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

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SCIENCE AND THE PUBLIC HEALTH

AMONG the wide range of subjects included in the programme of NATURE, one of the most important to mankind in general is certainly "the public health." We propose in the following article to lay before our readers an account of the way in which the attention of different nations, at various times, has been directed to this matter, until at last it is beginning to be recognised as a necessary study for all.

It would seem at first sight hardly necessary to spend words on defining the aims of a science, of which the name "Health" is so expressive, but the various writers on the subject have not thought so, and the old formula, "the art of preserving the health," has been often changed.

Londe, apparently from a dietetic point of view, says, "Hygiene is the science which has for its object the direction of the organs in the exercise of their functions," a definition which strangely limits the subject, and even excludes the most important and interesting part of it.

Oesterlen, desirous of bringing into view the two great divisions of hygiene, calls it "that part of our knowledge which has to do with the preservation and furthering of the health of individuals on the one hand, and of the community at large on the other."

Michel Lévy says that it is "the clinical study of healthy man," by which definition he wishes to individualise the more general one; but even here we do not find what we want: indeed we prefer the original definition to all these alterations of it. Dr. Parkes thinks so too, for he says, "Hygiene is the art of preserving health, that is, of obtaining the most perfect action of body and mind during as long a period as is consistent with the laws of life; in other words, it aims at rendering growth more perfect, decay less rapid, life more vigorous, death more remote."

And now we come to the extension which Bouchardat has given to the ordinary definition, "Hygiene is the art of preserving the health." But how can we preserve health? Plainly by doing our best to keep away disease. And how can we do this? By checking the causes of disease. To this end we must know these causes,—and here we have the grand object of hygiene; it is the science which studies the causes of disease, and points out the means of avoiding them.

The knowledge of causes is the great aim of all science properly so called, and no study ought to be honoured with that name which has not this end in view.

"Prevention is better than cure" is an old proverb, and, what is more, a very true one, and it is *prevention* that the hygienist studies—prevention of disease of whatsoever kind by the removal of its causes. The means by which diseases are prevented are often those which answer best for their cure; and here we perceive the link which joins hygiene with medicine, and which constitutes what we may call the therapeutical side of our science.

Thus we see that hygiene takes into consideration, incidentally as it were, and in connection with medicine, the treatment of many forms of disease by methods other than the employment of pharmaceutical preparations—these methods are what Fonssagrives calls "the Hygienic Modificators," and are such as exercise, baths, change of employment, sea voyages, residence in a different climate and above all regimen.

As the methods for the preservation of health are of the first importance to all human beings, we may expect to find provisions to this end among the writings of the ancients, especially in the codes of the lawgivers: and such is the case; take for example the writings of Moses,—they are replete with most excellent hygienic regulations, which his followers were obliged to observe under pain of severe penalties.

Look at the institution of circumcision, the provisions for the separation of the lepers from the healthy people, the command not to eat swine's flesh, the prohibition of the marriage of near relations. Besides these and many other important generalities, we find the great Hebrew legislator descending to the inmost details of family life—giving a regimen admirable in its adaptation to the climate of the countries for which it was intended; directing the burial of excrementa and refuse matter of all sorts in the earth; fixing the laws of marriage, of concubinage, of servitude, and of all social relations.

It is to the strict observation of these sanitary regulations that one of the best-known writers on hygiene of the present day, M. Michel Lévy, does not hesitate to ascribe the singular immunity of the Jewish race in the midst of fearfully fatal epidemics; which immunity was so marked in the middle ages, that it brought upon them "accusations the most absurd, persecutions the most atrocious."

We turn now for a moment to China, and find a people in many respects in a very high state of civilisation, a people who had used the mariner's compass ages before it was known in Europe; but a people who, from want of communication with other nations, have made no advance at all, perhaps, for thousands of years, who have gone on increasing in numbers at such a rate that they now form one-third of the population of the whole world, so that their country is crowded to an extent hardly conceivable. Surely we can learn something from them which will be of service to us in the management of our overgrown towns! Yes; in one thing at least they are our masters—they waste nothing; what they take from the earth they give back directly to the earth; every atom of their sewage matter is employed as manure; and how otherwise would it have been possible for so immense a population, without any external resources, to live on such a comparatively limited portion of the earth's surface, and to *keep it fertile* for so many centuries?

One of the best instances of the power of cultivation in improving the condition of a country is to be found in Lower Egypt, formerly the centre of civilisation of the world, now in a most abject condition: the inundations of the Nile, while the country was peopled with intelligent races, were the great source of its fertility, but are now the cause of the insalubrious marshes that generate the Plague, and make that country one of the most unhealthy spots on the face of the globe.

To come nearer to our own country, let us see what were the hygienic conditions of ancient Greece and Rome. Had the practical application of the principles of public health anything to do with the high state of civilisation to which those countries rose—a state which has, in some respects at any rate, never since been equalled? Had it anything to do with the success which attended the Roman armies, and led to the formation of that enormous Roman empire? Let the facts speak for themselves. What strikes one more in reading the classical authors of those countries than the continual mention of gymnasia and of baths? We find that a certain portion of time was set apart daily for bodily exercise, and thus a full development of the body was produced, and the greatest resistance given to those two great enemies of mankind, disease and death. It is true that all this training was part of a grand military system, that the youths were thus encouraged to compete for the prizes in the Olympic games and in the Roman gymnasia that they might become good soldiers; but did this prevent the cultivation of mental acquirements? Again let the facts give the decision. Do you wish to see fine buildings, buildings so well constructed that they have lasted comparatively untouched by decay for centuries? Do you wish to study beautiful sculptures, statues anatomically perfect to the minutest details, and of unsurpassed artistic elegance? You go to Athens! You go to Rome! Do not fancy that we contend for bodily exercise as against mental studies: we merely maintain that a sufficient daily corporal exercise is absolutely necessary for the proper performance of the functions, both of mind and body.

But we have not yet done with Rome. We have mentioned the baths of that city; but how were they supplied with water? Ah! here we have need to hide our faces for shame. Surely we, with all the immense advantages of scientific engineering, manage to supply our cities with water as well as the people of two thousand years ago; at any rate, with all our steam engines and manufactories, we require at least as much as they did. When we turn to the pages of Frontinus, what do we find? That at the time at which he wrote, about A.D. 92, there were actually *nine* large aqueducts by which water was brought into Rome, beside some smaller channels; these aqueducts were in some cases entirely covered over throughout their whole length, and were driven underground or supported by high arches, as occasion required. Several of them, as the Anio Vetus, the Claudian, and the Anio Novus, were from 42 to 49 miles in length, while the total length of the Marcian was actually 54 miles. The water was brought by the two Anios from the river Anio, by the others from various springs and lakes around Rome; the two newest ones, the Claudian and the Anio Novus, were made because "*seven aqueducts seemed scarcely sufficient* for private purposes and public amusements."

The supply appears to have been equivalent to more than 332 millions of gallons per day, or (since the population was certainly not more than a million) at least 332 gallons per head per day—say, six times the amount that we have now in London.

But beside the aqueducts, there was a capital system of sewers at Rome, consisting of the "Cloaca Maxima" and a series of smaller channels flowing into it. The above remarks give an idea of the admirable manner in which the means for the conservation of the public health were made a subject of State legislation in ancient Rome, and of the determined way in which all obstacles were vanquished, in order that the city might be made as healthy as possible.

Not only have we the example of the ancients in these matters, but we have hygiene reduced to a system by Hippocrates, and associated, as it should always be, with medicine. In reading his Aphorisms, one is struck by the excellent dietetic regulations which he gives, for the observance of gymnasts, and for the guidance of physicians in treating acute and chronic diseases. His third section, which treats of the influence of the seasons of the year, and of the various ages of man in the production of diseases, is also very remarkable.

The very names of the works of Hippocrates show how great a hygienist he was. "About Food," "About the Use of Liquids," "About the Diet of Healthy People," and especially his treatises on "Air, Water, and Localities," and on "Epidemics," are works which well entitle their author to be considered the father of experimental hygiene.

After Hippocrates comes Celsus, during the 1st century of our era, who devotes the first chapter of his first book "De Re Medica" to the exposition of rules concerning diet, and recommends the avoidance of too great regularity by healthy persons.

But we must not pass over the works of Galen, which were so numerous as to form a complete treatise of medicine, and which exercised so enormous an influence over the medical practice of the whole world during many centuries. Galen flourished during the latter part of the 2nd century after Christ, and was for some time physician to the gymnasia at Rome. He revived the doctrines of Hippocrates, especially the celebrated one of the four humours (blood, bile, phlegm, and atrabile), and considered that the different temperaments were produced by mixtures in various proportions of these humours with the four elements—earth, air, fire, and water, and with the four physical qualities—heat, cold, moisture, and dryness.

The Sicilian School sprang up in the 11th century, and was the offspring of the ancient Greek and Arabian medical schools. Its practice is handed down to us in a quaint Latin poem, in which a great deal of truth is mixed up with a great deal of trash, and in which we find bad therapeutics based upon faulty pathology. It is from this school that the doctrines of Hippocrates and Galen, together with the fancies of later times, were spread abroad over Europe. Thus we find that the experimental methods of the fathers of medicine were confused with a host of traditions derived from the Arabian alchemists; so that the rational methods of treatment, adopted by Hippocrates and his more immediate successors, were neglected; and diseases were treated instead by a host of supposed infallible remedies, of which the action was not at all investigated. And what do we find as the result of this change of practice? That epidemics raged with the most fearful intensity all over Europe, epidemics which were only known accidentally before, and which, finding favourable conditions for their spread in the utter neglect of hygienic observances, came from their natural seats in hot eastern countries, and committed unheard-of ravages in Europe. Look at the Plague, that fearful epidemic of the eastern part of the Mediterranean! It is true that we have accounts of terrible visitations of it in Greece, and particularly of one which depopulated Athens in the second year of the Peloponnesian war, when the disease was introduced into that city (then fearfully overcrowded) by a ship from

Egypt, that entered the Piræus: at various times also, and particularly in the year of the city 389 (before the building of the aqueducts), the Roman capital was visited with the same calamity: but this is nothing to the fearful visitations with which all Europe was afflicted during the 14th, 15th, 16th, and 17th centuries.

The last appearance of the Plague in Europe was in 1719, when it was introduced into Marseilles by a ship that had been refused admittance into the port of Cagliari in Sardinia. Even then its course might probably have been stopped, had its malignant nature been recognised soon enough; but this was not the case, and more than 90,000 persons were killed by it. Here we have a clear proof of the value of preventive measures. Sardinia was saved because the king refused the admission of the ship into the port of Cagliari; Marseilles was ravaged because a like precaution was not taken.

In England we are accustomed to manage affairs in a less official manner than they are managed abroad, and the result is that improvements, although more difficult of introduction, are often more surely brought about with us than with our neighbours. It is certainly not because we are less hygienic in our habits than other nations, that we have so few books on hygiene, or that our Medical Schools have not looked upon it as a sister science with Medicine; but because it seemed to take no special line, and because it seemed to be so much everybody's business: now, however, since the formation of the General Board of Health and the Registrar-General's office, such a mass of information with regard to the statistics and to the causes of disease has been obtained, that it seems necessary to make a special study of this science, and no longer to allow it to be taught accidentally as an appendage to Pathology or Therapeutics. W. H. CORFIELD

SCIENCE EDUCATION IN GERMANY

I.—THE GERMAN UNIVERSITY SYSTEM

THE most striking point of difference between the condition of science teaching in Germany and in England lies in the great facilities and encouragements which, in the former country, are given to the study of science in its highest development. In primary education, we are in England probably doing as much or more in the way of encouraging the teaching of elementary science as is being done in Germany, or elsewhere. It is our richly endowed Universities which have as yet failed to play the important part in this essential feature of modern education which, from their position and means, we have a right to expect them to do, whilst other less wealthy Colleges and educational establishments, quite as capable of giving the highest scientific instruction, have to battle with almost overwhelming difficulties. Government, on the other hand, true to its supposed function of simply assisting those who cannot help themselves, only gives pecuniary aid towards the science instruction of the working classes; and, with a singular want of foresight, provides no systematic means of training the teachers,* who are left to pick up their education as best they may.

