that heard at Grey Town being heard not only on board wooden ships, but from the shore.

I myself heard it from the shore, in the island of Monos, in the Northern Bocas of Trinidad. I heard it first about midnight, and then again in the morning about sunrise. In both cases the sea was calm. It was not to be explained by wind, surf, or caves. The different descriptions of the Grey Town noise which Mr. Dennehy gives, will each and all of them suit it tolerably. I likened it to a locomotive in the distance rattling as it blows off its steam. The natives told me that the noise was made by a fish, and a specimen of the fish was given me, which is not *Centriscus scolopax*, the snipe-fish, but the trumpet-fish, or *Fistularia*. I no more believe that it can make the noise than Mr. Dennehy believes (and he is quite right) that the *Centriscus* can make it.

This noise is said to be frequently heard at the Bocas, and at Point à Pierre, some twenty-five miles south; also outside the Gulf along the Spanish main as far as Barcelona. It was heard at Chagreasancas (just inside the Bocas) by M. Joseph, author of a clever little account of Trinidad, on board a schooner which was, of course, a wooden one, at anchor. "Immediately under the vessel," he says, "I heard a deep and not unpleasing sound, similar to those one might imagine to proceed from a thousand Æolian harps; this ceased, and deep and varying notes succeeded; these gradually swelled into an uninterrupted stream of singular sounds, like the booming of a number of Chinese gongs under water; to these sounds succeeded notes that had a faint resemblance to a wild chorus of a hundred human voices singing out of time in deep bass."

He had, he says, three specimens of the trumpet-fish, said to make the noise, either by "fastening the trumpet to the bottom of a vessel or a rock," or without adhering to any object. The whip-like appendage to the tail, which he describes, marks his specimens at once as *Fistularias*.

Meanwhile, it is but fair to say that Mr. W. W. Spicer, a few weeks since, called attention to this "Sirene," or musical fish, in Hardwicke's *Science Gossip*, commenting on an account of its being heard commonly in the Bay of Pailon, Esmeralda, on the Pacific shore, in latitude 4° north. I replied shortly in the same excellent magazine, and offered to write further, a promise which I should have redeemed, had not I understood that my learned friend Dr. Günther, in the meanwhile, was about to write on the matter himself, telling far more than I could have told.

Another instance of this sound being heard on board a wooden ship (and this time again in the Pacific) is given (in p. 304 of Mr. Griffith and Colonel Hamilton Smith's edition of Cuvier's Fishes, on no less an authority than that of Humboldt who (say the editors and authors of the Appendix) did not suspect the cause. "On the 20th of February, 1803, toward seven in the evening, the whole crew were astounded by an extraordinary noise, which resembled that of drums beating in the air. It was at first attributed to the breakers. Speedily it was heard in the vessel, and especially toward the poop. It was like a boiling, the noise of the air which escapes from fluid in a state of ebullition. They then began to fear that there was some leak in the vessel. It was heard unceasingly in all parts of the vessel, and finally, about nine o'clock, it ceased altogether. From the narration (says Cuvier) which we have extracted, and from what so many observers have reported touching various Sciænoids, we may believe that it was a troop of some of these species which occasioned the noise in question."

For there is, without doubt, a great deal of evidence to show that certain Sciænoids make some noise of this kind. The *Umbrinas*, or "maigres" of the Mediterranean and Atlantic are said to be audible at a depth of twenty fathoms, and to guide the fishermen to their whereabouts by their drumming. The fishermen of Rochelle are said to give the noise a peculiar term, "seiller," to hiss; and say that the males alone make it in spawning time; and that it is possible, by imitating it, to take them without bait. The "weak-fish" of New York, (*Labrus squetaquee* of Dr. Mitchell) is said to make a drumming noise. But the best known "drum-fishes" are of the genus *Pogonias*, distinguished from *Umbrina* by numerous barbules under the lower jaw, instead of a single one at the symphysis. M. Cuvier names them *Pogonias fusca*, and mentions that "it emits a sound still more remarkable than that of the other Sciænoids, and has been compared to the noise of several drums." The author of the Appendix states that these "drum-fish" swim in troops in the shallow bays of Long Island; and according to Schœpf (who calls them *Labrus chromis*) assemble round the keels of ships at anchor, and then their noise is most sensible and continuous. Dr. Mitchell, however, only speaks of their drumming when taken out of the water. Species of the same genus, if not identical, are found as far south as the coast of Brazil; and it is to them, probably, that that noise is to be attributed which made the old Spanish discoverers report that at certain seasons the nymphs and Tritons assembled in the Gulf of Paria, and made the "Golfo Triste glad with nightly music."

How this noise is produced, if the theory be true, I cannot say. Early naturalists looked, naturally, towards the large and strong swimming bladders, observing, at the same time, that these have no communication with the intestinal canal, nor with the exterior generally.

It only remains to me now to quote the opinion of Dr. Günther, to whose courtesy I owe the sight both of the fish and of its pharyngeal and vomerine teeth. He thinks, with later naturalists, that the noise might be made simply by large shoals of "drums" grinding these teeth together, whether in masticating the crabs, &c., on which they feed, or for mere sport.

I would, therefore, request Mr. Dennehy, or any officers of the Royal Mail steamers who may visit Grey Town, to try if they cannot catch a *Pogonias* or two. Of course, finding them there will not prove that they make the noise, but it will be at least one fresh link in a long chain of evidence.

And so I leave the matter, apologising for having quoted from no later authority than the Cuvier of 1834, which is the only book accessible to me; and for myself, "holding it for rashness hastily to avouch or deny aught amid such fertility of Nature's wonders."

C. KINGSLEY

[Mr. Kingsley will find references to all the various authors who have written on Sciænoids generally, and "Drum Fishes" especially, in Dr. Günther's "Catalogue of Fishes," vol. ii., p. 270 *et seq*.]—ED.

WITH reference to the communication published in last week's NATURE, on "Strange Noises heard at Sea off Grey Town," it does not appear necessary to refer these noises to any occult galvanic agency, or magnetic influence in connection with iron ships, although at first sight, and more especially as there is much ferruginous sand in the vicinity, and as the sounds are heard only in iron ships, and not in wood-built, copper-bottomed vessels, there seems ground for such an idea. The solution I would venture to offer is that these noises proceed from "musical fish" or shells.

Musical sounds proceeding from under water, agreeing in character with those described by Mr. Dennehy, appear to be known on the western coast of India and on the coast of Chili. A very interesting account of these musical sounds will be found in Sir Emerson Tennent's work on Ceylon, from the author's own experiences at Batticaloa in that island. His impressions as to the gentleness and harmony of the sounds are as vividly described as those of your correspondent from the Royal Mail Ship *Shannon*: and although Sir E. Tennent throws no light on the remarkable periodicity of the phenomenon, yet he gleaned by his inquiries that the sounds were heard at night, and most distinctly when the moon was nearest the full. Your readers will find the details at p. 468 *et seq*., 2nd vol., Edition of 1859.

The iron ship is, in all probability, from the thinness of the plates, a far better musical sounding-board than the thick-bottomed wooden ships, and here we may have the reason of the delicate sounds not being heard in the latter class of vessel.

It has always appeared to me that this particular locality of the River San Juan and its embouchure at Grey Town, offers a rare field for research to the naturalist and speculative geologist.

In my early service—1834—I was engaged in the Admiralty nautical survey of the then harbour at the entrance of the River San Juan, subsequently well known as Grey Town. At that time it afforded a secure and fairly spacious anchorage for a few vessels of even 24ft. water (sheltered by a sandy peninsula) with a wide and clear approach.

Between 1834 and 1839 the end of this sandy peninsula, Arenas Point, advanced considerably across the entrance towards the opposite shore, in a depth of five-and-a-half fathoms. In 1859, the point had reached to within a cable's length of the main land, or over 6000ft. in advance of its position twenty-five years previously, in depths varying from 33ft. to 18ft., practically closing the port except to a small description of vessel.

These great geological changes—if they may be so called —in so short a period of time, destroying as they have done a useful port, are an interesting, and, so far as I know, an unique fact; but the point to which I would wish to refer in connection with the musical fish (?) is the vast amount of animal life observed at the time of the original survey alluded to. The port literally swarmed with fish, but we could not venture to haul the seine more than twice, from the circumstance that large alligators came up in it, to the consternation of the fishermen and the destruction of the nets. Sharks of huge size rendered precaution from falling overboard a matter of some moment, as an unfortunate pet monkey discovered by being instantly seized. This abundance of life, proof of good feeding-ground, may have some connection with a well-developed species of musical fish; but this speculation must be left for your naturalist readers. F. J. EVANS

PERHAPS your correspondent, Charles Dennehy, M.R.C.S.I., R.M.S. *Shannon*, may find an interpretation of the nocturnal musical phenomenon (mentioned in NATURE, No. 28) experienced by iron ships when at anchor in seven or eight fathoms, with a bottom consisting of *a heavy, dark sand and mud containing much vegetable matter*, in the following natural system of gas-escape. In examining certain pools of water in the East, notorious for their poisonous qualities at certain seasons of the year, I was aware of intermittent risings of vast quantities of bubbles. The waters rested on vegetable deposits; if these were stirred up, large globules rose with considerable force, and I came to the conclusion that these air risings were due to the escape of gases from the decomposing vegetable matter. If any metallic body had met these bubbles as they rose, some sound would have been produced, the nature of it depending on various causes. The reason of the sound being heard on board ship between twelve and two, and not between two and four, is owing to a very simple, but beautiful rule of law: as the gases are at all times collecting, we might suppose that they would be at all times escaping, but as the surface of the bottom is of an elastic nature, the water pressure imprisons the gas as if it were within a valve; but when the force of the gas overpowers the water pressure, there is a bubbling escape till the collected gases are expended, and thus I account for the sounds continuing "*about two hours, with but one or two very short intervals*." It is by no means improbable that the musical performance occurs more than once in the twenty-four hours, though the ordinary noises of shipboard prevent its being audible. I believe there is no other way of accounting for this incident; but the test I would propose is to stir up the bottom on a calm day with considerable force; if large quantities of air-bubbles arise, the sailors may rest satisfied that the concert is not given by ghost, mermaid, or siren, but simply by a continued contact of myriads of gas globules against the ship's bottom. The stirring up will not necessarily cause the sound, as the bubbles may be diverted by undercurrents. H. P. MALET

The Sources of the Nile

IN the fifth (May) number of the *Geographische Mittheilungen*, I publish an article and two maps on "Livingstone's Travels and Discoveries from 1840 to May 1869," one of the maps being carefully compiled from the original Portuguese publications of the Portuguese journeys since 1798—viz., those of Dr. Fr. José de Lacerda e Almeida, the Pombeiros Joao Baptista and Pedro, Major Monteiro, and others, showing all that is at present known of those regions. Both maps and text keep aloof from theories and speculations as to the connections of rivers and lakes discovered by Livingstone and the Portuguese with the Nile.

Of the two points at issue, the one as to the connection of the Lake Tanganyika with Albert Nyanza, Livingstone says:—"Tanganyika and Nyige Chowambe (Baker's?) are one water;" but gives no proof of it, having evidently derived his information from hearsay. The most reliable information on this point seems to me that supplied by Burton (Journal R. G. S., vol. 29, p. 254):—"At the head (northern end) of the Tanganyika lies the land of Uzige," in which land, "according to the guides, six rivers fall into the Tanganyika in due order from the east—the Kuryamavenge, the Molongwe, the Kavinvira, the Kariba, the Kibaiba, and westernmost, the Rusizi or Lusizi. The latter is the main drain of the northern country, and the best authorities, that is to say those nearest the spot, unanimously assert that it is an influent."

Regarding the Kassabi, the upper course of which was explored by Livingstone, Ladislaus Magyar, and Rodriguez Graça, it appears to me that the most reliable information we possess of its lower course is that supplied by Livingstone, as collected by him when at Cabango in 1855 (Livingstone's Missionary Travels in South Africa, pp. 457 and 458):—"Several of the native traders here having visited the country of Luba, lying far to the north of this, and there being some visitors also from the town of Mai, which is situated far down the Kasai, I picked up some information respecting those distant parts. In going to the town of Mai, the traders crossed only two large rivers, the Laojima and Ohihombo. The Kasai flows a little to the east of the town of Mai, and near it there is a large waterfall. They describe the Kasai as being there of very great size, and that it thence bends round to the west. On asking an old man, who was about to return to Mai, to imagine himself standing at his home, and point to the confluence of the Guango and Kasai, he immediately turned, and pointing to the westward, said, 'When we travel five days (thirty-five or forty miles) in that direction, we come to it.' He stated also that the Kasai received another river, named the Lubilash. There is but one opinion among the Bovonda respecting the Kasai and Guango. They invariably describe the Kasai as receiving the Guango, and beyond the confluence assuming the name of Zairé or Zerézeré. And the Kasai, even previous to the junction, is much larger than the Guango, from the numerous branches it receives. Besides those we have already crossed, there is the Chihombo, at Cabango, and forty-two miles beyond this, eastward, runs the Kasai itself; fourteen miles beyond that the Kaunguesi; then, forty-two miles further east flows the Lolua; besides numbers of little streams, all of which contribute to swell the Kasai. The town of Mai is pointed out as to the N.N.W. of Cabango, and thirty-two days or 224 miles distant, or about lat. S. 5° 45'. It is evident, from all the information I could collect both here and elsewhere, that the drainage of Londa falls to the north and then runs westward. The countries of Luba and Mai are evidently lower than this, and yet this is of no great altitude, probably not much more than 3,500 feet above the level of the sea. Having here received pretty certain information on a point in which I felt much interest, namely, that the Kasai is not navigable from the coast, owing to the large waterfall near the town of Mai * * *" AUGUSTUS PETERMANN

Redaction der Mittheilungen aus
Justus Perthes geographischer Anstalt,
Gotha, May 2

Scandinavian Skulls

IN his recent lecture on the "Forefathers of the English People," Professor Huxley says, "It is a very remarkable circumstance that the skulls of the existing Scandinavians . . . are *long*;" and he contrasts their dolicephalous type with the round forms of South German, Swiss, and ancient Belgic heads. He also thinks it likely that the Scandinavian invasions of England brought a "longer form of head" into fashion amongst us. The same doctrine is taught by Sir Charles Lyell, in his "Antiquity of Man," and even in the sixth edition of his "Elements of Geology," he says that the Scandinavian skulls of the dolmen period are brachycephalous, or round; those of the iron age being dolicephalous, or long.

Such notions were once current in Sweden and Denmark, but they are now exploded. Originally deductions from history, they rest on no basis of observed fact, and archæology plainly contradicts them. Thirty or forty years ago, Scandinavian *savants* believed, on historical and philosophical grounds, that Lapps and Finns were the earliest inhabitants of the Baltic North, that after them came a Celtic, and finally a Gothic invasion. As Scandinavian archæology grew into a science, and the remains discovered were seen to fall into a stone, a bronze, and an iron series, the three groups collected were, in obedience to the previously existing historic theory, respectively labelled Finnish, Celtic, and Scandinavian. Now, it happened that the first *two* obviously prehistoric skulls found in Scandinavia were of the round type, on which circumstance a learned person (Retzius, if I remember rightly), jumped—in characteristic nineteenth-century style—to the conclusion that the *whole dolmen race* was round-skulled. Never was a more monstrous generalisation built on a miserable collection of two particulars. There are known to exist in museums about 80 skulls attributed to dolmen men, some of which are, perhaps, of questionable origin. These crania are of every conceivable type, being, in fact, identical with modern churchyard skulls. No one pretends that their form is short, or Celtic, or Finnic; and some authorities allege that they are mostly long. These facts are notorious enough in the North. They were ventilated at the late Copenhagen Archæological Congress, and it was not denied on any side that the stone age skulls would suit modern Danes and Swedes. The short skulled stone man is in fact gone the way of the basilisk and the Vital Force, and it is time for him to take his departure from the authoritative scientific teaching of Great Britain.

Professor Huxley appears to believe that the Northern Bronze, or Iron Man, was long skulled. Although this view is quite unsupported by facts, it may be backed by an argument from the domain of the Higher Criticism. In the Museum of Rosenberg are casts of the so-called Gold Horns, the originals of which precious runic articles were stolen nearly 70 years ago. One of these horns bears the inscription—"Ek hleva gastim holtingam horna Favido," which every runologist can read easily enough. But no two runologists agree even approximately in their versions, so that no date can be given to the horns from inferences built on the style of the inscription. However, Professor Steenstrup has pointed out that some figures of men engraved on the horns have heads of a longish appearance, which conclusive fact tells in favour of Professor Huxley's dolicephalous doctrine, although some learned Danes consider that the skulls represented on the horns were obviously Oriental and not Scandinavian.

According to the highest Copenhagen authorities, there is no ground whatever for the assertion that modern Scandinavian skulls are of the long type. It is equally incorrect to say that Scandinavians are fair-haired and blue-eyed

Copenhagen G. STRACHEY

The Anglo-Saxon Conquest

IN an interesting paper, quoted at p. 661 of NATURE, Prof. Rolleston dwells upon the proportion of short-lived male skeletons, found in Anglo-Saxon interments, as contrasted with the older character of the Romano-British interments, deducing therefrom a conclusion as to their respective longevity. The writer appears to have forgotten that the youth of Romano-Britain had for many generations been forcibly expatriated—drafted abroad to feed the armies of Imperial Rome. A. HALL

Analogy of Colour and Music

MR. W. S. OKELY accuses me of having criticised his letter "far too hastily," and writes that he does *not* compare the *diameters* of Newton's rings with one another, but their *cubes*. On referring to his letter in NATURE for Feb. 10, I read as follows:—"Professor Zannotti, of Naples, gives for the *diameters* of the rings from red to red, the cube-roots of the numbers 1, $\frac{8}{9}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{3}{5}$, $\frac{9}{16}$, $\frac{1}{2}$. The intervals between these, taken successively, are $\frac{9}{8}$, $\frac{16}{15}$, $\frac{10}{9}$, $\frac{9}{8}$, $\frac{10}{9}$, $\frac{16}{15}$, $\frac{9}{8}$." Your readers can now judge whether my failure to apprehend Mr. Okely's measures was due to my undue haste or his obscurity of expression. When Mr. Okely speaks of my "doubting the accuracy" of Professor Zannotti and M. Biot, he is drawing entirely on his own imagination; what I *did* doubt was the value of the deductions drawn by Mr. Okely from their figures. I *now* doubt his power of distinguishing between external facts and those evolved from his own moral consciousness.

Trin. Coll. Cambridge, May 4 SEDLEY TAYLOR

Colour of the Sky

YOUR correspondent "H. A. N." will find some interesting remarks on the blueness of the sky in Professor Tyndall's "Glaciers of the Alps" (p. 257, &c.), and one or two additional notes in my "Alpine Regions," p. 150. With regard to the colour of the sky at great heights, I can inform him that in fine weather the blue becomes deeper as one ascends, as has been noticed by many persons accustomed to mountain climbing. The most striking instance that I have seen was during an ascent of Monte Rosa, 15,217 feet. On this occasion the colour was so deep as almost to approach a black, as deep as or deeper than the richest hues of *Gentiana acaulis*. This intensity of colour was only very conspicuous during the last few hundred feet of the ascent; and in expeditions to mountains of nearly the same height I have not often seen it approached, never surpassed. Mr. Hincliff in his "Summer Months among the Alps," p. 111, calls attention to the same phenomenon on Monte Rosa, and very appositely quotes Shelley:

> The sun's unclouded orb
> Rolled through the black concave.

T. G. BONNEY

The Royal Society

I CANNOT but think that the list of candidates recommended by the Council for election into the Royal Society published in your last number will be read by the outside world with considerable surprise. I look in vain in it for the names of two men, at least, of world-wide reputation, and well known as no mere *dilettanti* in their respective sciences, who were among the candidates, while the names of others are found there, which are on everybody's lips with the thought, What have they done to merit the scientific distinction which is looked on by every lover of science as almost an opening of the gates of paradise? Is it possible for us outsiders to learn anything of the considerations which govern the election? NOT AN F.R.S.

The Origin of Species and of Languages

ALTHOUGH the origin of languages is due, doubtless, to the gradual variation, selection, and combination of a few primary sounds, partly emotional, partly imitative; yet the process differs essentially from the Darwinian in one all-important respect—that it is carried on by the countless efforts of *rational* beings. No irrational animal, though capable of uttering emotional sounds that are quite intelligible to its fellows, and though in some instances capable of imitating both natural and articulate sounds in a remarkable degree, has ever formed a language, simply because it wants reason. Therefore the analogy, in so far as it really holds, seems to tell against the Darwinian theory, in as far as that ascribes the origin of species to *reasonless* variation and selection.

To me this seems a most important consideration. But I cannot trespass further on your space.

Stirling WILLIAM TAYLOR

TAUNTON COLLEGE SCHOOL

THE educational scheme which occupied much of the late Lord Taunton's attention during the last years of his life, but of which he only saw the beginning, has now come into practical working. Under ordinary circumstances the development of an ancient Grammar School into a modern Public School would merely pass as one of the now frequent symptoms of advance in English higher education. Thus the removal of Bishop Fox's foundation (A.D. 1522) to a fine range of buildings outside Taunton, would hardly demand notice here. Our readers, however, whose attention was taken by Mr. Tuckwell's paper on Science Teaching in Schools (NATURE, No. 1), will see that the application of his system on a much enlarged scale is likely to affect considerably the position of science in the West of England. While calling public attention to the admirable educational arrangements of this particular school, we wish to remark on science teaching in schools in general, with regard to two points which we observe to be often misconceived by the very teachers and parents whom they especially concern.

First, as to the amount of other work displaced by the introduction of Physical Science as one of the regular parts of the school course. In the mediæval system, still not extinct, the forty-two working hours per week were given almost exclusively to classics. In any really good school these hours have now to hold at least an equal average of classical learning, beside English and French, sometimes German, as well as mathematics, geography, history, &c. The problem of doing much in the same time as used to be spent in doing little, is, to a great extent, solved by mere improvement of method. The old classical teaching was so clumsy and repulsive, that its results, so far as it suits the new system to strive for them, may be obtained in one quarter to one half of the time formerly allowed. In addition to this, there are some products of the old system which the new must almost perforce abandon. Latin verses demanded a minimum of ten hours per week out of a total of forty-two working hours. Now, it cannot be too clearly impressed on the minds of persons interested in education, that the time required for giving a well-grounded acquaintance with elementary science is four hours per week.

Second, it is often thought by parents that science, while valuable to boys about to pass certain examinations, or to enter certain professions, is merely of the nature of an "extra accomplishment," not affecting the rest of the educational course. Nothing can be less true. It would be nearer the fact to say that the especial importance of science-teaching in schools, is in its serving beyond any other known means to open children's minds, to stimulate their reasoning powers; not to teach dull formulas, learnt by a *memoria technica*, but to start boys and girls on a course of realising and comprehending life and nature. This statement (as is right with a statement concerning physical science) is one to be tested by direct experiment. Take a class of children brought up to learn Latin and Greek, Geography and History, and Mathematics, but on whose minds the idea has scarcely dawned that these matters concern real places and people and things. Unfortunately, nothing is easier than to find such classes, grinding on, year after year, in the fond belief that, because school work is dull and toilsome, it must be profitable. Now, let an intelligent teacher give these unlucky children an elementary science lesson: for instance, how it is that bodies fall, what causes summer and winter, how the thermometer does its work. In half an hour's time it will be seen in the very faces of the children, that the lesson, independently of its value for itself, has actually repaid the time spent on it, in the newly-aroused attention and reflection it has gained for other studies. It is no exaggeration to say that four hours of really live teaching in science fully pays for itself in the improved quality of the rest of the week. For this cause it is that science is not made optional at the Taunton School. It is taught simply, and with inexpensive apparatus; but every boy is required to collect his own specimens, to perform his own experiments, and to show at every step that he knows what he is doing.

It seems to us that in some few of the really enlightened public schools, such as that we are now writing of, nearly the highest ideal of training has been attained to, compatible with the present habits of English life. When boys, fresh from an intelligent governess at home, or from a ladies' preparatory school of the best sort, go through the full school course from 11 to 17, working steadily on without flagging and without strain or hurry, at an education which they understand to be the direct and purposeful preparation for active business or professional life, such boys start with success in their hands. It is the result of such education that the professional "crammer" tries to simulate when he endeavours to make 12 months' over-work, ruinous to body and mind, produce at the examiners' table the semblance of seven years of steady mental growth. The examiner knows better, and the real business of after-life shows before many years are out the difference between cram and real education.

THE SCIENCE OF EXPLOSIVES AS APPLIED TO WARLIKE PURPOSES

II.—RECENT IMPROVEMENTS IN THE MANIPULATION AND FIRING OF EXPLOSIVE CHARGES

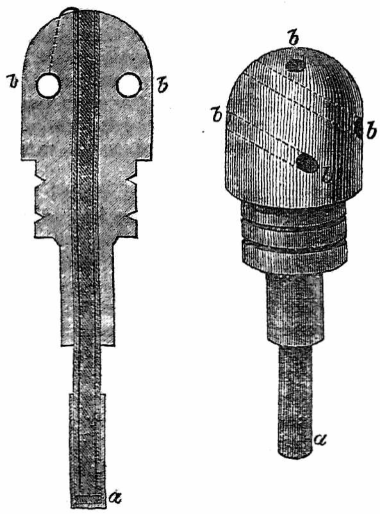
As we have already shown, the employment of explosive charges is a branch of warfare to which the attention of military engineers has been directed for some time past. For warlike purposes, as also for the destruction of wrecks or other submarine obstructions, explosions have been frequently applied in earlier times, but the methods resorted to for igniting them were, as may be supposed, exceedingly crude and primitive; sometimes a clock-work arrangement was used, sometimes an encased slow match, and, occasionally, explosion was brought about by means of heated shot dropped down a metal tube. As would naturally be inferred, the difficulties and the frequently unsatisfactory results attendant on explosions of this kind rendered their profitable application a matter of considerable doubt, and few successful records of their employment are to be found.