* The few Queen's prizes and other exhibitions for instruction in the Royal School of Mines cannot in any respect be considered as a *system* of science education for teachers.

The university system of Germany is now so different in character from that of England, that it is difficult to believe that these institutions, of the same age and standing, were founded on the same type, and perhaps equally so to explain how they came to be so essentially different. The cause of this difference appears, however, to me to lie less in the necessarily varying nature of national character and requirements, than in the simple fact that in Oxford and Cambridge the system of colleges founded originally as benefactions to religious societies by private donors, and still retaining a party and religious character, has swamped (or nearly so) the university; and that the college tuition interferes with, and is indeed often absolutely opposed to, that of the proper educating body which it was intended only to supplement. In Germany the college system does not exist, and the university has always remained supreme in its locality; it knows of no interference, religious or otherwise, in its own sphere; its system of education is regulated according to one principle, and one spirit of emulation pervades the whole staff of teachers.

It is singular to notice that the German universities, which are all of them Government institutions, every professor being a civil servant of the Crown, taking the oaths and receiving salary and pension, do not suffer from what we are apt to consider the deadening influence of Government service. On the contrary, this system now holds, and has always contained, the highest and best intellectual life of the nation, replete with energy both as regards teaching power and original research. This may be explained by the fact that although the universities are State institutions, yet they aré practically free as regards their internal government. Each Professor teaches as he thinks best, and Ministerial interference with the regulations of the Senate is of the rarest occurrence. In another point of view, it is well to compare the Government universities of what we Englishmen are even yet too apt to consider as the despotic and illiberal German powers with our free (!) universities. In Germany all, from prince to peasant, who choose, can and do come to the university, provided they bring certificates of having passed the exit examination of their gymnasium, as a proof of due qualification to benefit from the university instruction. Thus, the small government of Baden supports two universities, to the benefits of which persons of all classes, of all religious denominations, and natives of all countries are permitted to enter, without limitation of number, without religious test of any kind, and for the payment of ridiculously low fees. Can we say that our universities are as free? or that we in England possess any other institutions which fulfil for us the duties of these High Schools for the German people?

The university system of Germany has most certainly succeeded in stimulating intellectual activity, and fostering a spirit of original inquiry amongst the teachers, and thus creating a true profession of learned men. On the other hand, it offers sufficient inducement to aspiring students to devote themselves to special pursuits, and raise their aims to something higher than mere "Brodstudien," by opening out to them a path, often arduous and rugged, by which a man of ability may rise, from privat-docent and extraordinary professor, to the highest position of university eminence. This free infusion of new blood into the teaching staff is one great secret of the vitality of the German system; another, certainly, is the well-known principle of "Lern und Lehr-Freiheit." The professor is, on the one hand, perfectly free to treat his subject as he thinks best; and the student has a free choice amongst the various teachers of the particular department of study to which he may devote himself. Can our system, with its far larger pecuniary means, with its hundreds of scholarships and non-resident fellowships, compare in these respects, as inducing men to devote themselves to study, with the German universities?

There is no doubt that the secondary school education in England is inferior, in breadth and completeness, to the strict gymnasial system of Germany. Hence our universities are obliged to act more as finishing schools, occupied with raising the general level instead of carrying out the more scientific, higher, and more original studies which form the professional side of education, the "Fach-studien" which constitute the essential elements of the German system.

In even the smallest German university the four faculties of Philosophy (or art studies), Law, Medicine, and Theology exist in active operation. In the first of these faculties, all those students enter who desire to study either Philology and the cognate subjects, Historical science, the Mathematical sciences, or any of the various branches of Physical science.

The Law students confine themselves to their own Faculty where the theory of the profession is brought before them in a scientific order before they begin to learn the practice of the law.

In Medicine, the danger of a knowledge acquired by practice alone, and the necessity of a scientific education, are too patent to have escaped attention even in England; and hence the establishment of our numerous medical schools, attached to large hospitals. In Germany, such medical schools unconnected with other faculties are unknown; medicine forms an essential feature of every university system; and even comparatively small towns, as Heidelberg and Würtzburg, have their large and well-regulated hospitals, and are able to draw to themselves such men as Helmholtz and Kölliker. On the advantage of association of medical students with those pursuing other studies it is needless to enlarge.

In Theology there are frequently two faculties, one based upon Catholic and the other upon Protestant principles; these are found to work satisfactorily, and in Germany all who enter either Church must have at any rate gone through a regular course of theological instruction.

Another grand point in which the German university excels the English is the much larger proportion of qualified teachers which we find in the former.

As an example of the enormous teaching power in Germany, let us take the Philosophical Faculty in the University of Berlin. Here four professors and five other lecturers give twenty distinct courses each semestre (half year) in the science of Chemistry alone, including several on systematic chemistry, the history of chemistry, the chemical foundations of geology, metallurgy, pharmacy, &c. Under the head of Physics the following ten distinct courses were given by seven Professors during the summer semestre of 1868, and, in addition, a physical laboratory is conducted by Prof. Magnus:—

	Hours weekly.		Hours weekly.
Experimental Physics	4	Physiological Optics	4
Technology	5	Mechanical Theory of Heat	1
Acoustics	4	Hydrography	1
Capillary Theory	2	Physical Geography	2
Theory of Light and of Optical Instruments	2	Instruction in Methods of Physical and Geographical Observations	3

In the Biological subjects, ten professors and lecturers gave twenty-one courses, theoretical and practical. In Classics and allied subjects, thirteen professors and eight lecturers gave twenty-three courses; and on other linguistic subjects, eighteen professors and lecturers gave forty courses. In Mathematics, six professors and lecturers gave thirteen courses. In what we should call Mental and Moral Philosophy, including pædagogy, eleven professors and lecturers gave nineteen courses. In Economic and Agricultural sciences, seven professors and lecturers gave twelve courses. In History and Geography, nine professors and lecturers gave thirteen courses. In *Belles-lettres* and the Fine Arts, seven professors gave ten courses. It must be remembered that all the courses enumerated above belong to the Faculty of Arts (*Philosophische Facultät*), and are exclusive of the three other faculties, in each of which the subjects are represented in a similar proportion.

It is, of course, impossible for us in England to attempt to set up a system on this scale; but we cannot be too fully aware of the miserably insufficient way in which these studies are represented in our country; and we may rest assured that the existence, in due proportions, of a plurality of teachers is an indispensable pre-requisite for both breadth and depth of study. Where only one teacher is charged with one leading branch of study, it is barely within his power to provide the systematic teaching necessary for pass-men; whereas if, as in German universities, several teachers lecture concurrently on subdivisions of a subject, the more advanced students have the opportunity of studying more thoroughly some one section of their science. The teachers are also induced, by the opportunity of lecturing on special subjects, to engage in profounder investigations; and thus that other aim of university institutions—the advancement of science and the promotion of a learned class—is furthered. This is a consideration—at least, however, so far as England is concerned—for a remote future: it is sufficient to insist on the necessity of this plurality of teachers in order to ensure really effective teaching. The same subdivision of each subject appears in all the German universities. Thus in Göttingen, by no means one of the recently founded universities, and not subject in any special degree to those influences which have so remarkably fostered the growth of the sciences of observation and experiment, we find the following courses given in 1868:—

In Göttingen, Chemistry is (against the usage in Germany) attached to the Medical Faculty; there are, however, three divisions—the general, the physiological, and the agricultural. In the first, we find Professor Wöhler, with four skilled assistants; two of these being also professors. In the physiological division is another professor, with one assistant; and in the agricultural division, is one professor and one assistant. There are, further, four laboratory servants.

Professor Wöhler delivers the principal course of lectures on systematic chemistry. His assistants lecture on special branches.

The whole staff directs the laboratory; and over and above these are the two professors of physiological and agricultural chemistry, who conduct their own laboratories.

In Physics, Professor Weber and his assistants, Professors Listing and Kohlrausch, conduct an excellent physical laboratory, and lecture on the several branches of physics—systematic physics, optics, electricity, &c., light and heat, meteorology. Professor Ulrich treats of hydrostatics and hydraulics.

In Natural History, Professor Keferstein lectures on comparative anatomy, and performs zootomical demonstrations in the Zoological Museum during eight hours weekly to the students; for four hours weekly the Museum is open to the public, when the same Professor is present to conduct demonstrations. Two professors lecture on Botany (each six hours weekly), and combine with their lectures excursions and demonstrations in the Botanical Garden; there is also a third assistant professor. Professors Sartorius Von Waltershausen and Von Seebach lecture each four or five hours weekly on Mineralogy and Geology, and conduct practical demonstrations in the Museums.

In Heidelberg, as in Berlin and Göttingen, and in some respects even in a more perfect measure, large provision is made for the study of physical science. The *Physical Laboratory*, conducted by Professor Kirchhoff, is very successful. Once weekly Professor Kirchhoff lectures, with experiments, on a given subject; in the following week each student in the laboratory goes through the experiments for himself, and in this consists the essence of the course. Students can also prosecute independent research for several days in the week.

The *Chemical School* of Heidelberg has always been a celebrated one, and since the appointment of Bunsen to the university its renown has greatly increased. In no other European laboratory, with the single exception of that of Liebig at Giessen, have so many promising scientific chemists been trained, and this has been wholly due to the untiring interest shown in each student by the illustrious Professor, who, devoted heart and soul to his science, imparts to his students a portion of that interest in, and zeal for, original investigation, which are the real marks of a scientific spirit. Many of the chemical students at Heidelberg come, as with us, to study the science for the sake of its subsequent applications to manufactures, medicine, or pharmacy (for all the German druggists and pharmaceutical chemists are wisely compelled to attend a regular university course), but many, probably a large fraction of the number, study the science for its own sake, most of these students intending to qualify themselves for the higher posts of scientific instruction in various countries. Amongst the companions of those who studied at Heidelberg with the writer were men who are now making rising reputations in most of the German universities, or in the various institutions of France, Russia, Portugal, Great Britain, and America.

The *Physiological Laboratory*, conducted by the celebrated philosopher Helmholtz, is a novel and important feature in the Science Department in Heidelberg. A handsome and spacious building has recently been erected for the use of the Professors of Physics and Physiology. This embraces lecture-rooms, laboratories, rooms for apparatus and instruments, and for conducting special scientific investigations, besides dwelling-houses for the professors and their families.

In another article I propose to inquire more closely into the cost of establishing and working the Science Department of the German universities.

HENRY E. ROSCOE

A POINT IN MUSCULAR PHYSICS

SOME Physiologists abound in statements touching the correlation of forces in living things, and are very fond of repeating the old parallel between a muscle and a steam-engine. We have no desire to deny the aptness of the illustration, but it is as well to bear in mind that, in actual point of fact, the exact correlation of heat and mechanical force has not, as far as muscle is concerned, yet been made fully out. The point of failure is this—suppose we have two muscles: let one muscle when it contracts have to pull against a weight and so produce a decided mechanical effect; let the other muscle have no such weight to pull against, and so in contracting produce no mechanical effect (the trifling weight of the muscle itself we may disregard). According to the doctrine of the correlation of forces, the heat given out in the first case ought to be less than that given out in the second, by reason of the total force produced by the combustion of the muscle going out partly as mechanical force instead of wholly as heat. We suppose of course that exactly same amount of contraction takes place in both cases, and indeed that the muscles are perfectly identical in circumstances, except so far as their load is concerned. Heidenhain some few years ago, however, found out that there was, strange to say, more heat given out in the first case. He also discovered the reason of it, which is that when a muscle is put on the stretch, as, for instance, when a muscle has in contracting to pull against a weight, *all the chemical changes in the muscle are augmented*, and that roughly in proportion to the amount of strain.