During the past few years our knowledge of the science of explosives has been considerably enlarged. Not only has the subject of igniting charges been studied to such an extent as to form, at the present time, almost a science of itself, but the nature of the combustible material has likewise been changed and improved; and military and naval engineers have thus been placed in possession of a source of power, of which we hardly know whether to admire more its unlimitable force, or its wonderful plasticity.

The first practical application of electricity to igniting gunpowder, although such a proceeding was considered possible both by Franklin and Priestley, was not made until about thirty years ago, when some French military engineers employed a voltaic battery as a means of explosion. The method used by these officers was the simple and well-known one of connecting the two conducting wires by a thin platinum thread, the resistance offered to the passage of the electric current by that metal causing its temperature to be raised to a degree sufficient to ignite any charge of gunpowder in contact with it. This manner of applying the electric current as a source of heat is both simple and practical, but it frequently lacks, besides other qualities, the essential virtues of certainty and instantaneity, and it was for this reason that further investigations of the subject have been from time to time carried on. Among others, Colonel Verdu, a Spanish officer, made some progress in the matter, and was successful by the aid of a Ruhmkorff induction coil in exploding several charges simultaneously. This officer's first attempt was to fire the gunpowder by simply allowing a powerful spark to pass from one pole to the other of two wires imbedded in the charge; he found, however, that ignition in this manner was by no means to be relied upon, but that by covering the poles with fulminate of mercury, a substance more readily inflamed, the desired result was readily secured. Some successful results were also obtained about the same time by employing a particular electric fuze, known as Statham's.

A few years later, in 1856, Sir Charles Wheatstone and Mr. Abel devoted considerable time to the prosecution of further researches, and each of these gentlemen contributed an important discovery, which had the effect of perfecting this interesting application, and rendering it a practical and valuable aid to military science. The employment of electricity induced by magnetism was suggested by Sir Charles, who, after some preliminary experiments, constructed an exploding instrument in which the electricity was created by the rapidly revolving armatures of a compound magnet; and the successful application of this machine was effected through the agency of an electric fuze, devised by Mr. Abel, and of which a sketch is here given.

The chief condition to be fulfilled in the construction of an electric fuze was the preparation of a compound which should combine high conducting power with great susceptibility to ignition, and this, after patient and renewed investigation, was ultimately accomplished. A mixture of subphosphide of copper and subsulphide of copper with chlorate of potash afforded a composition which was exploded with perfect ease and certainty by a current from a small magneto-electric machine, a larger apparatus of the same kind being capable of igniting twenty or thirty of these fuzes almost instantaneously. The means at command afforded, under certain circumstances, by a Wheatstone Exploder and the Abel fuzes, can scarcely be valued too highly, and it has been stated that the Governor of Malta, if provided with these valuable aids, might by himself conduct the defence of Valetta Harbour from his own drawing-room window. This may indeed be a vainglorious boast, but as a matter of hard fact we may mention that the Time Guns at Newcastle, Edinburgh, and other northern towns, have been ignited for some years past from Greenwich Observatory, through many hundred miles of wire, by an Abel fuze with infallible precision and certainty.



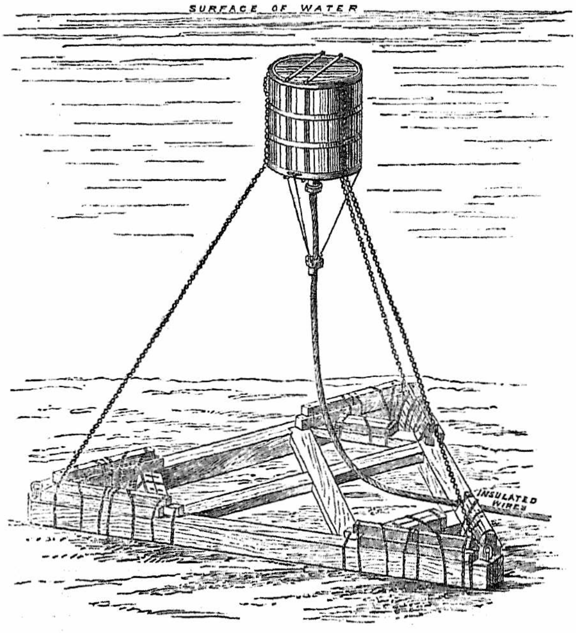
Section *Perspective view*

ABEL FUZE

a, cap of composition, into which the two poles of the wires are fixed.
bb, metal eyes for connecting the insulated wires with the fuze.

Since the date of these improvements, much further experience has been gained in regard to the most suitable description of apparatus to serve as exploders, frictional and dynamo-electric machines, as also miniature voltaic batteries taking the place of the Wheatstone instrument; the electric fuze has however stood its ground in spite of many rivals, and still continues to be used for the ignition of explosive charges, including torpedoes and submarine mines.

As mentioned in the first part of this paper, the Americans employed electricity for firing some of their torpedoes, but they are by no means the only nation who has done so. In the Austro-French war, when the capture of Venice was feared by the Austrians, a very ingenious system of electric torpedo defence was organised at that seaport by a distinguished officer of Engineers, Colonel von Ebner. A camera obscura was erected in proximity to the harbour in such a manner that the horizontal table of the instrument reflected the whole area of the channel. Large wooden cases, each containing 400 pounds of gun-cotton, were lowered at certain fixed distances into the water, and as these disappeared one by one, a small row-boat described at the time a circle round the spot to indicate the extreme confines of the distance at which the torpedo would prove effective; an observer was stationed in the camera as these operations were going on, carefully watching their reflection in the instrument, and as each torpedo disappeared into the water, he marked with a pencil its precise locality on the white table, tracing also the ring formed by the row-boat. Thus a series of circles was formed in the camera, each of which was marked with a distinctive number, and in this way a miniature, but exceedingly correct, plan of the obstructions in the harbours was prepared; the wires in connection with the torpedoes were afterwards led up into the camera obscura and furnished with numbers to correspond with the circles. By means of this arrangement a sentinel stationed in the apparatus might at once explode any one of the torpedoes, as soon as he observed the reflection of an enemy's ship pass within the limits of the circles marked upon the table. The channel itself was quite clear of any suspicious buoys and beacons, and appeared to the enemy wholly free from obstruction.



GUN-COTTON ELECTRIC TORPEDOES CONSTRUCTED AT VENICE IN 1859

In our own country the question of torpedo warfare has for some years past been the subject of study and investigation, and a system has lately been elaborated which owes its origin mainly to Mr. Abel, the scientific referee of the War Department, and which is at once so simple and practical that it cannot fail, in the future, to form a new and interesting branch of war science.

Mechanical torpedoes present so many serious defects (as for instance their liability to get out of order, the risk incurred in mooring them, and the danger they involve, when once sunk, to friend as to foe), that all idea of their employment was at once abandoned by our authorities, and the investigations confined to the devising of efficient electric torpedoes. Of these many descriptions have been designed, but the two kinds held most in favour are the self-exploding instruments, and those which are capable of sending a signal when touched by a passing vessel to indicate the proper time of effecting their ignition from the shore.

The self-acting electric torpedo is of very simple construction, the following being a general outline of one form of it. An Abel fuze is fixed in the torpedo, one pole of which is connected to a constant battery on shore by means of an insulated wire, while the other pole is in communication with an insulated metal plate fixed inside a pivot in the upper part of the machine. Upon this pivot swings a moveable hood, or cage, and the latter, though not affected by the motion of waves, will, upon being struck by a passing vessel, swerve round and come into metallic contact with the insulated plate above mentioned, thus completing the electric circuit with the earth, or, more strictly speaking, with the water. As will be readily perceived therefore, in this case, a single wire only is needed to connect one element of the battery with the fuze, the other element being of course allowed to pass to earth. In the other description of torpedo, a *circuit closer* of the same construction is used, and this on being struck furnishes a signal to the shore, whence a sentinel at once explodes any charge, or charges, which may be in the vicinity of the submerged machine. When disconnected from the batteries, these torpedoes naturally cease to be a source of danger, and herein lies one of the most valuable qualities of the electric exploding method. If considered desirable, the machines need in fact never be put into an active state except in a case of imminent danger. Thus, if a fleet of friendly vessels were pursued by hostile ships, the sentinel on the look-out would not connect his batteries until the former had passed over the torpedoes, and when the machines were well left behind, by simply turning a switch arrangement he would be enabled instantly to close the line of defence, and set up a formidable barrier not to be passed with impunity.

In the simplest form of electric torpedoes (such as the majority of those used in America) where ignition is brought about by simply sending a current through the circuit, one wire leading from the torpedo to the battery and another to earth, the employment of the Abel fuze presents one very important advantage. Explosive machines fitted with these appliances may, when in position, be tested at any moment to ascertain their state of efficiency, and the operator is thus made cognisant of the serviceableness or otherwise of his apparatus and batteries; this operation is effected by simply passing a weak current through the wire and fuze, which although insufficient to produce ignition, is yet powerful enough for the transmission of signals.

Where a large number of torpedoes are grouped together, it is found undesirable, except in special cases, to use either the frictional or dynamo-electric machines for exploding the fuzes, for the reason that a current sent from one of these instruments to ignite a specific charge, induces similar currents in adjacent wires and at once causes a wholesale explosion. Constant voltaic batteries or piles are therefore generally resorted to, and the construction of simple forms of these from rough, handy materials (some sheet zinc and copper, a few pieces of wood, and a little vinegar and common salt) is a favourite occupation among sailors who have received elementary instruction in this system of warfare.

By employing in torpedoes, instead of powder, a heavy charge of gun-cotton, and exploding this by the newly-discovered method of detonation, a force is developed which, it is no exaggeration to say, would prove fatal against a vessel of the strongest and most cunning construction.

NOTES

WE are glad to be able to announce that the arrangements for the Eclipse Expedition are progressing very rapidly and satisfactorily, and that there seems every chance of everything being done which can insure success. In response to their circular, the Council of the Royal Astronomical Society have received upwards of sixty applications from observers anxious to help in an examination of the phenomenon. It is proposed that, if possible, there shall be two expeditions; one to Spain, the other to Sicily. The desirability of this is obvious, as the chances of bad weather are thereby considerably reduced. Unfortunately, those who know Sicily well state that the region to be visited is so brigand-ridden that other precautions besides those usually employed in Eclipse Expeditions will be desirable. The Italian Government, which will also, we believe, send an expedition to Sicily, will, doubtless, look to this. The French Expedition will observe in Algeria.

OUR Berlin Correspondent writes that Baron Liebeg has recovered from his recent severe illness.

WE regret to learn that Mr. Archibald Geikie, who recently left England to investigate the Geology of the Lipari Islands, was prostrated by fever as soon as he arrived there, and is in such a weak state of health, that he has been ordered back to England.

AN Imperial decree has been published in Paris, ordering that the Minister of Fine Arts shall henceforth bear the title of Minister of Literature, Science, and Art, and also that his department shall include the superintendence of the Institut de France, Academie des Sciences, the libraries, learned societies, and the like. When shall we get *our* Ministry of Literature, Science, and Art?

THIS will be a week of Anniversary Meetings. On Monday the annual réunion of the Royal Geographical Society will be held at one o'clock, and of the Victoria Institute at four; and on Tuesday the Linnean Society will celebrate its anniversary at three, and the Ethnological at four.

THE *British Medical Journal* states that the chair of Physiology, in the University of Prague, vacant by the death of the celebrated Purkinje, has been filled by the appointment of Dr. Hering, of Vienna. It was offered to Professor Helmholtz, who, however, preferred to remain at Heidelberg.

AT the annual meeting of the Newcastle Natural History Society on the 10th inst., a discussion took place on the present position of the Alder Memorial Fund. It was stated that while the original intention was to raise 600*l.* to carry out the memorial scheme, only about 300*l.* had been collected since March 1867. After some discussion, it was agreed to make efforts to raise an additional 100*l.*, which was considered a sufficient sum to carry out the objects proposed.

AT the recent general examination for women, held by the University of London, five passed in the "Honours" Division and four in the First Division. Of the seventeen candidates, five were from the Cheltenham Ladies' College, all of whom were successful, two being placed in the Honours and three in the First Division.

MR. J. W. ELWES, of King's College and the London University, and Mr. W. T. Sollas, of the Royal School of Mines, have been elected (equal) Exhibitioners in Natural Science, at St. John's College, Cambridge. There were eight candidates; the examiners being Prof. C. C. Babington (Botany), Prof. Humphry (Physiology), Prof. W. G. Adams (Physics), Mr. Bonney (Geology), and Mr. Main (Chemistry).

A RECENT number (94) of the German series known as "A Collection of Popular Scientific Treatises, edited by R. Virchow and Fr. von Holtzendorff," is a lecture on the Glacial Period (*Die Eiszeit der Erde*), by Alexander Braun. It gives a clear and concise history of the observations and arguments by which geologists have been led to the conclusion that a lengthened period of extreme cold overspread the greater part of Europe before the commencement of the historical epoch.