This observation by Heidenhain seems to us one of very far-reaching and often-recurring importance, though apparently it has hardly as yet gained the attention it deserves. At all events it put a stop for a while to any satisfactory settlement of the question we are considering. Quite recently, however, Fick has devised an experiment which seemed to him to avoid the difficulty that had discomfited Heidenhain. The gist of it is simply this. He has two muscles in every way treated alike except in the following point. One muscle he allows to pull a weight up by the force of its contraction, and then lets the weight, when the contraction has passed over, pull the muscle down again. The other muscle pulls up the same weight in the same way, but at the moment that the contraction is at its maximum the weight is slipped off. The muscle then by virtue of its elasticity returns to the length natural to it when unloaded; directly it has reached this point the weight is slipped on again, and the muscle is again ready for a contraction.

It is obvious that in the first case the muscle does no actual work at all; after the contraction the weight undoes what the contraction did. In the second case, on the other hand, the weight is lifted up to a certain point and left there; real work is done.

Such being the case, the temperature of the first muscle ought to rise higher than the second; and when each muscle has been made to contract a good many times this rise ought to be appreciable. Fick finds in fact that it is so. And so we seem here to have what we desired; for both muscles *during contraction* are subject to the same strain; and hence Heidenhain's objection is obviated.

That cautious inquirer is not, however, yet satisfied. He asks "if during contraction an increase of strain produces an increase in the total chemical processes (metamorphosis) of the muscle, are we to think that the effect of the strain ceases to be felt immediately the contraction is finished, and is not carried on into the period of relaxation?

And moreover, putting the matter to an experimental inquiry, he finds, as a matter of fact, that when two muscles are treated as in Fick's experiment, one strained at all times, and the other strained only during contraction, the amount of chemical change taking place in the first, as evidenced by the generation of acid, is distinctly larger than in the second. So there the question remains for the present.

THE PROJECTED CHANNEL RAILWAYS

THE first question to be asked about a railway between England and France would be properly one upon its importance, and on the value of such a railway to the social and commercial interests of the two countries.

Let us consider the present situation and the circumstances which would affect, favourably or otherwise, a Channel Railway.

A sheet of water, impassable at all times to the bulk of a people, although a highway of their sailors, is a most effectual barrier between two countries. Free intercourse is checked; the exchange of ideas and thought limited to a small class of traders and travellers, not to mention the learned, who in all countries form but a minority of the people.

Two nations so situated are generally cold towards each other, and in time materially differ in their mode of living, in their ideas, habits, and in their institutions. A free intercourse need not necessarily obliterate the peculiarities of different races; but it has always been an effective means of moderating prejudices.

To attempt a description of the numerous and subtle ways by which the mind of populations may be taken hold of—and even be guided—would be beyond our present object; but as a means of self-education and consequent civilisation, there could not be a more powerful instrument than railways, because they offer the readiest, most convenient, and the cheapest means of communication between one individual and another.

Half-a-century ago the bulk of a nation was enclosed within its own walls; only a small minority could afford to travel and to observe, *to exchange and to induce thought.* That in which all schools must necessarily fail, or at least can succeed but indifferently—viz., the education of the million—railways are accomplishing with extraordinary rapidity; their civilising influence is constantly at work: they cover England more than any other country, and accordingly England derives all the benefit which that institution may confer on a people. Railways are also in a great measure covering France, Belgium, Germany, &c.; but there is an essential difference between the effect which they may produce in England and on the Continent. In England they interchange and mix the ideas and habits principally of the Anglo-Saxon race, some twenty odd millions; on the Continent they cause to mingle several great nations of different race: certainly more than sixty millions are there under the operation of railways as an institution.

The civilising influence of railways is, in England, accordingly confined to one groove—one main Anglo-Saxon line—and the effect on the English people cannot but remain elementary: on the Continent, however, their civilising power derives its material from several distinct and essentially different sources, viz., the Teutonic and Gallic races, and some others of minor consequence, the material of which, interwoven and allied by the affinity of thought, forms a compound of a different nature and character, differing as much as compounds differ from their elements.

That these causes have been in operation in the manner indicated, we may easily trace in the relative progress made within one generation in England and on the Continent. When railways were in their infancy, England was, in her institutions and industry, much ahead of any country. Railways have improved the condition of every people, but has the improvement not been very much greater on the Continent? It may be urged, that there was more room for improvement in those countries: that may be so, but this would not affect the case, for there was and is room enough for improvement at home.

Within one generation railways have produced wonderful revolutions on the Continent. The despotic governments of several great nations have given way to truly liberal institutions; continental industry rivals already that of England. And how was all that brought about? The immediate causes of these changes may seem innumerable; and yet, there is only one great cause at the bottom of all this change, viz. *enlightenment of the people;* and we claim a large share of this result for the institution of railways.

If, then, the combination of thought originating from different sources has so much advanced and civilised the Continent, what would be the effect upon England if a railway could suddenly bring the bulk of her people in close contact with the continental nations? A more complex, a higher compound would be formed, and what the ultimate effect of this change might be the future alone could tell; all that can be said with certainty at present is this, that *enlightenment must follow in a potential form.* Excursion trains would take the million to and from either country; excursions to and from Paris would be made with the same convenience and comfort as now between Manchester, Liverpool, London, and other large towns; in short, the social effect of the change would be immense; and how would it affect the commercial interests? Enough has already been said to show that a channel railway in good working condition would accomplish wonders, and it may be easily perceived that, though all will be gainers by the change, England would gain the most.

This being so, then, the next point is to analyse the different projects which have been proposed for bringing the result about. Among these, the Bridge scheme has naturally received considerable public attention. To the non-professional mind it appears a plausible proposition, and enough support has been given to its promoters to enable them to promise wonders.

We have no *definite* plan of the proposed bridge, but we have a Channel Bridge Company; we have not even a definite outline of the main engineering features, but we have the assurance of the success of a model which, in the opinion of the projector, might be enlarged to *any extent.* The span of the bridge is evidently not agreed upon, nor is the construction of the piers determined; we are assured that we may have any span we like, and that there is no difficulty about the piers; in fact, the only thing wanted to complete this great national work in *three* years, appears to be a subscription of eight millions sterling to the credit account of the Channel Bridge Company.

The vagueness of the scheme is the safeguard of its promoters. We cannot even describe the propositions without running the risk of being contradicted on every point; it is even intimated that it is premature to discuss the scientific questions of the Channel Bridge scheme.

We have a few facts, however, on which we may safely enlarge. It is admitted, that from Dover to Blanc Nez, a distance of twenty-one miles, a number of piers are indispensable. In 1868, the distance was to be crossed by ten spans, each over 9,000 feet in the clear, and we have a diagram of that monster bridge. In 1869 rumour will have it that the number of spans is to be increased from ten to thirty, making the reduced span still over 3,000 feet in the clear. With the first proposition we should have had nine piers, with the latter, twenty-nine, washed by the waters of the Channel.

Whatever the ultimate number of piers may be, it is evident that some of them must be constructed in water exceeding 30 fathoms, or 180 feet in depth (according to the Admiralty Chart); moreover, these piers are to be 360 feet above high water, making the total height of the structure of some of them over 540 feet from the bottom of the Channel. Let us see how one of these pyramids is to be constructed midway the Channel.

The projector discards masonry, for no operations 180 feet below water level are practicable; and as the foundations themselves would have to be carried down another indefinite number of feet, the depth and consequent pressure would render life, and therefore work, impossible.

A new construction of piers had to be invented, and herein should be found the virtue of the design; let the agents of the Channel Bridge Company tell their story:—

The project depends in effect on two remarkable innovations in the construction and establishment of the piers and metallic beams. In addition to the considerable height to which the former rise above the water (120 yards), the bases of the piers are sunk to the bottom at a depth varying from 28 to 52 yards. Except the centre one, all the piers at their foundations measure 130 yards in width and 87 yards in length, diminishing upwards, and forming at the summit a square of 66 yards on each side. The centre pier will be half as large again as the others. All the pieces composing the work are of cast-iron, and furnish, without increasing the weight, a power of resistance superior to all other kinds of construction.

As such ponderous piers could not be erected by the ordinary means, M. Boutet proposes to construct on the shore their lower parts or bases to a height sufficient to rise ten yards above high water, and as soon as the iron skeleton is put together and bolted, a number of large sheet-iron buoys are distributed about the immense surface of the base. At low water the metallic framework thus prepared is made to slide upon the shore to low-water mark. The tide, in rising, raises this raft or base of iron lightened by the buoys, and floats it. A tug steamer then removes it to its place, previously indicated by one of a line of buoys attached to an iron cable, stretched across the Straits at a depth of eighteen yards. By raising one of the buoys attached to the raft it is made to descend very slowly, the top being just above the level of the sea when the base touches the bottom. Thus are avoided all the preliminary works under water, which constitute the greatest difficulty in the way of a bridge across the Channel.

Certainly, we have here Baron Munchausen over again. These cast-iron piers, with a base of 390 ft. by 260 ft., over 200 ft. high, we are informed, are to weigh about 2,500 tons. What is the thickness of their metal to be? Information is wanting on this point; but an iron structure of these dimensions, to bed itself on the bottom of the Channel, could not be designed of less than ten times the weight named.

Assuming, for the sake of argument, that the rise of the tide would float that structure away by the means above described—and our business is to analyse the project as it is, not to suggest or attempt to improve on it—may we not ask with surprise, where would the centre of gravity of this floating structure be? Its centre of gravity would be about ninety feet above the level of the water, and at least one hundred feet *above* the centre of displacement. Why do our ships not upset, what insures their stability, and why do they right themselves? Mainly, because their centre of gravity is in its lowest position, *below* their centre of displacement. Here, however, we have a floating structure in which the centre of gravity would be enormously *above* the centre of displacement, and in its highest position. A slight oscillation, a breath of wind would overturn it, and suppose it could be floated away from shore, it would topple over—right itself upside down; the "sheet-iron buoys" would be uppermost, and the structure below them, forming a gigantic wreck somewhere in the Channel.

So much, then, about the piers. It may give the ordinary reader an idea of the character of this scheme. Shall we say anything about the 9,000 and odd feet clear span? At first sight it appears to be a typographical error; surely 900 and odd feet were meant; but then we meet with the fact of the Channel being divided into *ten* spans, so there is no getting out of it.

The whole proposition is the offspring of a highly imaginative mind. Of all the schemes or suggestions to cross the Channel by rail, this is the most incoherent. *There is nothing in it*—not one point of merit. It is not bold, because it lacks the spirit of boldness, viz. Sense. Not a trace of an engineer's mind is to be found in it. Our asylums produce innumerable schemes of this kind, but they are not permitted to disturb the public mind. It is a relief to have done with it. We are glad to say there are several projects which do not lack either sense or ability on the part of the originators. Some of them appear practicable, and one or two highly promising of success, and these will form the subject of our next communication.

DANA'S MINERALOGY

A System of Mineralogy: Descriptive Mineralogy comprising the most Recent Discoveries. By James Dwight Dana, Silliman Professor of Geology and Mineralogy in Yale College, etc., aided by George Jarvis Brush, Professor of Mineralogy and Metallurgy in the Sheffield Scientific School of Yale College. Fifth edition, 8vo. pp. 827, figures 617. (London: Trübner & Co.)

I.

FORTY years ago mineralogy was a fashionable subject in England; wealthy people collected minerals, though probably but few of those who did so ever made mineralogy a serious study. But mineralogy, under the then received doctrines of Mohs, was rather a system than a science; rather a system by which the place of a mineral in a classified list, grouped after little else than external appearances, could be determined by a few simple experiments, than a science dealing with the more subtle properties and qualities of the objects it classifies, and treating external resemblances as of no importance unless associated with analogies in composition or chemical type. No doubt it is to a great progress of mineralogy in this latter direction, associated as it has been with a corresponding development of crystallography and crystallographic optics, that the falling off in the votaries of these sciences is in a great measure due.

The mere collector for collecting's sake would prefer now-a-days to expend his money on shells or his research on fossils or plants, for a tolerable familiarity with which little preliminary education is needed, to investing his means and puzzling his mind with a science which has become a department of chemistry, and needs, besides sound chemical ideas, a thorough practical acquaintance with another and that a mathematical science, namely, crystallography.