MR. C. P. SMITH reprints, as a separate publication, an epitome of a paper read before the Brighton and Sussex

Natural History Society on Nov. 11, 1869, under the title of "The Moss Flora of Sussex, together with Notes on the Structure and Reproduction of Mosses."

THE first volume is published of Dr. Oppolzer's "Lehrbuch zur Bahnbestimmung der Kometen und Planeten."

A PAMPHLET lies on our table entitled "History of Modern Anæsthetics, a second letter to Dr. Jacob Bigelow, by Sir J. Y. Simpson, Bart." Without entering into the merits of the controversy between the Scotch and American doctors, it is but just to the memory of Sir James Simpson to say that it appears to have been conducted by him in an admirable spirit of courtesy which is not always found in scientific discussions. It is admitted on both sides that the first case of an anæsthetic operation under sulphuric ether occurred at Boston on the 30th of September, 1846; and the first case of an anæsthetic operation under chloroform occurred at Edinburgh on the 15th of November, 1847. The last sentence of Sir James's letter to Dr. Bigelow, written when the grave was almost closing upon him, is full of touching pathos:—"With many of our profession in America I have the honour of being personally acquainted, and regard their friendship so very highly, that I shall not regret this attempt—my last, perhaps—at professional writing, as altogether useless on my part, if it tend to fix my name and memory duly in their love and esteem."

IN the *North American Review* for April appeared an article entitled "Darwinism in Germany," from the pen of Mr. Charles L. Brace, giving a *résumé* of the present state of biological speculation on the Continent.

MR. WILLIAM HUGHES, Professor of Geography in King's College, London, reprints "Geography in its relation to History," a lecture delivered at the Birkbeck Institution; and "Geography, what it is, and how to teach it," a paper read before the College of Preceptors.

THE *Food Journal* for May commences a somewhat minute description of Mr. Twining's Museum of Domestic and Sanitary Economy at Twickenham, one of the most interesting and really valuable collections ever brought together by private enterprise.

DURING the present year, the following medals will be awarded for the encouragement of photographic discovery:—A large silver medal, by the French Photographic Society, for the best transparent pellicle that can be devised for the transfer of *clichés*; a large gold medal, by the Vienna Photographic Society, for the best dry process; and two silver and two bronze medals for other deserving inventions. The Hamburg Society also promises medals for important discoveries.

AT the sitting of the Paris Academy of Science for May 2, the President announced the death of Professor Lamé, a member of the Institute since 1843. The deceased, a very celebrated physicist and mathematician, was born in 1795, educated at the Ecole Polytechnique, and was for some time engineer in the Russian service. On his return to France, he was appointed Professor of Physics at the above-named school, and remained in that capacity until the year 1845, when he was elected Examiner at the school. In the year 1848 he was appointed Professor in the Faculty of Sciences at Paris. Among his very many published works those on mathematics and the elasticity of bodies are the most celebrated.

ACCORDING to the *British Medical Journal*, the weight of the late Sir James Simpson's brain, including the cerebellum, was 54 ounces. While, as is well known, the ratio between intellect and size of brain is by no means close, yet there can be no doubt that it is very important. Most of our great men have had large crania. The male brain ranges chiefly between 46 and 53 ounces, its average being 49½ (Quain and Sharpey). That of Cuvier is stated to have weighed 64 ounces, and that of the late Dr. Abercrombie 63 ounces, but it is possible that some error may have crept in through the use of weights of different standards. If not, Sir James's brain, whilst much above the average, did not nearly reach those of the celebrated men we have mentioned; but at the same time, the convolutions were remarkably numerous; they were, says a correspondent, "twisting and twining round on each other as if they could not find room within the head. The island of Reil was very wonderful."

THE frontispiece to the *Photographic Art Journal* for May is the first published example of Mr. Woodbury's new patent process of photo-mechanical printing in printing-ink. It was printed in a copper-plate press from a plate produced at the establishment of MM. Goupil, at Paris. It is entitled "Orpheline," and is a copy of a drawing by Girardet, an eminent modern French artist. The other illustrations in the same journal are a photograph by Messrs. Edwards and Kidd's photo-mechanical or surface-printing process, of a drawing made at Chartres last October by Mr. A. E. Browne; and a copy by the photo-engraving process of M. H. Garnier, of Paris, of an old lithograph by the celebrated French painter Géricault.

AN interesting application of photography to legal evidence has just taken place. The Spanish Government having refused to give up the *Tornado*, an English vessel captured some time since, or to give compensation to the owners, our own Government has acquiesced in the decision, a photographic copy of the private instructions given to the captain by the owners having proved conclusively the more than doubtful character of the vessel.

THE *American Entomologist* for April appears under the new title of the *American Entomologist and Botanist*. Mr. Charles V. Riley continues the editorship of the entomological department, while the botanical section is undertaken by Mr. George Vasey, of Richview, Illinois, who has long been known in the West as a careful botanist. The paper is published at the enterprising south-western capital, St. Louis, Missouri, a town which also supports the *Grape Culturist*, a monthly journal devoted exclusively to grape culture and wine making, and the *St. Louis Journal of Agriculture*, published weekly. An epitome of its contents will be found under the head of "Scientific Serials."

AT a recent meeting of the Paris Chemical Society, M. Scheurer-Kestner read a paper on the composition of fossil and recent bones. He finds that bones which have been buried for long periods contain, besides ossein, which is insoluble in water, another organic nitrogenous substance, soluble in water, and into which he supposes ossein to be slowly changed. Running water gradually removes this soluble modified ossein, and consequently the ancient bones found in loose impervious soils contain very little organic matter, while those buried in compact clay may retain a large quantity of it. The rate of decomposition thus varies with the nature of the soil; but in the same soil M. Scheurer-Kestner believes that the relative age of different bones can to a considerable extent be determined by their chemical composition.

THE *Scientific American* states that Mr. Sherwood has invented an ingenious method for the separation of animal fibre from vegetable. The process does not alter the colour or structure of the animal fibre, and permits the use of cotton or linen separated from it for numerous purposes. It is sufficient to suspend the goods in an atmosphere of nitrogen or carbonic acid, and to cause the vapour of perfectly dry sulphuric, phosphoric, or hydrochloric acid to enter the room. These fumes disentangle the vegetable fibre, and leave intact the animal—the two fibres can thus be separated and appropriated to their respective uses.

ACCORDING to the *Chamber of Agricultural Commerce*, Belgium sent us during the year 1869 3,000 tons of meat, poultry, and rabbits; and the birds, at any rate, we might as well have fed and hatched at home. Belgium exported in the same year 34,375 tons of raw beet-root sugar. What prevents us making sugar for ourselves in the United Kingdom? Certainly not climate, for the Hon. Agar Ellis, M.P., has grown sugar-beets this year in several parts of Kilkenny county; and Dr. Völcker's analysis of the roots finds a proportion of 8·94 to 10·91 per cent. of crystallisable sugar, while a proportion of only 8·5 per cent. is said to be sufficient to remunerate the sugar manufacturer. The sugar-beets grown near Lavenham, Suffolk, in 1868 contained, according to the same analyst, from 9·62 to 12·84 per cent. of crystallisable sugar.

A PARLIAMENTARY return has just been issued showing to what extent the Act for establishing libraries and museums has been adopted. At Manchester the Public Free Library was opened on the 6th of September, 1852; the public subscription amounted to 12,823*l.*, of which 813*l.* 18*s.* was contributed by artisans and workpeople, numbering upwards of 20,000 persons employed in the various industrial establishments in the city and neighbourhood. On the question of maintaining the library, the number of votes recorded in favour of the adoption of the Act was 3,962; against its adoption, 40. The news-rooms during the evening hours are constantly crowded; from the published tables it appears that the total number of readers had increased from 39,944 in 1853 to 135,877 in 1868. Between 1863 and 1864 the numbers fell from 91,121 to 58,589, showing to how great an extent the libraries are used by the classes affected by the cotton famine. The number of borrowers, though subject to a slight fluctuation at the same period, has shown a comparatively steady increase from 2,000 in 1853 to 27,749 in 1868. The daily average of visitors in 1868 was 5,575, or upwards of 1,700,000 during the year. The total number of volumes in the library in June 1869, was 40,498 in the reference library, and 49,791 in the lending department.

THE Prussian Government appears to have definitely decided on introducing the Vautherin (iron) sleepers in the place of wood on the State railways. A contract has been recently entered into with the Saarbrück works, for the supply of 30,450 sleepers, intended for the railways from Trèves to Saarbrück, from Saarbrück to Neunkirchen, and from Neunkirchen to Bingerbrück. By this means it is thought also that the inconvenience will be avoided which has been experienced in France from the excessive destruction of the forests, and the great excess of the consumption of timber over the native production.

THE gradual destruction of fish in the rivers of Germany by the unrestricted fisheries has begun to attract serious attention, and the evil is beginning to be felt also in the coast fisheries. M. Schmarda, who has been commissioned by the Austrian Government to inspect and report on the French fisheries, estimates the quantity of fish caught on the coast between Cherbourg and Toulon at upwards of 58,000,000 kilogrammes in the year.

IT is stated that the Roman Catholics of San Francisco are building an "earthquake-proof" church. The side walls above the basement are only 30 feet high; at this height a roof rises, which, with the main roof, is supported independently of the walls, by two rows of pillars inside of them. Both roofs are firmly bound to the pillars, and the pillars are fastened together by iron cross-beams, secured with heavy iron bolts, forming a network of great strength. The theory of the plan of construction is, that should the pillars be shaken down, the roof would be launched outside the walls, thus giving a chance of escape from the ruins. In thus falling, the roof would be carried aside a distance of 80 feet, the length of the pillars.

IT can scarcely be said that any amount of water is too great for the supply of public and private wants, but as the expenses increase rapidly with the volume supplied, a limit is in practice soon reached and cannot readily be exceeded. The average amount of water consumed per diem for each person is estimated at about three-and-a-half pints, below which proportion physical suffering commences. The quantity required for washing purposes is estimated at about one gallon. A considerable quantity is also required for the consumption of animals, for watering the streets, gardens, &c., the extinction of fires, and other purposes. The following table shows the quantity supplied in different cities to each inhabitant per diem, expressed in litres (= 1·7 pints).

Rome	944	litres derived from	springs
New York	568	,, ,,	springs and rivers
Marseilles	470	,, ,,	ditto
Besancon	246	,, ,,	ditto
Dijon	240	,, ,,	Rosoir springs
Bordeaux	170	,, ,,	springs and rivers
Metz	125	,, ,,	ditto
London	95	,, ,,	rivers
Lyons	85	,, ,,	springs and rivers
Brussels	80	,, ,,	ditto
Geneva	74	,, ,,	rivers
Grenoble	65	,, ,,	springs
Paris	60	,, ,,	springs and rivers
Montpellier	60	,, ,,	springs
Havre	42	,, ,,	ditto
Liverpool	28	,, ,,	ditto

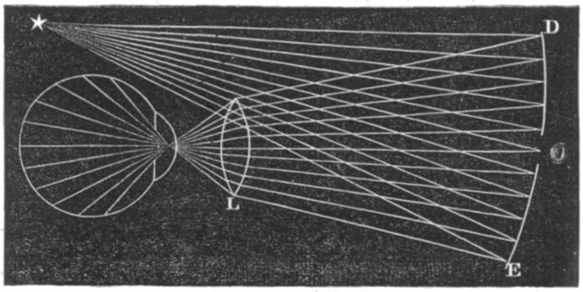
THE *Field* quotes the following from the *Toronto Globe*, illustrative of the much-disputed fact that the queen-bee can be fertilised within the hive. The observer is Mr. Malone, of Garden Island:—"I first made some small nuclei hives, and inserted three frames in each (with brood and comb in them), and placed a queen cell in each in such a manner that by turning a button I could see the cell. As soon as the queen was hatched I caught her and placed her in a cage 6in. square by 8in. long, two sides of the cage being wood, the rest wire, and placed a good number of worker bees in with her, and put the cage on the top of the frames in a hive containing a good swarm of bees, having first removed their queen. When the queen was five days old, that is, on the fifth day, I took out all the worker bees from the cage, and placed seven nice large drones in with the queen. I left the queen and drones together forty-eight hours in the cage, having placed them back again on top of the frames, and replaced the cover and plugged up the ventilators which are in the sides of the cover, to keep out the light. Of course I put some honey in the cage, out of the reach of the bees below in the hive, to keep the queen and drones from starving. Each time on examination, I found (with one exception) a dead drone, having all the end of his abdomen burst open, and twice I noticed evidences of impregnation. To make myself doubly sure that they were fertilised by this method, I introduced the queens into new swarms, and closed the opening so that nothing but a worker bee could go in and out, and all the queens (with one exception, as mentioned above) in a few days commenced laying, and reared nicely-marked Italian workers."

THE REV. E. O'MEARA, A.M., is preparing a catalogue of Irish Diatomaceæ. This catalogue will appear in the form of a report to the Royal Irish Academy, and will, we presume, be published in its Transactions. A synonymy of all the species will be given, and figures of all the new species, or of species the figures of which are not easily accessible. This catalogue, which will be the result of many years' labour, will, we believe, form a worthy supplement to "Smith's British Diatomaceæ."

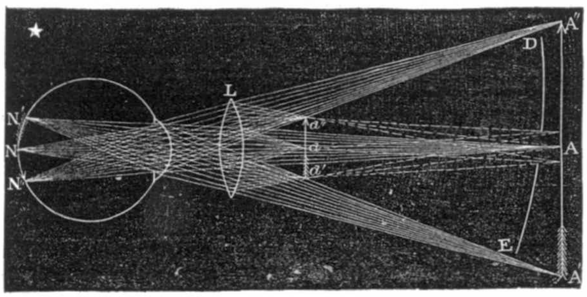
COMPLAINTS have appeared in some of the Dublin papers that the library of the Royal Dublin Society was closed for a week during the Dublin Cattle Show. It is also rumoured that a complaint of the same kind was forwarded to the authorities at Kensington. When it is recollected that this is, perhaps, the only equally large library in Europe that is open to the public from 10 A.M. to 10 P.M. throughout the year, it will be seen that the public have little real cause of complaint in its being closed for eight or ten days in the twelve months.

A NEW FORM OF OPHTHALMOSCOPE

THE principal steps that have been made during the last twenty years in the knowledge of the healthy and of the diseased conditions of the eye have been effected by the employment of the ophthalmoscope, an instrument so simple, and yet so valuable, that, like other discoveries, it is only remarkable that the knowledge of the facts on which its construction depends should have so long remained unfruitful. Under all ordinary circumstances, when we look into the pupil of the eye of another person, however widely dilated it may be, it appears of an intense black hue, because the degree of illumination is insufficient to render parts so deeply seated visible, the principal portion of the light being intercepted by the head of the observer. An exceptional instance, however, is sufficiently familiar to every one, in which a brilliant reflection may be observed to occur from the back of the eye. It is that of an animal crouching in the corner of a cellar, whilst the observer is standing at the door, or looking towards a window, to which the back of the observer is turned. The principle on which the ophthalmoscope is founded is identical with this, the eye under observation being illuminated by a pencil of light proceeding, as it were, from the eye of the observer. This is accomplished by placing a steady source of light at the side of or above and somewhat behind the head of the person under observation, whilst the observer reflects its rays into the eye of the subject by means of a plane or concave mirror, the centre of which is perforated by a small opening through which he looks. The back, or fundus of the globe, then comes into view, presenting a red, or greyish red glare, the illumination being greatly increased by the use of a lens at L, as shown in the accompanying little



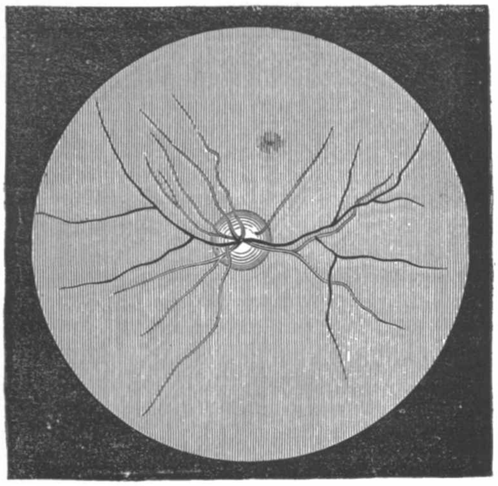
woodcut, from the recent work of Dr. Williams of Boston, where the rays of light emanating from the star are reflected from the concave mirror DE, and rendered convergent by the lens L, lighting up the whole of the posterior surface of the globe; some of the rays returning from this pass through the opening in the mirror, and are seen by the observer at O. The precise mode in which the image is formed is shown in the following cut, borrowed



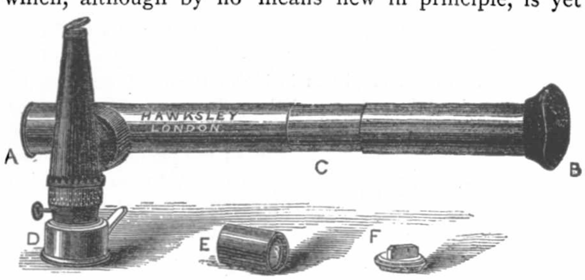
from the same work. The rays returning from N, N′ N″ representing a portion of illuminated fundus, are brought to a focus by the convex lens L, at A, A′ A″, and then form, the inverted aërial image of the fundus, which is seen by the observer.

The image which comes into view under these circumstances, especially if, as is usual, the pupil be dilated by the employment of a little belladonna or solution of atropine, is represented in the following woodcut, which we have carefully drawn from a child of twelve years of age. The reader must imagine the general surface to be of an orange vermilion, or scarlet vermilion tint, though in the negro it is of a very dark vermilion; the colour being produced by the reflection of the light from the capillary blood-vessels of the choroid.

In the centre is a yellowish white spot, which is the optic disc, or point of entrance of the optic nerve. This is perforated by the branches of the central artery and veins of the retina, the lighter double lines representing the arteries and the darker the veins. Above and a little to the right is a spot which is the true centre, and at the same time the most sensitive part of the eye; from its colour it is sometimes called the macula lutea, or from its being



slightly depressed below the surface it is termed the fovea centralis. The changes which the optic disc, the blood-vessels, and the retina undergo in disease can of course be readily followed, and may thus enable a positive opinion to be pronounced on cases which were formerly incapable of being distinguished even by the most acute observer. Nay, it has recently been suggested by M. Poncet to employ it as one of the most reliable means of ascertaining that *death* has really taken place. A great variety of forms of the instrument have been suggested, but the ordinary hand ophthalmoscope has proved the most convenient in practice, requiring only that the room should be darkened, and that there should be some steady source of light. Dr. Beale, however, has lately suggested a form of self-illuminating ophthalmoscope, which, although by no means new in principle, is yet



convenient in application, doing away with the necessity of a dark room, and furnishing a very steady and good light. It is represented in the preceding figure, and consists of a tube, A B C, of which the extremity B is closely applied to the eye to be examined, thus shutting out all extraneous light. D is a paraffin lamp which can be easily connected or removed, the rays falling on a perforated mirror, and being reflected towards B, a convex lens being interposed near C, which can be approximated to or made to recede from the eye by the movement of the draw-tube B.

We have tried the instrument in a number of cases, and have found that while it enables a very good view of the fundus to be obtained with facility, it has the drawbacks of smelling disagreeably and also of becoming rather unpleasantly hot, from the proximity of the lamp to the eye of the observer—an inconvenience that might be remedied by placing the lateral tube at a greater distance from the end A.

H. POWER

SCIENTIFIC SERIALS

THE PROGRESS OF CHEMISTRY (*Jahresbericht über die Fortschritte der Chemie und verwandter Theile anderer Wissenschaften.*) Unter Mitwirkung von Th. Engelbach, Al. Naumann, W. Städel; herausgegeben von Adolph Strecker. Für 1868. Erstes Heft. Ausgegeben am 15 Februar, 1870. Giessen J. Ricker'sche Buchhandlung. 1870.

Of the 480 pages of this part, 133 are occupied by general and physical, and 155 by inorganic chemistry, the remainder being devoted to organic chemistry.

In the first section we find an account of the method devised by Hofmann for determining the vapour densities of solids and liquids in a Torricellian vacuum, and which promises such valuable results in many cases. Tomlinson's observations on the properties of chemically clean surfaces are here noticed; and also Guthrie's experiments on the conduction of heat by liquids. A long abstract of Becquerel's papers on electro-capillary action opens the section on electro-chemical investigations, and in the division on optical chemistry Tyndall's researches on the chemical action of light find a place. Two of the channels into which much chemical thought has been directed during [the last few years are clearly indicated by the notices of numerous papers on dissociation and spectrum analysis.

In the section on inorganic chemistry we have some additional experiments in support of Frankland's theory of the cause of the light emitted by luminous flames; the combustion of hydrogen and carbonic oxide in oxygen under a pressure of ten atmospheres, and the burning of heated phosphorus vapour in hot chlorine being mentioned. Graham's researches on the occlusion of hydrogen by metals, and on the curious combination which this element forms with palladium are noticed at considerable length. The next paper to which we shall direct attention is one which at present stands amongst those on inorganic chemistry, but the compounds herein described bid fair shortly to occupy a section by themselves in a position intermediate between mineral and organic bodies; we refer to the researches of Friedel and Ladenburg on silicic oxychloride, and silicium iodoform; the study of compounds having the same constitution as well-known organic bodies, but in which silicon plays the part of carbon, promises to enable us, ultimately, to explain the constitution of that very extensive class of complex bodies containing silicon, which are found so abundantly in nature. We have a long notice of Meyer's investigations of indium and its compounds, and one on Mills's researches on the ammoniacal cobalt compounds.

Among the papers on organic chemistry, we have that of Troost and Hauteufeille, on the decomposition of mercuric cyanide at different temperatures and pressures; and the very important one by Berthelot on the synthesis of hydrocyanic acid, which he obtained by the passage of electric sparks through a mixture of acetylene and free nitrogen. A considerable space is devoted to the researches of Jungfleisch on the chlorine derivatives of benzol, and to Oppenheim's investigations of the isomeric compounds of allyl and propylene. Berthelot's valuable researches on the hydrocarbons are continued, his observations on styrol and its compounds being given. The foundation of one of the most interesting and valuable discoveries of the last few years is contained in this volume, viz., the conversion of alizarin into anthracene by its distillation from powdered zinc. Since this paper was published, its authors, Messrs. Graebe and Liebermann, have succeeded (as our readers well know) in effecting the inverse transformation, and thus producing the colouring principle of madder from one of the products of the destructive distillation of coal. We also find here the discovery of the first acetylene of the aromatic series, by Glaser in acetenylbenzol or phenylacetylene. Linnemann's preparation of normal propylalcohol and the synthesis of butylalcohol by Lieben, are noticed, as are the researches of Stenhouse on tetra- and tri-chlorochinon.

All students of chemistry will heartily welcome the appearance of the Jahresbericht, though the usefulness of the first part is much impaired for want of the index. It is very much to be regretted that this very valuable book does not appear at an earlier date; in this case the first part of the report has been published thirteen months and a half after the expiration of the year to which it refers. It must be allowed that the labour required for such a work is very arduous, but it would be a great convenience to chemists if it were possible to expedite its publication. It is reported that the Council of the Chemical Society of London intends to issue fortnightly, or monthly, short abstracts of all papers on chemistry and the allied sciences published in England and abroad. These abstracts will be made by competent chemists, and will be printed as soon as possible after the appearance of the original memoirs. Such a collection of abstracts would be invaluable to many who, in consequence of their living away from London, or owing to other circumstances, have no opportunity of reading the periodicals: it would also be extremely useful to many who, though within reach of journals, have not the time to devote to the perusal of the very numerous papers published at the present time. All chemists, and many others taking a general interest in science, must wish every success to the efforts of the Council of the Chemical Society, though it is to be feared that such a journal would scarcely, at present at least, prove a commercial success.

THE *Revue des Cours Scientifiques* for May 7 contains M. Blanchard's lecture before the *Réunion des Sociétés Savantes*, at the Sorbonne, on Scientific Work in the Departments; the continuation of Bernard's lecture on Suffocation by Charcoal fumes; and the conclusion of M. Bouley's on Madness. In the number for May 14 we find M. Kuhne's lecture on the Science of Life, delivered on the occasion of the inauguration of the Physiological Laboratory at the University of Amsterdam; a paper by M. E. Fournier on the Ergot of Rye, being the first of a series on the parasites of cereals; and a continuation of M. Bernard's paper.

THE *American Entomologist and Botanist* for April contains several good articles. A paper entitled "Wheat-rust and barberry rust" (placed singularly in the entomological department), defends the accuracy of the statement well known to European botanists, but which appears to have been attacked in America, that the neighbourhood of barberry trees is a prolific cause of rust in wheat; the fungus which causes the latter disease, *Puccinia graminis*, and the fungus which produces the bright yellow spots on the leaves of the barberry, *Œcidium berberidis*, being, in fact, different conditions of the same plant. An article entitled "Scientific Language," justly rebukes the tendency to use long latinised words where plain English words would do just as well, and especially the coining of barbarous compound terms, derived from two or three different languages. There are also several good descriptive papers, both entomological and botanical, specially interesting to American naturalists and collectors.

SOCIETIES AND ACADEMIES

LONDON

Entomological Society, May 2.—Mr. A. R. Wallace, president, in the chair. Mr. Hewitson exhibited a collection of new and rare butterflies, from Tropical America.—Mr. Frederick Smith exhibited a collection of *Hymenoptera*, from Japan.—Mr. McLachlan exhibited some exotic dragon-flies.—Mr. Bates exhibited several new exotic *Copridæ*.—Mr. G. R. Crotch sent for exhibition British specimens of *Trachyphlœus laticollis*, a beetle not previously recorded as indigenous to this country.—Papers were read, on Equatorial *Lepidoptera*, by Mr. Hewitson; on some new *Neuroptera Odonata*, by Mr. McLachlan; on new *Copridæ*, by Mr. Bates; and on Australian *Curculionidæ*, by

Mr. Pascoe.—"A Catalogue of British Neuroptera," compiled for the society by Mr. McLachlan, and published by the society, was on the table.