To a similar cause is due, in part at least, the comparative indifference with which crystallography is treated by chemists and mineralogy by our geologists.

No doubt these two great sciences, chemistry and geology, between them cover nearly all the ground occupied by mineralogy. But our chemists are engrossed by great problems that may be said to be involved in the nature, if not even in the structure, of the gaseous molecule; they have hardly yet turned to that side of the problem which will one day be illustrated by the physics of the crystal molecule. So again the geologist in his character of historian of the earth is occupied with the relations of the manifold forms of life that have congregated on our globe, and their distribution in time; or else with the great dynamical causes that have engineered this "dædal earth" of ours into its present superficial form. And in England the chemical causes to which so large an amount of change in the character and bulk of rocks and in minerals is due are rarely within the grasp of our leading geologists.

In Germany it is otherwise. There, a preliminary education in mathematics or in chemistry, and by natural sequence in crystallography and mineralogy, is the almost universal introduction to the study of geology. So that to the German student, crystallography, as a science of observation with the goniometer, and of calculation with formulæ, is no rare accomplishment; and the little collection he makes during his student years, whether of minerals or of chemical preparations and crystals, forms a nucleus round which is gathered a great deal of valuable and exact knowledge, which he builds on work with his goniometer and his balance, and often with the microscope at home or his hammer in the field. The School of Mines here is producing a few men with many of these qualifications, but it may be questioned whether a more mathematical basis is not needed in that as in other similar educational institutions in England.

At any rate we do not turn out here the many-sided geologists that Germany produces, as witness the school of chemical geologists with Bischof at its head, or the admirable works on petrology by German authors; for the German geologist does not write on rocks till he has acquired a scientific acquaintance with the minerals that compose them.

In France, again, the nation of Haüy, if mineralogy, perhaps from the smaller importance of French mining industry, is not so widely pursued as it is in Germany, it has nevertheless always had its careful, thorough, and scientific votaries. Indeed, in our own day, the researches of Des Cloizeaux, following up those of Grailich, and his brilliant little constellation of Viennese crystallographers, have shown how absolutely essential is the study of the optical constants of crystals to any complete science of chemistry or mineralogy. We may, indeed, console ourselves for our shortcomings in England by the reflection that to an Englishman is due a system of crystallographic notation, and an extended use in crystallography of spherical trigonometry, which have long given to that science a greater symmetry and simplicity in its formulæ; so that now the system of Professor W. H. Miller is gradually displacing every other on the Continent.

But when we turn from Europe to America, we should expect that we should have to judge by other standards; for there a sterner call summons men to the study of mineralogy than is the case in the Old World. Where any pioneer on a new bit of mountain land may light upon mineral wealth like that of the Washoo district of the territory of Idaho, there is a need for pioneers who are mineralogists; and it is but justice to the American instinct for perceiving, and genius for supplying, whatever is wanted under novel conditions of life, to say, that in mineralogical science and mining enterprise the Americans have been equal to the demands and to the splendid opportunities that the New World has presented to them.

Of this the work, the title-page of which heads this article, is an admirable evidence. Written to meet the wants of eager and intelligent young ore-seekers in the vast stretches of plain and mountain between the Atlantic and the Pacific, it has satisfied these wants perfectly, and helped to produce (we had almost written has produced) an admirable American school of mineralogists. But it has done more than this: it may almost be called the text-book of mineralogy for Europe; and it is so for the reason that its ingenious and talented author is laborious; and is not only laborious, but able to throw off a prejudice like an old garment. It is this freshness of mind and power of work that has made the successive editions of his mineralogy not only *not* reprints, but essentially original books, and even made them an interesting pyschological study of one who may be taken as a typical American man of science.

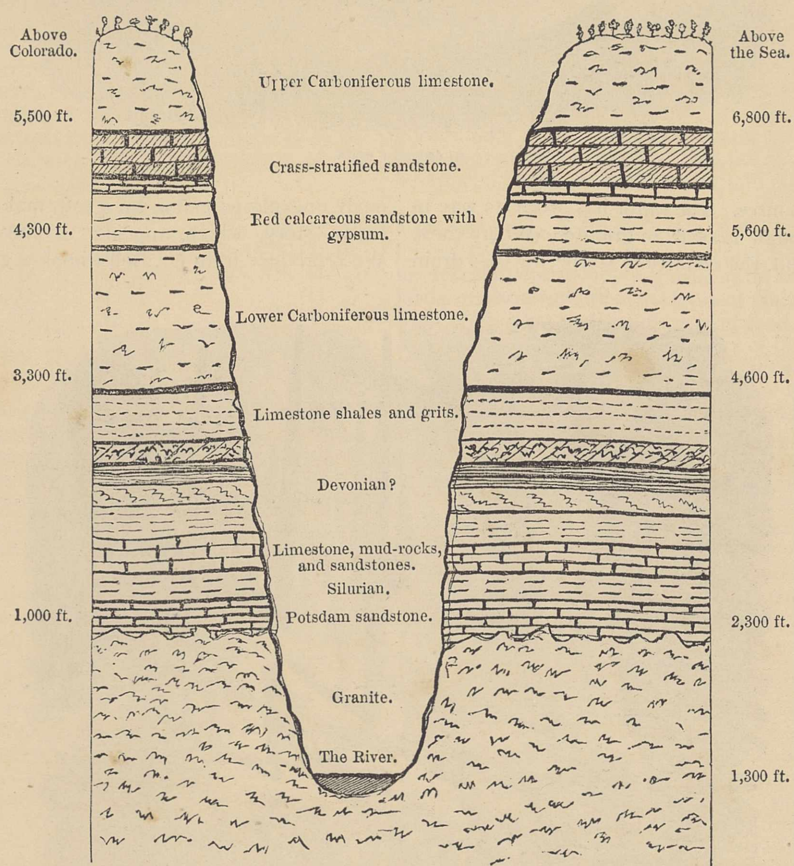
The chief features that distinguish the large and handsome volume representing Professor Dana's new, that is to say, his fifth edition, are—Firstly, modifications in his system of classification; Secondly, alterations in the nomenclature; and Thirdly, a new chemical notation. Professor Dana still retains his peculiar graphic method for the representation of the zones of crystals and his notation for their planes. Both of these, we believe, he will discard in some future edition which we earnestly hope that he may live to carry through. The notation is rather complicated than simplified by the employment as symbols of the letter *i* in its different phases of italic and capital, which, together with the figure 1, are used to represent what, in fact, are the most frequently recurrent and concurrent planes of a crystal. The far greater elegance of the stereographic projection for the representation of the zones of a crystal than the sort of contracted and symbolised Quenstedtian method employed by Professor Dana will certainly prevent this latter from ever becoming adopted in other works. Passing from the crystallographic to the chemical notation, we may say that Professor Dana accepts a sort of nuclear theory of chemical combination, and illustrates this by a corresponding notation. As, however, the use of this system is only partially introduced into the work, we may dismiss it with the remark that, inasmuch as the use of formulæ of one shape or another to express a particular compound can only be a relative and not an absolute expression of the modes in which its elementary units are combined, when one such formula or system of formulating is to be conventionally selected for adoption, that will be the best to select which expresses best the relations between the compounds from the point of view of the author employing them. Professor Dana's does not seem to us to meet this requirement as from the point of view of the mineralogist. N. STORY MASKELYNE.

BELL'S NEW TRACKS IN NORTH AMERICA

New Tracks in North America: A Journal of Travel and Adventure in 1867–68. By W. A. Bell, M.B., F.R.G.S., &c. With a map, 20 lithographs, 22 woodcuts, and 3 botanical plates. 2 vols., 236 and 322 pp. (Chapman & Hall.)

THIS is an unusually important book of travels, giving interesting particulars of the vast wild Western country which, though still the home of the Apache and the Buffalo, is every day being more and more brought into subjection by the settlers, traders, miners, capitalists, and railways of the "Anglo-Saxons" of America, as Dr. Bell calls them.

The author was well placed for obtaining reliable information, having been attached in 1867 to the surveying expeditions of the Pacific Railway as photographer and physician. In this manner he travelled "about 5,000 miles beyond the pale of civilisation and railways." His contributions to the physical geography of the astonishing country south-west of the Rocky range are carefully done. He writes a brief treatise on the natural drainage system of the district, and especially of the Great Basin, which is considerably larger than France, and so-called because none of its rivers reach the sea. The reason of this is not that it is a basin with a rim all round to act as an insurmountable barrier to drainage, but rather because it is in reality a collection of hundreds of smaller basins, each of which has its stream and lake, which lose by evaporation and percolation what is supplied by the limited rainfall. Cultivation is, however, increasing the rainfall in Utah, and the Great Salt Lake has consequently of late years been steadily rising. The rainfall from year to year is irregular. At Fort Yuma, on the borders of California and Arizona, it was in four recent years 0·33, 8·57, 4·20, and 2·94 inches. Irrigation must be resorted to for all agricultural operations.



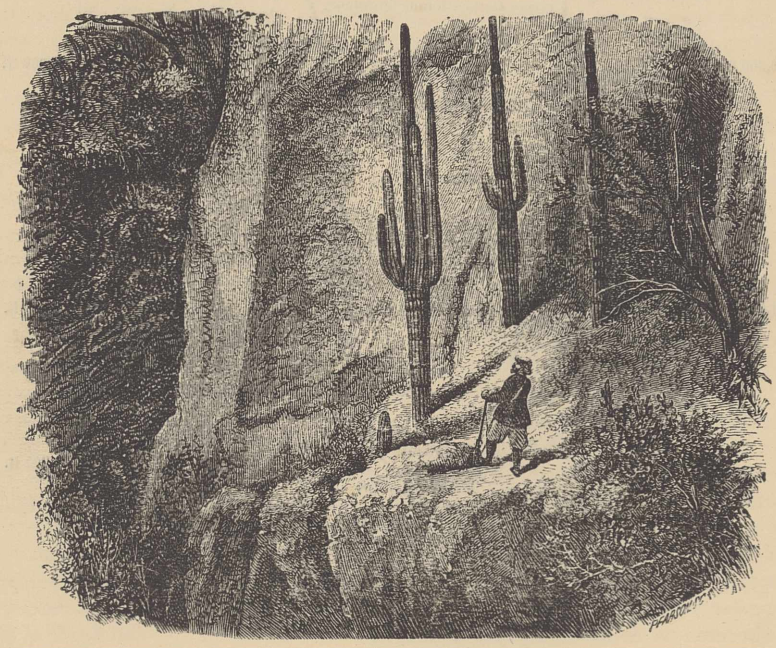
SECTION OF THE CANON OF THE COLORADO ON THE HIGH MESA, WEST OF THE LITTLE COLORADO (BY J. S. NEWBERRY, M.D.)

The barren, monotonous mountain ranges of the great basin are rich in minerals. One silver lode, the Comstock, yields annually four millions sterling, or more than all the mines in Mexico, and Nevada furnished twenty million dollars of gold in 1867 to California's twenty-five. Copper and iron are also plentiful, and the unworked coal-fields are numerous. Hydraulic power is now employed in mining in California. The machine used was invented in 1852 by one Mattison, of Connecticut, and directs a stream of water from a two-inch pipe under a pressure of perhaps 200 ft. perpendicular, which gives a tremendous force, against a bank or hill-side, containing *placer* gold, tearing down the earth into the washing sluices with great rapidity. This powerful agent is stated to be changing the face of the country: obliterating valleys, levelling hills, turning rivers from their course, and covering fertile tracts miles in extent with bare heaps of gravel.

MUSHROOM ROCK

The most distinctive features of the great basin are the cañons, those narrow, deep, abrupt, and continous chasms at the bottom of many of which run rapid rivers, unapproachable by man or animal. They are due to the action of water, being formed by the passage through a dry region of never-failing and rapid streams, coming from distant sources exterior to the dry country. The water has worn its way in some instances through 1,000 ft. of granite. Where these deep cuttings abound, the country is sterile, for they drain it to the uttermost, and the streams lie far below the reach of surface animal or vegetable life. One cañon, that of the Purgatoire, has been so named because of the "bright, fiery-red sandstone" of which its walls are composed; the effect of the mass of colour is said to be wonderful. In another, the Aravaypa, a cliff below the average, was measured, and found to be 825 ft. high.

Here, when the sun had left the upper world, and night had really come, the blackness of darkness around was something awful, and the stars which covered the narrow streak of sky above seemed to change the heavens into a zigzag belt, every inch of which was radiant with diamonds.



THE CEREUS GIGANTEUS

In the valley beyond this cañon, nearly all the water of the Aravaypa sinks into the earth. But the cañon of cañons is the great cañon of the Colorada, discovered by Lopez de Cardenas in 1540, which is but 100 feet wide at its narrowest, while its greatest depth has been barometrically ascertained to be 7,000 feet, or one mile and a third. The sun only shines into this terrible chasm for an hour a day, and it is 550 miles long. At its bottom runs the swift river from which it takes its name. The account which Dr. Bell gives of James White's flight for life down this previously unexplored cañon on a raft, makes a wonderful sensation story, which appears to have found believers. We reproduce from Dr. Bell's book a geological section of this remarkable gorge.

The alkali flats form another distinctive feature in the basin. They are covered with salts, usually nitrate of soda, and being perfectly barren, form white glistening sheets which, in the dry unsteady atmosphere of the desert, become tantalising mirages. The plateaux of the basin region were the last portions of the West which were raised from the sea; even now subterranean fires are active, and it is quite possible that gradual upheaval may be still going on. Earthquakes are frequent; mud-volcanoes are still to be found in places; huge surface cracks have occurred within the memory of living men, and Dr. Bell counted 52 jets of steam issuing from the ground in one valley. A considerable number of the known species of cactus are found about the Mexican boundary line; of one of these, the *Cereus giganteus*, which is sometimes called the Monumental cactus, we give an illustration: the mistletoe grows in the same region. We also give an engraving of the "Mushroom Rock," one of the many similar monuments, denuded and abraded by water, which are to be found in the arid plains of Kansas. Dr. Bell's book contains thoughtful matter on the Indian races of the past and present sufficient for a monograph on the subject. He writes briefly and sensibly on the Mormons, denying the common assertion that Salt Lake City, setting aside polygamy, is a moral place, and stating that there is an entire absence of religious devotion. The Joe Smith anti-polygamy party are making rapid strides, especially in the numerous outlying settlements in Utah and Nevada.

OUR BOOK SHELF

Lehrbuch der Chimie, *gegründet auf die Werthigkeit der Elemente.* Von. A. Geuther, Prof. in Jena. Erste Abtheilung. (Jena: Dœbereiner, 1869.)

THE doctrine of Quantivalence plays a most important part in the general theory of modern chemistry; but when carried out to the extreme lengths which Dr. Geuther claims for it, this doctrine, so useful in the classification of elements, fails altogether to bear an original meaning. The following is an extract from a table, on page 16 of the above-named work, showing the Quantivalence of the elements according to Geuther:—

$H = 1$

As	V. III. I.	Na	V. IV. III. II. I.
Ba	II. I.	Os	VIII. VI. IV. III. II.
Br	VII. V. III. I.	S	VI. IV. II. I.
Cs	V. IV. III. II. I.	N	V. III. I.
Cl	VII. V. III. I.	Ag	IV. II. I.
Cr	VI. IV. III. II.	K	V. IV. III. II. I.
Fe	VI. IV. III. II.	Mn	VII. VI. IV. III. II.
Fl	(VII.) (V.) III. I.	I	VII. V. III. I.

Here, for example, we find potassium described as acting as a monad, a dyad, a triad, a tetrad, and a pentad element, and chlorine as a monad, dyad, triad, pentad, and heptad element. What does this do more than express, in a roundabout and inconvenient way, what Dalton long ago enunciated as combination in multiple proportions—that great law round which the whole structure of the science is built up?

The doctrine of Quantivalence is, in strictness, only applicable in the case of gaseous elements and compounds; bodies whose molecular weight can be estimated by their vapours obeying Avogadro's law of volumes, viz. that the molecule of an element or compound is that weight of the body which occupies in the gaseous state the volume of hydrogen gas weighing 2: the Quantivalence of an element being determined by the number of atoms of hydrogen or of chlorine, or other distinctly monad element or radical, which it may be able to take up in this molecular volume. By an extension of this reasoning, we term potassium a monad and barium a dyad metal, because we find that they each form only one compound with chlorine, potassium combining with one atom and barium with two; and we assume that KCl and $BaCl_2$ represent the respective molecular weights of the compound. Many metals, doubtless, may be considered to exhibit a variation in Quantivalence: such as iron in the ferrous and ferric chlorides; mercury in Hg_2Cl_2 and $HgCl_2$: though this difference may be also explained in the case of mercury by the two atoms of metal being joined together. But to term chlorine a heptad because it forms the compound $HClO_4$, or potassium a pentad because we know of the body K_2S_5, appears to be an exaggeration of a useful doctrine almost as unphilosophical as the divisible atoms of M. Delavaud. Apart from these views, Prof. Geuther's book will be welcomed by all chemists as containing clear and concise descriptions of many compounds not mentioned in other manuals, which are of much importance for the theory of modern chemistry. H. E. ROSCOE

Parasitology.—*Zeitschrift für Parasitenkunde.* Herausgegeben von Dr. E. Hallier und Dr. F. A. Zürn. Band I. Zweites Heft. 8vo. pp. 126, with 2 Plates, price 3*s*. (Jena, 1869. London: Williams and Norgate.)

THERE can be no more conclusive evidence of the vigour with which scientific researches are pursued in Germany than the fact that a circulation is found for a periodical publication devoted entirely to the study of parasites, animal and vegetable. We find in the present number reports of observations on the *Aspergillus glaucus*, and two other newly-discovered parasitic Fungi, found in the passages of the ear, and connected with certain forms of deafness, and a description of a cure in the case of the former species by the external application of alcohol. The greater part of the number is devoted to a dissertation by Dr. Hallier on the parasites of infectious diseases. A portion of this paper is occupied by a discussion whether the minute *Myxogastres* found on decayed wood, grass, &c., belong to the animal or vegetable kingdom. Since the only high authority who has maintained the animal nature of these parasites, Dr. de Bary, in opposition to Fries, Berkeley, and others, has since apparently altered his views, the question may now be considered as disposed of. If the apparent spontaneous motion of the young germinating spores of *Trichia* and other Fungi be considered proof of an animal nature, the same argument must be applied to the zoospores of certain Algæ. A. W. B.

Serials

Hardwicke's Science Gossip, for December, contains, among others, articles on the employment of wild flowers for decorative purposes (in gardens), on the invasion of ladybirds, on the structure of the hairs of plants, on variations in the *Primulaceæ*, on the influence of food and light on *Lepidoptera*, and on the natural history of the Ruff and Reeve.

The *Monthly Microscopical Journal* for December (No. 12) contains some remarks on the nineteen-band test-plate of Nobert, and on immersion lenses, by Mr. J. J. Woodward, United States Army; a paper on high-power definition, with illustrative examples, illustrated with a plate of test-objects, by Dr. G. W. Royston-Pigott; and one entitled "My Experience in the Use of various Microscopes," by Dr. H. Hagen. These relate to the instrument and its use. The papers devoted to subjects for investigation are—one by Mr. Staniland Wake, on the Development of Organisms in Organic Infusions, and further remarks on the Plumules or Battledore Scales of some of the *Lepidoptera*, by Mr. John Watson, the latter illustrated with a plate. The Microscopical Society's Proceedings contain some interesting remarks on the Scales of the *Thysanura*, in connection with Dr. Pigott's paper.

The recent numbers of the *Revue des Cours Scientifiques*, a periodical which is hardly so well known in this country as it deserves to be, and which is intended to furnish a general weekly statement of the proceedings of the principal scientific societies both in France and in other countries, contain translations of Dr. Christison's historical account of the operations of the Royal Society of Edinburgh from 1783 to 1811; of Sir Roderick Murchison's anniversary address to the Geographical Society in May last; and of the first of Dr. Bence Jones's lectures on Matter and Force, delivered before the Royal College of Physicians. Of foreign scientific doings, we find a translation of Carl Vogt's paper on the Primitive History of Man, read before the meeting of German naturalists at Innsbrück, and M. Vulpian's lecture on Pathological Anatomy, delivered at the Faculty of Medicine in Paris.

THE DEEP-SEA DREDGING EXPEDITION IN H.M.S. "PORCUPINE"

NATURAL HISTORY (*continued*)

THIS being a preliminary report, I will make only a few remarks as to the Mollusca obtained in the expedition, and with respect to that part of the sea-bed which I investigated :—

1. *The Mollusca are mostly Arctic or Northern.*—This I have shown in my narrative as regards the western coasts of Ireland, which have hitherto been supposed to belong zoologically to what Professor Edward Forbes called the "Lusitanian" province ; and the present remark applies not only to deep water, but to shallow water, and even the bays. In Prof. Wyville Thomson's cruise to the south-west of Ireland occurred two species, which I was quite unprepared to see. These were *Solarium Siculum*, and an unmistakeable fragment of *Cassidaria Tyrrhena*. The former inhabits the Mediterranean, Madeira, Canaries, and the coast of Portugal ; and the latter has not been noticed north of Brittany. Such exceptions, as well as *Ostrea cochlear*, *Murex imbricatus*, and *Platydia anomioïdes*, it is difficult to account for ; but as all these species are said to inhabit deep water, the Equatorial current may have carried them northwards in an embryonic state ; or it is possible that they may be likewise Northern species, and have not yet been discovered in high latitudes. We are nearly ignorant of the Arctic Mollusca, owing to the difficulty of exploration ; and those who assume that the marine fauna of the circumpolar seas is poor or wants variety, ought to see the vast collection made by Prof. Torell at Spitzbergen. The greatest depth at which he dredged there was 280 fathoms. The soundings taken in 1868 by the last Swedish Expedition reached 2,600 fathoms, when a *Cuma* and a fragment of an *Astarte* came up in the *Bulldog* machine. Soundings, however, are very insufficient for zoological purposes. Judging by the results of our own expedition this year, which have increased to such a wonderful extent our list of the British marine fauna living beyond the ordinary line of soundings, it may fairly be taken for granted that the Arctic marine fauna is much less known than ours. I have not the slightest doubt that by another expedition to Spitzbergen, provided with improved machinery, and under the charge of the Professor at Lund or some other able zoologist, the species obtained would be double the present number. It is evident that the majority, if not the whole of our submarine (as contra-distinguished from littoral or phytophagous) Mollusca originated in the North, whence they have in the course of time been transported southwards by the great Arctic current. Many of them appear to have found their way into the Mediterranean, or to have left their remains in the tertiary and quaternary formations of the south of Italy ; some have even migrated into the Gulf of Mexico, as I will presently mention.

I cannot see much (if any) difference between the Mollusca from the warm and cold areas of Dr. Carpenter. The number of species from the cold area, which also occurred in the warm area, is forty-four. Other species from the cold area, and not from the warm area, are eleven. Of these last, five are undescribed, and one is apparently sub-fossil and may be a relic of the glacial epoch ; so that there remain five only which are Arctic and North-American, but which were not found in the warm area.

2. *Additions to the British Mollusca.*—Although I am aware that the discovery of what are called "new" species does not rank high as a scientific fact, it is still interesting to all zoologists as well as collectors ; and it must not be forgotten that the important subject of zoö-geographical distribution depends in a great measure on such discoveries, and especially on the relation of any local fauna to other faunæ. The number of species new to our seas and procured in this expedition is no less than 117. Of these, fifty-six are new to science, and eight were supposed to be extinct as tertiary fossils. Sixteen genera are new to the British seas, including five which are undescribed. Some of the species and genera, however, are represented by single specimens, and a few by fragments. These whet one's appetite instead of satisfying it. The total number of species of our marine Mollusca, inclusive of littoral species but exclusive of the Nudibranchs (none of which latter were met with except in the bays), is 451, according to the latest work on the subject, 'British Conchology :' so that more than one-fourth has been added in the course of a few months. All that I could do by continual dredgings in comparatively shallow water during the last sixteen years was to add about eighty species to the number described by Forbes and Hanley. I regard the present (although a large) addition as merely an earnest of future acquisitions. Almost every square mile of the sea-bed yields different species, some being apparently local or restricted in their distribution. In fact the treasury of the deep is inexhaustible.