Ethnological Society, May 10.—Special meeting held at the Museum of Practical Geology, by permission of Sir R. I. Murchison, Bart. Prof. Huxley, LL.D., F.R.S., in the chair. Dr. O'Callaghan was announced as a new member.—Col. Lane Fox read a letter from Lieut. Oliver, R.A., relative to the destruction of the fine menhir of Le Quesnel, in Jersey, described in the last number of the Society's Journal.—Sir J. Lubbock, Bart., and Mr. J. S. Mackie made remarks on the importance of the labours of the society in obtaining reports on the present condition of our megalithic monuments.—Prof. Huxley then delivered an address on the Ethnology of Britain. He showed that the early accounts of the inhabitants of these islands, such as that given by Tacitus, prove the existence of two types of people physically distinct—the one being tall, fair, yellow-haired, and blue-eyed, whilst the other was short and dark, with dark hair and black eyes. This dark type, as exemplified in the ancient Silures, closely resembled the people of Aquitania and Iberia, whilst the fair type of south-east Britain was physically related to the Belgæ of north-east France and what is now Belgium; and these again resembled the old Germani, who dwelt on the east bank of the Rhine. In this country both the fair and the dark people spoke Celtic—probably Cymric in Britain and Gaelic in Ireland. But on the Continent the dark type spoke a Euskarian or Basque tongue, while the ancient Gauls spoke Celtic and the Germani Teutonic. The Celtic and Teutonic languages both belong to the Aryan family, but the Euskarian appears to have no affinity to any other Eur-asiatic language. None of the invasions to which Britain has been subjected has introduced any new race-element. It is doubtful whether the Romans strengthened the fair or the dark type of the pre-existing population, but it is certain that the invasion of the Low Dutch from the shores of North Germany bordering on the Baltic and the North Sea strengthened the fair element, as also did the incursions of the Danes. The effect of the Norman conquest would be shown by Dr. Nicholas.—The Rev. Dr. Nicholas then read a paper "On the Influence of the Norman Conquest on the Ethnology of Britain." He first inquired what race-elements were present in Britain prior to the Conquest, and concluded that the blood preponderated considerably in favour of the ancient British race—a race which he did not hold to be purely Celtic. He then sought to determine what were the elements in William the Bastard's so-called "Norman" army, and showed that they were mainly Gaelic and Cymric. Hence the conclusion that the effect of this conquest was in the gross greatly gainful to the old British or Gallo-Celtic population.

MANCHESTER

Literary and Philosophical Society, March 22.—The following extract of a letter, dated March 21, 1870, from Sir William Thomson, D.C.L., F.R.S., hon. member of the Society, was read:—

"I have now at last got into good working order measurements of electrostatic capacity (which, perhaps, you may remember I was working on the first time you ever came to see me, and more or less almost ever since). I have two students of last year, junior assistants in my laboratory, measuring electrostatic capacities of condensers, and variations of specific inductive capacities of resistance, with sensibility of $\frac{1}{10}$ per cent., and with constancy in spite of accidental variations, generally within $\frac{1}{4}$ or $\frac{1}{8}$ per cent. My occupation on the Kinetic theory of gases has led me at last to come to definite terms as to the size of molecules. Ever since about the first year of my professorship I have taught my students that Cauchy's theory of Dispersion proves heterogeneousness, or molecular structure, to become sensible in contiguous portions of glass or water, of dimensions moderately small in comparison with the wave-lengths of ordinary light. I have spoken to you also, I think, of the argument deducible from the contact electricity of metals. This, I now find, proves a limit to the dimensions of the molecules in metals quite corresponding to that established for transparent solids and liquids by the dynamics of dispersion. In experiments made about ten years ago, of which a slight sketch is published in the Proceedings of the Literary and Philosophical Society of Manchester, I found that a plate of zinc and a plate of copper kept in metallic connection with one another (by a fine wire or otherwise) act electrically upon electrified bodies in their neighbourhood, and upon one another, as they would if they were of the same metal and kept at a difference of potentials equal to about three-quarters of that produced by a single cell of Daniell's. Hence, and from my measurement of the electrostatic effects of a Daniell's battery, published in the Proceedings of the Royal Society, for February and April, 1860, I find that plates of zinc and copper held parallel to one another at any distance, D, apart which is a small fraction of the linear dimensions of their opposed surfaces, and kept in metallic communication with one another, exercise a mutual attraction equal to

$$2 \times 10^{-10} \times \frac{A}{D^2} \text{ grammes weight.}$$

Hence, if they were allowed to approach from any greater distance, D', to the distance D, the work done by their mutual attraction is

$$2 \times 10^{-10} \times \frac{A(D'-D)}{D'D} \text{centimetre grammes;}$$

which, if D is very small in comparison with D', is very approximately equal to

$$2 \times 10^{-10} \times \frac{A}{D}$$

Now suppose a pile to be made of a great number (N + 1) of very thin plates alternately of zinc and copper, kept in metallic connection while they are brought towards one another. Let their positions in the pile be parallel, with narrow spaces intervening. For simplicity let the thickness of each metal plate and intervening space be D. The whole work done will be

$$2 \times 10^{-10} \times N\frac{A}{D}$$

The whole mass of the pile (if we neglect that of one of the end plates) is

$$NAD\rho,$$

where ρ denotes the mean of the densities of zinc and copper. Hence, if h be the height to which the whole mass must be raised against a constant force equal to its weight at the earth's surface, to do the same amount of work, we have

$$NAD\rho h = 2 \times 10^{-10} \times N\frac{A}{D}$$

which gives

$$h = \frac{2 \times 10^{-10}}{\rho D}$$

or, as $\rho = 8$, nearly enough for the present rough estimate,

$$h = \frac{1}{(200000D)^2},$$

Hence, if

$$D = \frac{1}{200000} \text{ centimetre,}$$
$$h = 1 \text{ centimetre.}$$

The amount of energy thus calculated is not so great as to afford any argument against the conclusion which general knowledge of divisibility, electric conductivity, and other properties of matter indicates as probable: that, down to thicknesses of $\frac{1}{200000}$ of a centimetre for the metal plates and intervening spaces, the contact electrification, and the attraction due to it, follow with but little if any sensible deviation the laws proved by experiment for plates of measurable thickness with measurable intervals between them. But let D be a two-hundred-millionth of a centimetre. If the preceding formulæ were applicable to plates and spaces of this degree of thinness we should have

$$h = 1{,}000{,}000 \text{ centimetres or 10 kilometres.}$$

The thermal equivalent of the work thus represented is about 248 times the quantity of heat required to warm the whole mass (composed of equal masses of zinc and copper) by 1° Cent. This is probably much more than the whole heat of combination of equal masses of zinc and copper melted together. For it is not probable that the compound metal when dissolved in an acid would show anything approaching to so great a deficiency in the heat evolved below that evolved when the metallic constituents are separately dissolved, and their solutions mixed; but the experiment should be made. Without any such experiment, however, we may safely say that the fourfold amount of energy indicated by the preceding formula, for a value of D yet twice as small, is very much greater than any estimate which our present knowledge allows us to accept for the heat of combination of zinc and copper. For something much less than the thermal equivalent of that amount of energy would melt the zinc and copper; and, therefore, if in combining they generated by their mutual attraction any such amount of energy, a mixture of zinc and copper filings would rush into combination (as the ingredients of gunpowder do) on being heated enough in any small part of the whole mass to melt together there. Hence we may infer that the electric attraction between metallically-connected plates of zinc and copper of only $\frac{1}{400000000}$ of a centimetre thickness, at a distance of only $\frac{1}{400000000}$ of a centimetre asunder, must be greatly less than that calculated from the magnitude of the force and the law of its variation observed for places of measurable thickness, at measurable distances asunder. In other words, plates of zinc and copper so thin as a four-hundred-millionth of a centimetre from one another, form a mixture closely approaching to a molecular combination, if, indeed, plates so thin could be made without splitting atoms. Wishing to avoid complication, I have avoided hitherto noticing one important question as to the energy concerned in the electric attraction of metallically connected plates of zinc and copper. Is there not a change of temperature in molecularly thin strata of the two metals adjoining to the opposed surfaces, when they are allowed to approach one another, analogous to the heat produced by the condensation of a gas, the changes of temperature produced by the application of stresses to elastic solids which you have investigated experimentally, and the cooling effect I have proved to be produced by drawing out a liquid film which I shall have to notice particularly below? Easy enough experiments on the contact electricity of metals will answer this question. If the contact-difference diminishes as the temperature is raised, it will follow from the Second Law of Thermodynamics, by reasoning precisely corresponding with that which I applied to the liquid film in my letters to you of February 2nd and February 3rd, 1858,* that plates of the two metals kept in metallic communication and allowed to approach one another will experience an elevation of temperature. But if the contact difference increases with temperature, the effect of mutual approach will be a lowering of temperature. On the former supposition, the diminution of intrinsic energy in quantities of zinc and copper, consequent on mutual approach with temperature kept constant, will be greater, and on the latter supposition less, than I have estimated above. Till the requisite experiments are made, further speculation on this subject is profitless: but whatever be the result, it cannot invalidate the conclusion that a stratum of $\frac{1}{200000000}$ of a centimetre thick cannot contain in its thickness many, if so much as one, molecular constituent of the mass. Besides the two reasons for limiting the smallness of atoms or molecules which I have now stated, two others are afforded by the theory of capillary attraction, and Clausius' and Maxwell's magnificent working out of the Kinetic Theory of gases. In my letters to you already referred to, I showed that the dynamic value of the heat required to prevent a bubble from cooling when stretched is rather more than half the work spent in stretching it. Hence, if we calculate the work required to stretch it to any stated extent, and multiply the result by $\frac{3}{2}$, we have an estimate, near enough for my present purpose, of the augmentation of energy experienced by a liquid film when stretched and kept at a constant temperature. Taking ·08 of a gramme weight per centimetre of breadth as the capillary tension of a surface of water, and therefore ·16 as that of a water bubble, I calculate (as you may verify easily) that a quantity of water extended to a thinness of $\frac{1}{200000000}$ of a centimetre would, if its tension remained constant, have more energy than the same mass of water in ordinary condition by about 1,100 times as much as suffices to warm it by 1° Cent. This is more than enough (as Maxwell suggested to me) to drive the liquid into vapour. Hence if a film of $\frac{1}{200000000}$ of a centimetre thick can exist as liquid at all, it is *perfectly certain* that there cannot be many molecules in its thickness. The argument from the Kinetic Theory of gases leads me to quite a similar conclusion.

April 19.—Annual meeting, Dr. J. P. Joule, F.R.S., President, in the chair. The report of the council having been read, the following gentlemen were elected officers of the society for the ensuing year:—President: E. W. Binney, F.R.S., F.G.S.; Vice-presidents: Dr. J. Prescott Joule, F.R.S., Dr. E. Schunk, F.R.S., Dr. R. Angus Smith, F.R.S., Rev. W. Gaskell, M.A.; Secretaries: Dr. H. E. Roscoe, F.R.S., &c., J. Baxendell, F.R.A.S.; Treasurer: T. Carrick; Librarian: C. Bailey. Of the Council: P. Spence, F.C.S., G. Venables Vernon, F.R.A.S., J. B. Dancer, F.R.A.S., W. Leeson Dickinson, H. Wilde, R. Dukinfield Darbishire, F.G.S. A paper on "Infant Mortality in Manchester" was read by Mr. J. Baxendell, F.R.A.S., who combated the assertion that the high death-rate of Manchester and other towns in the cotton manufacturing districts is due to the mortality among infants and young children being relatively much greater than in large towns in other parts of the country, a careful examination of the mortality returns showing that a much larger proportional number of deaths of infants and young children takes place in other towns, where the general death-rate is decidedly lower.

* Proceedings of the Royal Society for April, 1858.

CAMBRIDGE

Cambridge Philosophical Society, May 2.—Clement Higgins, B.A., Downing College, was elected a fellow. Communications:—By Professor Miller, F.R.S.: "On the best form for the ends of measures *à bouts*." The author found that the best form was that of two 'knife edges,' whose edges were in planes perpendicular to each other, and were not straight lines, but arcs of circles, whose centre was the opposite end of the axis of the bar. With this form the error (l being length of bar, and e distance between real and assumed position of the point where the axis intersects the bounding surface) $= \frac{e^4}{4l^3}$ while in the forms commonly used it was either $\frac{e^2}{l}$ or $\frac{2e^2}{l}$

By Mr. Bonney (St. John's College): Note on supposed Mollusc Borings in the limestone of Derbyshire. The author first described a large number of burrows which he had examined in the hills above Matlock; these were generally directed upwards, and too irregular in form to be *Pholas* burrows, as had been asserted; he then described some burrows observed in a scarp of limestone about nine feet above the stream in Miller's Dale, by the road-side. He believed this scarp to be artificial; but whether so or not, the gorge was most distinctly one of fluviatile erosion, and he maintained that this case was fatal to the *Pholas* theory. He considered the burrows to be the work of *Helices*.