3. *Relation to North-American Mollusca.*—The late Dr. Gould, in his 'Report on the Invertebrata of Massachusetts' (1841), gave 176 species of marine Mollusca as inhabiting that coast. Mr. Mighels, Prof. Stimpson, and others have since described a few more species, making the total number about 200. I attifie] leas 6ohaieddnts of these as British, a dozen being from the present expedition. The size of North-American specimens is, so far as I have observed, smaller than that of our specimens of the same species, perhaps showing that their common origin was in the Arctic seas of Europe and not of America.

4. *Relation to Mediterranean Mollusca.*—In my last Report on Shetland dredgings, published a short time ago by the British Association, I discussed this subject so fully that it is needless to go further into it, except by calling the attention of the Society and all scientific men, particularly geologists, to the importance of ascertaining what has caused or is still causing the remarkable concordance which is observable between the marine Mollusca in the deeper parts of the North-Atlantic and Mediterranean. I cannot help now thinking that this concordance may be explained by the existence of an undercurrent into the Mediterranean through the Straits of Gibraltar, being probably a branch of the great Arctic current. Dredging researches ought to be carried on in the lower part of the Bay of Biscay, and off the coasts of Portugal and Spain into the Straits for the purpose of determining this vexed and highly interesting question. Dr. Carpenter's last cruise to the west of Shetland, at a depth of 290 fathoms added a remarkable species to our Mollusca in *Platydia anomioïdes*, a rare Mediterranean Brachiopod. The specimen is twice the size of those from the Mediterranean. *Octopus Cocco* of Verany is another remarkable discovery, and was dredged in 345 and 632 fathoms between latitudes 60° and 62° N. It was only known as Mediterranean, where it is stated by Verany to inhabit a depth of 100 mètres or nearly 55 fathoms. The dimensions of our largest specimen of this Caphalopod considerably exceed those given by Verany. I may here mention that my friend Captain Spratt, who co-operated with Prof. Edward Forbes in his Ægean exploration, has most obligingly placed at my disposal a very small quantity of material which he dredged in 1846, forty miles east of Malta, at a carefully ascertained depth of 310 fathoms. It contains among others the following remarkable species of Mollusca, all of which were found in the Porcupine expedition, and may be considered northern forms :—*Leda pellucida* (Phil.), *Leda acuminata* (Jeffr. M.S.), *Dentalium agile* (Sars), *Hela tenella* (Jeffr.), *Eulima stenostoma* (Jeffr.), *Trophon Barvicensis* (Johnst.), *Pleurotoma carinata* (Biv.), and *Philine quadrata* (S. Wood). This shows how imperfect is our knowledge of the Mediterranean fauna.

5. *Relation to Mollusca of the Gulf of Mexico.*—I hope soon, through the kindness of Professor Agassiz, to have an opportunity of examining and comparing the Mollusca dredged during the last three summers by Count Pourtales in the United States expeditions. The only species which I have yet seen from the Gulf of Florida are *Waldheimia Floridana* and *Terebratula Cubensis.* The former appears to be that variety of *Terebratula septata* (a Norwegian and now British species), which Professor Seguenza has described and figured under the name of *Waldheimia Peloritana*, from tertiary beds in Sicily; and the latter is closely allied to *Terebratula vitrea* (Mediterranean), and is perhaps a variety of that polymorphous species. Not only the external characters, but also the skeletons or internal processes of these American species correspond exactly with those of their European relatives. I must repeat that I am no believer in the doctrine or idea of species being "represented" in a geographical point of view. Species may be identical or allied, but not "representative."

6. *Gulf Stream.*—The northern character of the marine fauna observed during the Porcupine expedition is certainly at variance with the general notion that this "river in the ocean," or any branch of it, flows directly to our coasts; and I have elsewhere* endeavoured to show that the occurrence in northern latitudes of tropical shells, seeds, and timber may be accounted for by the surface-drift arising from the prevalence of westerly winds. But there is unquestionably a marine as well as an aerial circulation, Equatorial and Arctic currents as well as Trade winds.

7. *Nature of the sea-bed.*—In that part of my Report which contains a narrative of the expedition, so far as I was engaged in it, I have given some particulars which it is unnecessary to recapitulate. Some of the pebbles and gravel from my deepest dredgings (1,215 to 1,476 fathoms) have been examined by Mr. David Forbes, the eminent mineralogist; and he has kindly furnished me with the detailed report which I append to this communication. Among the pebbles and gravel were several fragments of true volcanic lava, which throw a considerable light on the course of the Arctic current along the western coasts of Ireland. He is of opinion that these volcanic minerals came from Iceland or Jan Mayen. Mr. Forbes has also, at my request, carefully and completely analysed a portion of the Atlantic mud from 1,443 fathoms, the pebbles and gravel having been previously removed from it by sifting; and the result shows that its chemical composition differs greatly from that of ordinary chalk. The sifted mud contains out of 100 parts 50·12 only of carbonate of lime, and no less than 26·77 of fine unsoluble gritty sand or (rock débris); while chalk consists almost entirely of carbonate of lime, and seldom contains more than from 2 to 4 per cent. of clay, silica, and other foreign material. But I do not say that this single analysis is conclusive. Mr. Forbes's further report on that head, as well as on a specimen of Rockall (for which I am indebted to Staff-Commander Inskip, who procured it in the Porcupine surveying expedition of 1862), also accompany this communication. I may observe that stony ground did not occur during the present expedition beyond about 550 fathoms, the sea-bed at greater depths being covered by mud or what is technically called "ooze." This superstratum appears to consist chiefly of decomposed animal matter mixed with the shells of Pteropods and *Globigerinæ*, which must have dropped from the surface of the sea. I have myself seen living *Globigerinæ* in great abundance taken with *Spiriales* in the towing net; and Major Owen's papers in the Journal of the Linnean Society for 1865 and 1866 leave no doubt not only that *Globigerinæ* and other free Foraminifera live on the surface of the mid-ocean, but that they have the power, by protruding their pseudopodia, of descending a few inches and rising again to the surface. Sessile or fixed Foraminifera, of course, cannot do this; but I have found some of these living on the surface and attached to floating sea-weed (*Fucus serratus*) at a considerable distance from land. The fresh appearance of the sarcode in Foraminifera taken from great depths does not of itself prove that they live there, when we consider the comparatively antiseptic or preservative property of sea-water as well as the extremely minute size of the aperture in each cell which contains the sarcode. Some Foraminifera, however, inhabit only the bottom of the sea.

8. *Bathymetrical conditions.*—So much has been said of late years (by myself among others) as to the depths of the sea being not merely inhabited but replete with life of a highly organised nature, and as to there being apparently no bathymetrical limit of habitability, I will content myself with noticing the Mollusca which were dredged in 2,435 fathoms. They were—(1) *Pecten fenestratus*, a Mediterranean species; (2) *Dacrydium vitreum*, Arctic; (3) *Scrobicularia nitida*, Finmark to Sicily; (4) *Neæra*, an undescribed species, Norwegian; and (5) *Dentalium*, a fine species, also undescribed. The first of these species was known to inhabit depths varying from 40 to 60 fathoms, the second 50 to 300 fathoms, the third 3 to 300 fathoms, and the fourth 50 to 60 fathoms. The *Dentalium* is an inch and a half long; and in 1,207 fathoms was taken a new species of *Fusus*, living and two inches in length. This last species, being one of a zoophagous tribe, must have had for its food prey of a suitable kind and perhaps of dimensions at least equal to its own. Abysmal life is not represented merely by microscopic organisms; and I suspect that there is no difference in size between the animals that live in shallow water and the greatest depths. Nor do I believe that such abysses are dark or devoid of light. Colour is assuredly not wanting, nor the usual organs of sight in the Mollusca and Crustacea. Living specimens of the *Dacrydium* from 2,435 fathoms are reddish-brown; and a fine live specimen of *Trophon latericeus* from 440 fathoms is bright rosecolour. *Dacrydium vitreum* makes a nest (like that of *Modiolaria discors* and *Lima hians*) consisting of a narrow tubular case twice as long as itself. This case is lined with a delicate membrane, and covered with small Foraminifera, particles of sponge, and coccospheres, which are firmly agglutinated. The *Dacrydium* inhabits the broader half, its front or ventral margin lying in the direction of the opening of the case. From 2,090 fathoms came a new species of *Pleurotoma*, alive, and having a pair of prominent eyes on short stalks; and the *Fusus* from 1,207 fathoms was similarly provided. In both these genera the eyes are perfect and not rudimentary. The eyes of the *Oncopus* from 632 fathoms are remarkably large and more highly organised than those of many fishes. The animals of this genus crawl with their arms, head downwards; and the common species (O. *vulgaris*) buries itself in sand and gravel. Instances to prove that colour and visual organs are possessed by animals at very great depths are innumerable; and they would lead us to infer that light (of what nature I cannot suggest) penetrates the sea to its profoundest base. None of the deep-sea animals appeared to be phosphorescent. Perhaps in the next expedition some photometric apparatus may be devised in order to solve this problem.

9. *Oceanic currents.*—The Arctic or Northern current probably runs with greater rapidity and force in some places than in others, where the flow seems to be very slow and feeble. Everywhere (as I pointed out in my Shetland Report for 1863) the motion must be extremely gentle or imperceptible at the bottom in deep water, as we find the most fragile and delicate corallines from stony ground quite uninjured.

10. *Geological considerations.*—Not the least interesting fact derived from this expedition was the discovery, in a living or recent state, of species hitherto supposed to be-

* "British Conchology," vol. i. Intr. pp. xcviii. and xcix., and Report of British Association, 1868, p. 236.

long exclusively to the tertiary formation and hitherto considered extinct. Such are *Leda excisa* of Philippi, and an undescribed species of the same genus (Calabrian and Sicilian fossils), *Scalaria corrugata* of Brocchi (Subapennine), *Kellia pumila*, *Neæra jugosa*, and *Cerithium granosum*, all of S. Wood (Coralline Crag), and an undescribed species of *Fusus*, which I propose to name *Sarsi*, lately found in the Red Crag. Mr. Wood is inclined to refer this last species to *F. Spitzbergensis* of Reeve; I regret that I cannot agree with him in such determination. Our Coralline and Red Crag beds notoriously contain a large proportion of northern species; and I was not far wrong in regarding the former as the "cradle" of the British Mollusca. I may here remark that, as in Shetland, valves and fragments of *Pecten Islandicus*, *Tellina calcaria*, and *Mya truncata* var. *Uddevallensis* (all Arctic species) were dredged in rather deep water, on the western coasts of Ireland; and a perfect specimen of *Leda arctica* was found in Loch Torridon. These shells are apparently in a semi-fossil condition; but it is impossible to say whether they are quaternary or recent.

As regards marine zoology, this expedition has produced results more important than those which have ever been obtained in any previous expedition of the kind by the enterprise of our own or any other nation; and I cannot help expressing a fervent wish that it may be renewed next year. The United States, France, Sweden, and Norway are prosecuting with great success this line of scientific research; and I feel confident that Great Britain, with her vast wealth, naval resources, intelligence, energy, and perseverance, will keep the lead which she has now taken.

As one of the naturalists who were privileged to assist in the late expedition I shall be happy again to place my humble services at the disposal of the Royal Society in continuation of the work, especially in conjunction with Dr. Carpenter and Prof. Wyville Thomson.