BRIGHTON

Brighton and Sussex Natural History Society, April 14.—Mr. Glaisher, Vice-president, in the chair. A communication from Mr. Gwyn Jeffreys respecting the Sars testimonial, was read by the Hon. Sec., after which a subscription was made among the members present, the Society not having power to vote its own funds for such a purpose. Mr. T. H. Hannah, the President, read a report on "Soundings made by Sir (Captain) E. Parry in 1818." These soundings were purchased some years since among the geological specimens of Sir E. Parry, from his widow, by Mr. J. Cordy Burrows, of Brighton, who deposited the geological specimens in the Brighton Museum, and gave the soundings to Mr. Peto. The discoveries of last year giving a prominence to sea-soundings, they were placed in January in Mr. Hannah's hands to examine microscopically, and report on their contents to the society. The soundings were made in Davis's Straits, and Lancaster Sound between 68° and 71° 15′ N. lat. and 73° and 78° 34′ W. long. at depths between 22 fathoms and 1,058 fathoms. Those under 58 fathoms contained nothing but stones and corals, some of the stones had evidently been rubbed by the action of a strong current; those from 201 fathoms were much less disturbed and consisted chiefly of a sandy material; from 674 fathoms there was an almost absence of inorganic débris, showing the non-existence of currents, and plenty of the testa of arenaceous foraminiferæ. In all the deep ones diatomaceæ were very beautiful, as well as sponge spicules and arenaceous foraminiferæ; but polycystinæ and cretaceous foraminiferæ were but sparsely found. He had also met with casts similar to those found in the greensand, and some highly organised spicules which he had not yet identified. At one of the microscopical meetings the slides would be exhibited. He much regretted they were not examined earlier, as they would then have preceded the discoveries of Carpenter and others, who, by the deep-sea soundings recently made, had opened out new ideas of life at great depths. Reference was then made to what had been done by Carpenter, Jeffreys, Thomson, and others in adding to our knowledge of the conditions of existence in deep sea; the nature of the animals and their economy together with the chemical conditions at great depths were also touched on, and the fact pointed out that changes of fauna depended not on latitude, but on the variations in the bottom temperature.—Mr. Wonfor, hon. sec., announced that the "Moss Flora of Sussex" was ready for distribution among the members, and that duplicate copies could be had at a nominal price, by applying to him, at 38, Buckingham-place, Brighton.

DUBLIN

Natural History Society of Dublin, May 4.—W. Andrews, Chairman of the Natural History Committee of the Royal Dublin Society, in the chair. The Chairman read a paper entitled "Ichthyological Notes." There are no subjects fraught with greater interest than discoveries which arise from a practical knowledge of any branch of science, whether it relates to botany, geology, or to any of the orders or genera of zoological investigations. When we contemplate the vast scope of the branches of the natural sciences, we cannot fail to meet most perplexing difficulties in the determining of correct classification, the opportunity of practical investigation not being afforded, for without that most essential aid, no certainty can possibly be arrived at, especially true characteristics depending upon habit, geographical range, seasons, depths, and peculiarities of soundings, and those natural causes which influence forms and changes of animal and vegetable life. The subject of the paper this evening relates to deep-water species, the present observations being with reference to notes on some fish occurring on the south-west coast of Ireland, in Dingle Bay, and off the coast of Kerry. Some most interesting crustaceans and species of rare fish have been met with, which are confined to peculiar soundings in deep water; yet I may say that at a depth beyond eighty fathoms much of interest as to variety of forms ceases, and the dredge in soundings of 100 fathoms, and beyond that depth, rarely brings up anything but remains belonging to shallower soundings, or those forms of Foraminifera Globigerina, which require microscopic manipulation in the determining of their numerous forms. It is singular, however, from what extreme depths minute crustacea, echinoderms, sponges, and corals are brought up; therefore I may say that when we proceed further than a depth of eighty fathoms, the interest, so far as the ichthyologist is concerned, closes. The object of this paper is to bring to notice a most interesting species of the Clupæidæ, the true anchovy (*Engraulis encrasicholis*) the first placed on record as captured on the shores of Ireland. I had heard of a species of small herring that had been taken in the herring nets, of a peculiar silvery brightness. I was delighted to obtain a specimen last autumn off Ventry Harbour, being another among the many interesting additions that have been made on that part of the coast of fish peculiar to the Mediterranean. The specimen exhibited is of full size, being in length six inches, thicker in proportion than the herring, no serrations on the abdomen, and the sides and belly being of the most silvery brightness, with no apparent scales. The back was a dark bluish green; the mouth with a remarkably wide gape; teeth exceedingly minute in the maxillary; none in the lower jaw; snout much projecting. At first examination I thought it might be a species of melletts, as it did not bear sufficient resemblance to several of the figures of the anchovy in works on ichthyology.—Dr. Foot then read a paper on the breeding of the Cereopsis Geese and Emus, in the Zoological Gardens, Dublin, and also laid before the meeting a paper on "Animal Luminosity," after which the meeting adjourned.

Royal Irish Academy, Monday, May 9.—Rev. Professor Jellett, B.D., president, in the chair. Dr. Stokes, V.P., F.R.S., read a paper on putrefaction occurring in some closed cavities, without the admission of air, and on the germ theory of Professors Lister and Tyndall.

Royal Geological Society, Wednesday, May 11.—Mr. G. Sanders, in the chair. Rev. Professor Haughton, M.D., read a paper on the probable geological effects of the permanent opening of the Suez and Darien Canals. The author regarded the Suez Canal as an interference with nature. He gave a graphic description of the two oceans, the Atlantic and Indian, with their two great offshoots, the Mediterranean and the Red Sea—seas with not a very limited rainfall area, and subject to immense evaporation; in fact, having all the circumstances in their favour to make them the seat of strong currents, the natural tendency of the meeting of which is to build up that vast sand or mud bar, the Isthmus of Suez. The new canal he regarded as a scratch of a spade by the hand of a child across the bar of two oceans, and the re-formation of that bar he regarded as certain—it would probably be re-formed beyond Port Said. He thought the Darien Canal would have a totally different success. The idea of forming this canal originated with Dr. Cullen, of Dublin. Nature, in scooping out the great gulf in which the West Indian islands lie, showed her determination to break through the Isthmus somewhere, and the great South Atlantic current would keep any canal open that was cut. The Americans thought that they would lower the temperature of Europe by removing so much of the Gulf Stream from us. But if their canal was one mile wide and 100 feet deep, they would take from us but $\frac{1}{1000}$ part of the heat we already possessed; and to make up this deficiency would cost the inhabitants of Dublin not more than 2*s*. 4*d*. for additional fuel to each family—a sum they might well lose for the good of the whole race. The palæontological effects would not be of much interest in the case of either canals: a few Red Sea cockles might wander into the Mediterranean, and even this would not occur in the Darien Canal, as the same species of fish and molluscs were found on both sides of the Isthmus of Panama; and man must not forget that he has no power over nature.—The Rev. Maxwell Close read a paper "On some Corries, and their Rock Basins, in Co. Kerry."

Institution of Civil Engineers of Ireland, May 11.—John Bailey, C.E., in the chair. Mr. Alex. McDonald read a paper, "Notice of Le Chatelier's Counter-pressure Steam System." Professor Downing, LL.D., read "Notes on the Transport of Minerals by wire ropes." The author suggested the use of stationary wire rope, the mineral boxes to be pulled up by a common hempen rope, and to slide up the wire rope.

EDINBURGH

Royal Physical Society, April 27.—R. F. Logan, president, in the chair. Thomas Edmonston of Buness, Shetland, was elected a member of the society; and the Rev. Samuel Fraser, Melbourne, Australia, a corresponding member. The following communications were read to the meeting:—I. Our Pets in Unst, Shetland, by Thomas Edmonston of Buness, F.R.S.L. A vote of thanks was given to Mr. Edmonston for his interesting communication, notice being taken by Mr. Scott Skirving of the fact that the thanks of all naturalists were due to him as the preserver, on his estate in Shetland, of one of the few breeding places still remaining in Britain of the Great Skua Gull. II. Australian Entomology.—Notices of the Tarantula (Spider) and Hornet, by A. F. Grieve, Brisbane, Queensland. Communicated by D. Grieve. The President (Mr. Logan) said the insect called a hornet by Mr. Grieve was a species of *Pelopæus*, belonging to the family *Sphegidæ*; it was probably *P. lactus*. The habit of this genus is to store up spiders in mud cells, but surely it could not do this with the immense *sleygale*, which Mr. Grieve had also described. III. (1.) On the Skull of the Ringed Seal (*Pagomys fœtidus*, Gray), with special remarks on the osteological characters of the lower jaw. By James M'Bain, M.D., R.N. (2.) Notice of Clay Nodules, found at a depth of 292 feet in boring for an Artesian Well at Umballah, in India. By Thomas Login, C.E., F.R.S.E. Communicated by James M'Bain, M.D., R.N. IV. (1.) Note of a saline incrustation sold by the natives at Old Calabar, Africa. (Specimens sent to Dr. Smith by the Rev. Dr. Robb were exhibited.) (2.) Ornithological notes. (Specimens exhibited.) (3.) Notice of the capture of the Spiny Lobster (*Palinurus vulgaris*) on the west coast of Scotland. (Specimen exhibited.) (4.) Note of the capture of the *Seymnus borealis*, the Greenland shark, in the Frith of Forth. By John Alexander Smith, M.D. V. Notes of various species of *Crustacea* from Shetland, Caithness, &c. By C. W. Peach. (Specimens exhibited.)

Botanical Society, April 14.—Sir Walter Elliot, president, in the chair. The following communications were read:—On the Flowering and Fruiting of *Aucuba Japónica*, by Mr. P. S. Robertson. The author had observed that recently-introduced female plants from Japan (grown in a cold pit) came into flower in January and February, while the male plants, grown in the same circumstances, never came into flower till the middle of March. Yet he had every year obtained a crop of young seedlings from the berries, although the female flowers were quite shrivelled before the male ones expanded. He found that the common spotted variety, long grown in this country, does not flower till May or June, although grown in the pit or house with the others, and begins to expand its flowers when the males are getting past; yet it also never fails to produce a crop of fruit with perfect seeds. He thought that the pollen must lodge for some time in the scales of the unopened flower-buds, or must reach the pistils before the flowers are expanded; but how to account for the fertilising of the early flowering varieties, he was at a loss. This year he has forced on the flowering of the male plants by placing them in strong heat, and has all the varieties of the male and female plants in full flower at very nearly the same time, and accordingly he anticipates a much larger produce of berries than in former years, when they were left to the ordinary course. He exhibited a branch bearing berries with perfect seed; yet when that plant came into flower, there had not been a male plant in the house where it grew for fully a month previously. Mr. Sadler stated that he had been informed by the Messrs. Lawson that when there was a great lapse of time between the flowering of male and female Aucuba plants, they frequently collected the pollen and kept it wrapped in paper until such time as the female flowers were ready for fertilisation, when it was applied to the stigmas, and thus secured invariably a crop of fruit with perfect seeds. . By grafting the male plant on the female, the two kinds of flowers might expand nearly at the same time.—"Remarks on *Grimmia pruinosa* (Wilson's MSS.)." By Mr. William Bell. — "Remarks on *Bœhmeria nivea* (*Urtica nivea* of Linnæus)." By Mr. Sadler.—"Memorandum on Ipecacuanha." By Mr. Clements R. Markham.—"Report on the Open-air Vegetation at the Royal Botanic Garden." By Mr. M'Nab.—"Remarks on the Embryos of the White Water-Lily (*Nymphæa alba*), and the Date Palm (*Phœnix dactylifera*)." By Professor Dickson.

Paris

Academy of Sciences, May 9.—The following mathematical papers were read:—"Some results obtained by the infinitely small displacement of an algebraical surface," by M. A. Mannheim, presented by M. Chasles; "On the division of hyperelliptical functions," by M. C. Jordan; and "On the existence of new classes, each containing an unlimited number of plane algebraical curves, the arcs of which present an exact representation of the elliptical functions of the first kind," by M. Allibert.—MM. Croullebois presented a reply to the remarks of M. Jamin, on the index of refraction of water.—A note, by M. G. Guéroult, on harmonic and melodic intervals, was presented by M. H. Sainte-Claire Deville.—A memoir, by M. C. A. Valson, on molecular actions, based on the theory of capillary action, was also presented by M. H. Sainte-Claire Deville.—M. C. Sainte-Claire Deville presented a note by M. E. Renou, on the latent heat of ice, in reply to M. Jamin's note, read at the last meeting.—M. Fizeau called the attention of the Academy to some errors which, he thought, had slipped into a communication by Father Secchi.—M. Regnault presented, in the name of M. Pfaundler, a claim of priority in the method employed by M. Jamin for the determination of specific heats.—M. Delaunay presented a note on the sun's spots, by M. Sonrel, in which the author called attention to some photographs exhibited by him, by which the perturbations of the surface of the sun are shown to have been lately remarkably active; a note, by M. H. Tarry, indicating the chief points of M. Respighi's theory of scintillation; and a second note, by the same author, on showers of dust and blood-rains. The author ascribed these phenomena to the action of cyclones upon the desert of Sahara.—MM. A. W. Hofmann and O. Olshausen communicated a memoir on the isomers of the cyanuric ethers.—M. Wade communicated a note confirmatory of M. Duchemin's remarks on the destruction of carp by toads; he referred to toads found fixed upon pike. M. d'Esterno remarked that the toads thus found attached to fishes were all males, and that this attack took place only at the breeding-time of the toads.—M. C. Robin presented a note by MM. Legros and Onimus, on the choreimorphic movements of the dog; and M. Balard communicated an extract of a letter from M. Castelhaz, on the employment of bromide of sodium, instead of bromide of potassium, as a medicine. The following papers were also read:—"A memoir on solids subjected to flexion," by M. L. Aubert; and "A note on the preparation of optically neutral sugar," by M. Maumené.