J. GWYN JEFFREYS

⁂ At the Meeting of the Royal Society at which the observations described in the above paper were communicated, Professor Alexander Agassiz gave an account of the principal results arrived at by the American Dredging Expedition. The ground explored was limited to a length of about 120 miles by 60 to 90 miles in width between the Florida Keys and the Northern Coast of Cuba, and although the depth reached was by no means as great as that attained by the last British expedition, not being much more than one-third of it, about 820 fathoms, yet the results were fully as striking, and agree in the main points with the conclusions arrived at by the English explorers. Commencing with the sponges, which contained a great number of siliceous forms, he gave as the results of the examination of Dr. Oscar Schmidt, of Graatz, the specific identity of the majority of the species with Mediterranean, Azoric, and Atlantic species, showing a geographical range quite unprecedented, and extending the Atlantic fauna from the Gulf of Mexico to the Bermudas, the Azores, the Mediterranean, the Western Coasts of Europe, and extending far north to the boreal regions of Norway, Iceland, and Greenland. These same results would apply, as far as the collections have been examined, to the Echinoderms, Mollusca, and Crustacea, though the number of identical species in these branches over this extensive Atlantic area is much smaller. Among the Echinoderms, the *Echini* specially showed several new and interesting forms, recalling types characteristic of the cretaceous period; one genus especially, the genus *Salenia*, is represented in our seas by a most interesting species. Another cretaceous type, a new genus of *Spatangida* (Pourtalesia) was found in deep water in Florida, and like the Crinoid genus *Rhizocrinus*, was also dredged by the Porcupine expedition. Several other species of Echinoderms were also shown to be identical on both sides of the Atlantic.

Prof. A. Agassiz gave besides an instance of one of these so-called cretaceous generic types, which was only the young stage of a well-known genus represented from the time of the chalk through the tertiaries, and which is now found living in the tropical seas, showing how careful we ought to be in our generalisations when drawn from a class where the transformations from the young stages to the adult are as great as they are in Echinoderms. He gave as an example of this the case of two species of Echini, one of which is known under one generic name (*Stolonoclypeus*), as the adult, in Florida, while the young is known under a different generic name (*Echinocyamus*) in Europe, and endeavoured to explain by the action of the currents the migration of the pelagic embryos, many of which remain in a helpless condition for several months, and thus to show how changes of currents, brought about by the elevation or subsidence of portions of continents, would fully account for the present limitation of marine faunæ. The presence of corals at great depths will also materially alter the views generally received of the depth at which reef-builders may work, and modify to a certain extent Darwin's theory of the reefs, and their mode of growth. Prof. A. Agassiz alluded to the probable continuation of the exploration of the Gulf Stream by Prof. Pierce, the superintendent of the W. S. Coast Survey, who was carrying out the plans laid out by his predecessor, Professor Bache; and trusted that the Coast Survey would carry on the investigations so successfully inaugurated, thanks to the enlightened views of Professor Pierce, and the executive ability of the assistant in charge, Count Pourtales. This exploration would consist of a series of normals to the coast of the United States, extending from Georgia to New York, completely across the Gulf Stream, thus extending sufficiently far north to meet upon a common ground the English expedition, which the British Government could not fail to send in consequence of the brilliant results of the two previous years.

SCHOLARSHIPS AND EXHIBITIONS FOR NATURAL SCIENCE IN CAMBRIDGE

THE following is a list of the scholarships and exhibitions for proficiency in natural science, which are likely to be offered in Cambridge during the ensuing year.

Trinity College.—One of the value of about £80 per annum. The examination (in chemistry, physics, physical geology, including meteorology and the elements of mineralogy) will be in Easter week, and will be open to all undergraduates of Cambridge and Oxford. Further information may be obtained from the Rev. E. Blore, tutor of Trinity College.

St. John's College.—One of the value of £50 per annum. The examination (in chemistry, physics and physiology, with geology, anatomy, and botany) will be on 29th and 30th of April, and will be open to all persons who are not entered at the University, as well as to all who have entered and have not completed one term of residence. In this College, moreover, natural science now is made one of the subjects of the regular college examination of its students at the end of the academical year (in May); and exhibitions and foundation scholarships will in consequence be awarded to students who show an amount of knowledge equivalent to that which in classics or mathematics usually gains an exhibition scholarship in the College. In short, natural science is on the same footing as classics and mathematics, both as regards teaching and rewards.

Christ's College.—One to four, and in value from 30*l.* to 70*l.*, according to the number and merits of the candidates, tenable for three and a half years, and three years longer by those who reside during that period at the College. The examination will be in April, 1870, and will be open to the undergraduates of Christ's College; to noncollegiate undergraduates of Oxford; to all undergraduates of Oxford; and any students who are not members of either University. The candidates may select their own subjects for examination. Besides these there are three other exhibitions perfectly open, which are distributed annually among the most deserving students of the College.

Clare College.—One of the value of 50*l.* per annum. The examination (in chemistry, chemical physics, comparative anatomy, physiology, and geology) will be on March 30th, and will be open to students intending to begin residence in October. The candidates must show such acquaintance with classics and mathematics as will qualify them to pass the previous examination.

St. Peter's College.—One of the value of 60*l.* per annum. The examination (in chemistry, botany, comparative anatomy and physiology) will be in June, and will be open to all students who are not members of the University, or who have not commenced residence in the University.

Downing College.—One or more, according to the merits of the candidates, of the value of 40*l.* per annum. The examination (in chemistry, comparative anatomy, and physiology) will be in March, and will be open to all students not members of the University, as well as to all undergraduates in their first term.

Sidney College.—Two of the value of 40*l.* per annum. The examination (in heat, electricity, chemistry, geology, physiology, botany) will be in October, and will be open to all students who may enter on the college boards before October 1st.

Although several subjects for examination are in each instance given, this is rather to afford the option of one or more to the candidates than to induce them to present a superficial knowledge of several. Indeed, it is expressly stated by some of the colleges that good clear knowledge of one or two subjects will be more esteemed than a general knowledge of several.

Candidates, especially those who are not members of the University, will in most instances be required to show a fair knowledge of classics and mathematics; such, for example, as would enable them to pass their previous examination.

There is no restriction on the ground of religious denomination in the case of these or any of the scholarships or exhibitions in the university or the college.

Further necessary information may be obtained from the tutors of the respective colleges.

It may be added that Trinity College will give a fellowship for natural science once, at least, in three years, and that most of the colleges are understood to be willing to award fellowships for merit in natural science equivalent to that for which they are in the habit of giving them for classics and mathematics.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents.*]

Mental Progress of Animals

I HAVE failed to meet with a satisfactory treatment of this subject either in works of mental philosophy or natural history. Sir John Lubbock, in "Prehistoric Times," refers to the likelihood of the sagacity of man and the wariness of animals proceeding *pari passu;* but he does not develop the idea or aid it by illustration, and I find that the tradition still widely prevails that the instinct and intelligence of animals is a thing fixed and unchangeable; and that the mammals which roamed over the world during the earlier and middle tertiary epoch must be credited with the same amount of sagacity as their representatives of the present day. Such statements are assumptions opposed to the current of any facts we possess on the subject. Much of what has been termed *cunning* in animals will be found to have been very much sharpened and made evident in quadrupeds and birds, owing to the new necessities imposed upon them by man the tamer or man the destroyer.

For it is under one of these two characters that man approaches animals, affecting them in the most complex and vivid manner. No bird or quadruped so high in the mental scale as the dog, horse, rat, rook, or sparrow, has been found in the lonely oceanic isles or in any region free, or all but free, from human influence; not because in these quarters such animals could not exist, but rather it would seem because the aboriginal fauna had no opportunity for the improvement of its wits by coming in contact with an enemy or friend so complex, dreadful, and ingenious as a human being.

One of the first impulses communicated to the wits of the wild animals is that derived from the sense of new wants. Now, this is what man supplies by his cultivated fruits and cereals. A feast is spread before quadrupeds and birds more generous than that of nature. But this banquet is guarded, and often becomes a baited trap in which the simple thief is caught; but a very slight increment of sagacity is sometimes enough to turn the scale, and this quickness of wit, especially in the first ages of society, as among existing savages, would be slowly met by improvement of trap. Necessity—on either side the mother of invention—would at last permit only wary vigilant enemies, since these alone could succeed, to hang round the skirts of kraals and wigwams, approach in twilight the crops near stockaded villages, prowl about places of interment, lodge in sewers, enter cellars; and, keenly alive to every sign of danger, multiply in spite of poison, trap, and gun, and in defiance of trained animals of their own and allied species, and that division of labour which gives us special hunters.

The fear of man is a slowly acquired instinct. Mr. Darwin, in his account of his travels, gives some interesting instances of the fearlessness of birds little exposed to man in South America. The crew of Byron's vessel were astonished at the manner in which the wolf-like dog of the Falkland Islands approached them merely out of curiosity. Compare these traits with the admirably organised expeditions for plunder of baboons, elephants, &c., and the rude customs acted upon for self-preservation of the half-wild dogs of the Peninsula and the East, wherein the care of the weak and young, the usefulness of sentries, the value of signals, the difference between sham and real danger, and the advantage of confusing traces of retreat, seem all to be known, and it will be pretty evident that man the thinker has to a considerable extent reacted on animals wild and domestic. Even in my own quarter it is the steady belief of the shepherds that the common sheep-dog has progressed in intelligence and docility within the last fifty years by careful selection. "Where the dog is not valued for intelligence, as in some Eastern countries, it is a much more stupid animal than with us."

Now were we in vision to behold that wonderful Miocene age, when the great mammals roamed over Europe unpeopled as yet by man, I am convinced that both they and the birds of the period would be less interesting and more monotonous in their habits than those which people Europe at the present day, and have for ages been engaged in a struggle for existence with a being so much superior to themselves; and that in prehuman times the horn, hoof, tooth, and coat of mail, to a far greater extent than now, ensured victories which other and more subtle agencies are now necessary to secure on the part of those animals nearest to man in organisation and habits.

Nov. 21 J. S.

The Suez Canal

I NOTICE in your number of 4th inst. an article relating to the Suez Canal (by Mr. Login, C.E., late of the Ganges Canal), and shall be glad if you will allow me to make a few observations with reference to it.

In making his suggestions, Mr. Login appears to have overlooked the fact that there is already a sweet-water canal connecting the Nile with the centre of the isthmus, and passing through the Wadi Toumilat, which it has watered and fertilised; and, further, that it is proposed, when the actual work of excavation in the maritime canal is completed, to commence irrigating operations on a large scale by means of this canal.

As to diverting the Nile, or one of its mouths, and thereby forming the great maritime canal, that is quite another affair. In the first place, if I remember rightly, the water in the present sweet-water canal, where it meets the great canal, is some twelve feet above the level of the latter—in other words, above the level of the sea. Does Mr. Login think, then, that to carry the water at this level for 50 or 60 miles across and above the shallow lakes of Menzaleh and Ballah and the plain of Suez would have required *less* excavation than the actual scheme? In the second place, as Mr. Login says, there would be locks at either end of the canal, which would be not only costly, but most inconvenient for ships in their passage. In the third place I doubt very much whether the whole stream of the eastern branch of the Nile would suffice to keep the canal and the great Bitter Lakes full. Some time ago, indeed, it was disputed whether the Mediterranean and the Red Sea *together*, pouring into the Bitter Lakes, would raise them to the level of the sea, owing to the influences of absorption and evaporation. The facts, however, proved to the contrary.

Still, Mr. Login is much more ambitious. With a *single* stream (that is to say, taking the eastern branch of the Nile at Damietta), less in volume than the present maritime canal, he proposes not only filling the Bitter Lakes to the level of the sea, but raising them to a level of at least twelve feet beyond it (thereby nearly doubling their present volume). Lastly, if the canal and Bitter Lakes could be filled sufficiently by the Nile spring the dry season, it would be overflowing during the floods, and if it could be filled only in the season of the floods, in the dry season it would be nearly empty.

As to the question of breakwaters at the Mediterranean end, Mr. Login rightly says that the annual deposit along the coast is hardly perceptible. I cannot see, therefore, what improvement the breakwaters he suggests would be upon the present ones, seeing that the easterly current *now* passes the extremity of the west pier with a speed of two or three miles an hour. He therefore not only proposes sending a current of at least five miles an hour for a considerable distance up the canal (as his plan infallibly must)—rendering it in strong prevailing winds almost impossible to get out from between his breakwaters—but also sacrificing a splendid harbour of 550 acres in extent.