Vienna

Imperial Academy of Sciences, April 7.—Prof. Barth presented a memoir on isomeric cresoles.—Dr. Boué made some propositions for the purpose of getting rid of the ignorance which prevails as to the intellectual doings of certain foreign nationalities. He suggested that the transactions of academies established in certain places should be accompanied by translations or abstracts in French, German, or English.—M. G. Tschermak presented a memoir containing the results of an investigation of the meteorite of Lodran, near Mooltan, which fell on the 1st October, 1868, with a notice of a specimen of meteoric iron presented to the Mineralogical Museum, from the desert of Atacama.—A memoir, having the title of *Formicidæ neogranadenses*, by Dr. Gustave Mayr, was read, containing an account of the species of ants found in New Granada, and referring especially to those forms which throw light upon the affinities of the Formicidæ.—Dr. E. Reitlinger communicated the results of an investigation upon the spectra of negative electrodes, and of Geissler's tubes which have been long in use, which he had carried on in conjunction with Prof. M. Kuhn. The observers compared the spectra of the negative electrodes in Geissler's tubes with nitrogen, hydrogen, and oxygen, with those of the other parts of the tube, and found them to differ. To Wüllner's observations on the production of a new spectrum in hydrogen tubes after long use, the observers added similar results with nitrogen tubes. The fluorescence of the glass extends in these tubes to other parts than those immediately around the negative pole.—M. F. Unferdinger presented a memoir on the transformation and determination of the integral

$$\iiint F\left(\frac{x^2}{a^2} - \frac{y^2}{b^2} - \frac{z^2}{c^2}, \alpha x + \beta y + \gamma z\right) dx\, dy\, dz$$

—Prof. Biesiadecki presented some investigations upon vesicle-formation and regeneration of the epithelium in the swimming membrane of the frog.—The report of the Central Observatory for meteorology and terrestrial magnetism for the month of March was communicated to the meeting.

April 21.—A memoir was read on some Pleuronectidæ, Salmonidæ, Gadoidæ, and Blennidæ, from Decastris Bay and Viti Levo, by Dr. F. Steindachner and the late Prof. R. Kener. Also one on the solution of dead organic matters, and one on the process of development and the structure of the walls of woody fibre, by D. T. Hartig, and one on the construction of a conic section, when this is defined by imaginary points and tangents.—Dr. Fitzinger presented the first part of his critical revision of the true Bats (*Vespertiliones*), containing the genera *Diclidurus*, *Taphozous*, *Saccolimus*, *Emballonura*, *Uroccyptus*, *Mystacina*, *Centronycteris*, *Saccopteryx*, and *Mosia*.—Dr. Horwath presented a paper on the production of inanition in animals by deprivation of heat.

April 28.—The following memoirs were read:—On the fish fauna of the Senegal (conclusion), by Dr. F. Steindachner; on the perfecting of involutions of high orders, by Dr. Emil Weyr; and on the determination of the sum of the angles of plane polygons, by M. A. Steinhausen.—M. von Haidinger reported upon some new observations relating to meteorites.—Dr. Boué again referred to his suggestion that the academies of northern and eastern Europe should furnish translations or abstracts of their memoirs in one of the three most familiar European languages.—Dr. T. Oppolzer presented a memoir on the transit of Venus in the year 1874.

New Zealand

Wellington Philosophical Society, January 29.—Annual meeting, Mr. J. C. Crawford in the chair. The election of the following office-bearers for the year took place, viz.:—President—Hon. W. B. D. Mantell, F.G.S. Vice-Presidents—J. C. Crawford, F.G.S.; R. Pharazyn, F.R.G.S. Council—W. T. L. Travers, F.L.S.; James Hector, M.D., F.R.S.; J. Kebbel; Wm. Lyon, F.G.S.; W. L. Buller, F.L.S.

Dr. Knox then gave a description of a specimen of *Bernardius Arnuxii*, which had been recently captured in the harbour, and the most important parts of the skeleton of which he had secured for the Museum. The animal was evidently full grown, and measured thirty-three feet, and what he desired to draw special attention to was the fact that while it presented well-developed teeth, yet they did not project through the gums, but were included in a deep socket with the tip covered in by thick fleshy gums. The use of such teeth, he considered, must be limited to the stimulation of the salivary glands by a reflex nervous process, as they could neither seize, divide nor masticate the food of the whale. Messrs. Mantell and Travers both considered that the teeth exhibited marks of the attachment of the gum round a projecting point of polished enamel, and that the teeth were probably enclosed in the retractile sheath of the gum. Dr. Hector stated that, in a recent description by Dr. Haast of a whale of the same species, it was stated to have shown its teeth when infuriated, which supported the view that the teeth were not completely undeveloped externally.—The next communication by Dr. Hector, on the interior of the North Island, gave the leading features of the geology of the Kaimanawa and Ruahine ranges, which had been recently examined by him. The modern tertiary rocks that form the eastern portion of the Hawke's Bay province, were described as rising in the interior to an altitude of 2,700 feet, but that it was probable that the Kaimanawa range and certain parts of the Ruahine mountains had always remained as islands above the tertiary sea. The tertiary rocks comprise three groups—1. Limestone containing a large percentage of existing shells; 2. Clay marls, containing few shells; and 3. Sandstones and conglomerates with irregular seams of coal, some of which might yet prove valuable as fuel. The upper group is of much later date than the others, but all are distinctly tertiary. The axis of slate rocks, which divided the tertiary series at the time of the development of the conglomerates, is within twenty miles of the present East Coast line, but is broken through by several modern rivers which rise in the Taupo plains; so that easy passes exist from Napier to the interior, a circumstance which has an important bearing on the opening up of the country. The Kaimanawa range is formed of the same slate and sandstone rocks as the Ruahine, but it lies at a considerable distance to the west of the proper axis of the island. The space left between them is occupied by the same tertiary rocks as on the east side, and which slope gradually to the sea-coast at Wanganui. As the tertiary rocks are quite free from any trace of volcanic matter, the eruption of the central volcanoes must have commenced after their deposit was completed. In referring to the auriferous specimens which had been found on Mr. Lyon's run at Kereru, Dr. Hector stated that chemical analysis had proved that, notwithstanding its granitic appearance, the rock to which the gold quartz was attached was only an altered form of the sandstone, as it contained traces of graphite, and 91 per cent. of silica. This is strongly in favour of the view that it is derived from the Ruahine range, as the sandstones in them have been previously mistaken for granite. After alluding to the recent increase in the activity of the volcanic forces in the Tongariro district, Dr. Hector described the route to the West Coast from the interior, and drew attention to maps and reports by Mr. Geo. Swainson and Mr. Field. He also exhibited a new geological map of the central district. The Hon. Mr. Fox considered that there was no doubt of the practicability of a route to Taupo district from the Wanganui coast. He believed that the track through the bush country was almost completed, and he was glad to find that no insurmountable obstruction would be encountered beyond that point. In reply to Mr. Mantell, Dr. Hector stated that he did not think that any rich auriferous quartz had been obtained in the Kaimanawa, but that his opinion remained unchanged as to the probability that gold would yet be met with in the district he had described.

PHILADELPHIA

American Philosophical Society, March 4.—A paper was read entitled "On the Periods of certain Meteoric Rings," by Prof. Daniel Kirkwood. Mr. P. E. Chase discussed the subject of the tides, referring to the recently-published theory of Prof. Challis, and contrasting his views with those of Airy and others. Prof. Cope read a paper "On *Adocus*, a genus of Cretaceous Emydidæ." Dr. Brinton read a paper entitled "Contributions to a grammar of the Muskokec language."

March 18.—Prof. Cope described the disinterment of a number of human remains from a pit in New Jersey, which probably belonged to some of the first European emigrants, whose history has not been preserved. He also exhibited photographs of human foot-tracks, sculptured in Cretaceous rocks of Kansas, and made observations on vertebræ of a large gavial from New Jersey. Dr. Brinton made some observations on a dictionary of the Maya language.

April 1.—Dr. F. V. Hayden described the position and appearance of the Tertiary strata on Green River, Wyoming Territory, mentioning the highly bituminous character of the shales. Prof. Cope exhibited two species of fishes from them, which he regarded as new, and named *Cyprinodon levatus*, and *Clupea pusilla*, and stated that their presence indicated connection with tide-water. Dr. Hayden mentioned the occurrence of insects and Myriopoda in the same shales.

DIARY

THURSDAY, May 19.

Royal Society, at 8.30.—Experiments on the Use of Alcohol (ethyl alcohol) in the Human Body: Dr. Parkes and Count C. Wollowicz.—On the Cause and Theoretic Value of the Resistance of Flexure in Beams subjected to Transverse Stress: Mr. W. H. Barlow.—On Deep-sea Thermometers: Commander J. E. Davis, R.N.—On the Difference between a Hand and a Foot, as shown by their Flexor Tendons: Rev. Dr. Haughton, and other papers.

Society of Antiquaries, at 8.30.—On recent discoveries in the Roman Wall, comprising Eighteen inscribed Altars: Rev. C. J. Bruce.

Chemical Society, at 8.—On some Bromine Derivatives of Coumarine: W. H. Perkin, F.R.S.

Anthropological Society, at 8 (at St. James's Hall).—Race in Music: Henry F. Chorley.

Royal Institution, at 3.—Electricity: Prof. Tyndall.

FRIDAY, May 20.

Royal Institution, at 8.—Atoms: Prof. Williamson.

SATURDAY, May 21.

Royal Institution, at 3.—Comets: Prof. Grant.

MONDAY, May 23.

Royal Geographical Society, at 1.—(Anniversary Meeting.)

Victoria Institute, at 4.—(Anniversary Meeting.)

London Institution, at 4.—Botany: Prof. Balfour.

TUESDAY, May 24.

Linnean, at 3.—(Anniversary Meeting.)

Ethnological Society, at 4.—(Anniversary Meeting.)

Institution of Civil Engineers, at 8.—Discussion on Hot Blast Stoves.—On the Relative Safety of different Methods of Working Coal: George Fowler.—On Coal Mining in Deep Workings: Mr. Emerson Bainbridge, Stud. Inst. C.E.

WEDNESDAY, May 25.

Geological Society, at 8.

THURSDAY, May 26.

Society of Antiquaries, at 8.30.

Zoological Society, at 8.30.—On Dinornis (Part xvi.). containing Notices of Internal Organs of some Species, with a Description of the Brain and some Nerves and Muscles of the Head of the Apteryx australis: Professor Owen, F.R.S.—Notes on the Anatomy of the Prongbuck (Antilocapra americana): Dr. J. Murie.—Some Remarks on the Poison Glands of the Genus Callophis: Dr. A. B. Meyer.—Notes on some Fishes from the Western Coast of India: Surgeon Francis Day.

Royal Institution, at 3.—Electricity: Prof. Tyndall.

BOOKS RECEIVED

English.—Balfour's Class Book of Botany, 3rd Edition (A. and C. Black).—Meteorology: Sir J. F. W. Herschel (A. and C. Black).—How Crops feed: S. W. Johnson (Trübner and Co.).—Lecture Notes for Chemical Students, Vol. I.; Inorganic Chemistry, by E. Frankland (Van Voorst).—Trowbridge's Annual of Scientific Discovery for 1870 (Trübner and Co.).—Stanford's Family Atlas; Stanford's Complete Atlas; Stanford's Cyclopædian Atlas (E. Stanford).—Mammalia: their various Orders and Habits, by L. Figuier (Chapman and Hall).—Researches into the Early History of Mankind, new edition, by E. B. Tylor (Murray).

Foreign (through Williams and Norgate).—Malacologia del Mar Rosso: A. Issel.—Lecons sur la Physiologie et l'Anatomie comparée de l'Homme et des Animaux, Tome ix. pt. 2: M.-Edwards.—Troschl's Archiv für N turgeschichte, 1870, pt. 1.—Publicato per cura dei Professori S. Richardi e G. Canestrini, Vol. II. Sect. 2.—Lehrbuch der chemischen Technologie zum Unterricht und Sebst-studium: D. F. Knapp.—XV. Tafeln zu H. Engelhardt's Flora der Braunkohlen-formation im Königreich Sachsen.

CONTENTS