I quite agree with Mr. Login in thinking that the Suez Canal will not only outlive all abuse, but become one of the greatest blessings to the civilised world.

Birkenhead, Nov. 11 EDW. RAE

The Poles of Mars

PERMIT me through your columns to inquire whether any experiments have been made, by polarisation, to test the statement that the light from the brilliant spots round the poles of Mars is *reflected?*

If nothing has yet been done, will some correspondent decide the point? G. W.

Nov. 25

Lectures to Ladies

IN the fourth number of NATURE there is a letter signed "M." on this subject, in which it is asserted that nearly all the women who most wish to attend these lectures, and who would most benefit by doing so, "are practically shut out from those at South Kensington and at University College, because none of the lectures are given in the evening." Your correspondent gives South Kensington credit for saying something about "persons engaged in tuition," but she adds that it is a mere mockery, as this very fact prevents their getting out in the daytime.

I can confidently say that the Committee for the Higher Education of Women most earnestly desires to interest and benefit those who are teaching others, and who feel the necessity of a better education for themselves; but I believe that the wider and more general object of the whole movement (of which this small committee for South Kensington and Chelsea forms a struggling and isolated element) is, not *so much* to improve those who are already engaged in teaching, as to elevate the tone of education amongst girls who will eventually be teachers, whether as governesses or as mothers.

This I think is enough reason for giving the lectures in the daytime, for it would be difficult for girls to come out alone to classes in the evening. Of course it is hoped that in time a regular system may be established for the training of teachers and students at once, but meanwhile we can but trust that even these weak forces, if they are rightly directed, may have some good effect, if it is only in awakening an interest in these subjects amongst those who can help.

It is very difficult, in London especially, to get at the class of students which we most wish to benefit. I think the fact is that, in London at least, schoolmistresses and governesses are, with a few exceptions, inclined to be narrow and conservative on the subject of educational improvements. If they would only come forward and interest themselves in the scheme their co-operation would be most valuable.

I hope that your correspondent "M." and others who feel as she does, may see this letter and will understand how difficult it is at the outset to satisfy so many conflicting requirements at once.

The course of lectures on Greek History and Literature which Mr. W. R. Kennedy is now giving on Saturdays at the South Kensington Museum is very thinly attended, which is exceedingly discouraging, especially as particular pains have been taken to make these lectures strictly educational, by means of questions set to be worked at by the students at home.

Brompton, Nov. 30 M. A. B.

The American Eclipse

DR. MORTON, Professor of Chemistry in the University of Pennsylvania, has kindly forwarded me photographs of the phenomena of totality. By combining in the stereoscope pairs of these, separated by intervals of about half-a-minute of time, the black globe of the moon appears projected far in front of the luminous prominences and the corona, which are, therefore, clearly seen to belong to the sun. Glass transparencies from negatives specially selected for this purpose, and appropriately mounted, would show these phenomena in a very striking manner.

WILLIAM CROOKES

NOTES

TO-NIGHT the physicists take their turn at the Royal Society, and the physical constitution of the sun will form one of the subjects dealt with.

WE believe that the communication to be read at the Royal Geographical Society on Monday will be one of great interest.

A PERIODICAL, after the model of the popular *Annales des Sciences Naturelles*, will be commenced in Paris at the beginning of the year. It is to be named the *Annales des Sciences Geologiques*. We are promised an important and fully illustrated memoir on the Geology of Palestine, by M. Lartet. The editors of the new journal will be M. Alphonse Milne-Edwards for the Palæontological, and M. Hebert for the Geological departments.

THE Swedish Academy of Sciences has just issued, under the title "Lefnadsteckningar öfver Kongl. Svenska Vetenshaps Akademicus efter År 1854 aflidna Ledamöter," the first number of a series of biographical notices of those of its members who have died since the year 1854. In the absence of the preface, which is deferred until the publication of the second number, we are unable to say whether all the members of the Academy are thought worthy a special biography, or only its most distinguished members. However this may be, we fear that very few of the twenty men, whose lives are recorded in this first number, are known to fame beyond the limits of their native land, notwithstanding that most of them have left behind them honourable records of scientific labour. We do not say all of them, because we notice an archbishop and a bishop, whose claims to admission to the Academy must, judging from their published works, have rested upon their social position or general attainments rather than upon their scientific labours.

WE have been favoured by Professor Newton, of Yale College, with the following notes as to the November star-shower:—"We were unfortunate here this year in observations upon the November meteors. Both nights, the 13th-14th, and 14th-15th, having been overcast. Through breaks in the clouds we saw a few stragglers, some of which were true November meteors, radiating from Leo, and leaving for an instant the soft trail peculiar to those bodies. But the number of meteors during the hour between three and four a.m. of Monday morning was probably not more than double or treble the usual number for any morning. The small part of the sky visible prevented any reliable estimate of numbers. Similar weather has rendered observation impossible at every station from which I have heard."

FROM a preliminary report made to the Association Scientifique de France, by M. C. Wolf, of the Imperial Observatory of Paris, we learn that the corps of observers appointed to watch the November star-shower was duly in the Marseilles district as previously arranged. On the night of the 12th, 210 stars were catalogued at Barcelonette, 116 at Marseilles, 120 at Montpellier, and only 31 at Orange (these last being merely sporadic). On the 13th, 130 stars were noticed at Orange. At this place the centre of the shower seems to have been much obscured by clouds, to the great disappointment of the observers. But elsewhere, especially at Turin, Marseilles, Valence, and Toulon, there was a magnificent display. The work of uniting the manifold results obtained, and deducing the distance of the bolides from the earth, as well as their radiant point, will shortly be commenced.

FATHER SECCHI writes to *Les Mondes* that the meteors of the 14th November were splendidly seen at Rome during half an hour when the sky was quite clear. Although this half-hour was not the time for the maximum display, no less than 183 meteors were observed. On the evening of the 13th, the meteors had already commenced to be visible in greater numbers than ordinary.

THE Rainfall Committee for 1860-69, in their report presented to the British Association at Exeter, remark that, as they are now on the eve of completing their decennial return for 1860-69, it behoves them to consider how they may best secure for the ensuing period the attainment of the objects for which they were originally constituted. They state that, even to those least acquainted with the subject, it will be apparent how much more desirable as well as easy it is to compare simultaneous observations than those wherein the observed values and their times are different. The number and distribution of the existing observation stations, though incomparably superior to that which existed some years since, is still capable of improvement; tracts of land, the rainfall of which as water-supply is of high importance, remaining without adequate observations, while other places are, if possible, too well provided. Mr. G. Symons requests us to announce that any persons who may be recording the fall of rain, or intending to record it, will oblige by forwarding to him, at 62, Camden Square, N.W., their names and addresses, in order that duplicate gauges may not be started unnecessarily near to them.

AT a recent meeting of the Ethnological Society some photographs of the great megalithic monuments in Wiltshire were exhibited. We understand that a scheme is now in progress to obtain funds for the purpose of procuring a series of photographic representations of the megalithic monuments found in England and France, and, if possible, in Europe and Algeria. Such a series, in which the compass-bearings and accurate dimensions would be given, would be invaluable to the student of archæology. Any of our readers interested in the work, who wish to know more of the details, are requested to communicate with the librarian, Royal Geographical Society, 15, Whitehall Place.

WE have been favoured by a correspondent with an account of a lecture given by Dr. Hector, at the New Zealand Institute, on the subject of Mining in New Zealand. The lecturer, in considering the mineral substances excavated from the superficial deposits, proceeded in the first place to give a short account of the building material. According to his statement, the number of building stones already worked in New Zealand is very large. They are generally divided into granites, limestones, and sandstones. There is a granite quarry at Adele Island, in Blind Bay; and the valuable stone also exists in unbounded quantities on the west coast of Otago, under circumstances most favourable for excavation and shipment. There is also very great variety in the colour and grain, whilst the quality is generally admitted to be excellent. Pure siliceous varieties of sandstones occur with the coal formations. The freestones are chiefly in the tertiary formation of New Zealand, from sandstone, to clay sandstones, and argillaceous sandy limestones, and pure limestone. The finest is the Oamaru stone, which, the lecturer stated, excelled most ordinary building stones in other parts of the world. There are no roofing-slate mines in New Zealand being worked, but there is no doubt that they exist. After reviewing the building materials, Dr. Hector passed on to the consideration of the valuable sands, the character and distribution of which were thoroughly explained.

WE have received the following note on the subject of the Holborn Valley Viaduct:—"From the position of the cracks in the columns it is evident that they have been bodily strained over towards the roadway. This may be accounted for by the great difference in weight between half the arch over the roadway and half the arch over the footway. Taking one girder and its load in each case, the weight of that over the roadway would be about eighty-five tons, and that over the footway only twenty-five tons; the additional weight over the column is eight tons, making therefore in all one hundred and eighteen tons supported by each column, and resting on a cap of the column which is five feet wide. Consequently, the centre of gravity of these weights is considerably out of the centre line of the column, and so tends to "cant" it over towards the roadway. Now, since a removal of the centre of pressure only one-sixth of the width of the cap from the centre line will double the strain on the edge nearest to the centre of pressure, the extra strain imposed on the side of the column nearest the roadway may be easily conceived. If in addition to this we assume the joints to be badly made (which appears probable), the cause of failure can no longer be a matter of surprise. For if the joints were made with convex faces no force would affect the outside filaments of the column, unless the whole column were crushed; but if concave, it is obvious that the edges would have to sustain the whole load. In the case of the Viaduct, as the load is unequally applied, the evil of the concave faces would be greatly exaggerated, and the column would necessarily be crushed on the faces nearest the roadway which support (as stated above) the greater weight. The report of the engineer may be shortly expected."

WE have received the following notes from our Dublin correspondent:—

Professor Jellett, B.D., has been almost unanimously elected as President of the Royal Irish Academy. One vote was recorded for Sir Robert Kane, F.R.S.

The Botanical Gardens at Glasnevin are known to the majority of the visitors to Dublin; they are beautifully situated on the banks of the little river Tolka, and contain a large collection of rare plants. Some years ago the Committee of Botany of the Royal Dublin Society, acting on the advice of the director of the gardens, purchased a large iron shed, in which they displayed portions of a collection of plants and their products useful to man. This structure was from the first quite unfit for preserving the valuable collection placed in it; the specimens were necessarily crowded together, and any arrangement was impossible. Still, the large numbers that visited this room to study the contents of the cases, and oftentimes to take notes of the history of the specimens, as told on their labels, testified to the great and intelligent interest that was taken in the collection by the public.

The special function of the Science and Art Department appears to be to provide for the improvement of the people in science and art, and they placed on the estimates for the four years between 1865 and 1869, a sum of 4,000*l.* for building a museum at the Botanical Gardens, close to the front entrance gate, through which so many thousand visitors pass in the course of each year. This sum, small though it may appear, would have been sufficient to have built and cased a large plain building, which would have contained all the present collection, and the additions to it, for many years; but though the money was voted by Parliament for several years, it was never applied to this purpose: and we think it but justice to the cause of science in Ireland, to call the attention of the Science and Art Department to this fact, and to urge them to have this sum inserted in the estimates for the coming year.

It is scarcely necessary to remind readers of NATURE of the importance of having the Museum of Economic Botany as close to the Botanical Gardens as possible, especially when, as in this case, these gardens are so largely resorted to; but it may not be amiss to inform them that the numerous members of the Royal Dublin Society have among themselves contributed, as donations, almost all the specimens in the present Economic Museum.

A local committee has been formed in Dublin of the "Veitch" Memorial. Dr. Moore, F.L.S., Director of the Botanical Gardens, Glasnevin, is the chairman, and a considerable number of subscriptions has been received.

AT a meeting of the Ashmolean Society, Oxford, Nov. 29th, Prof. Lawson read a short paper on Chlorophyll. Although he had made no original observations on this subject himself, he had no doubt but that a general view of what had been done recently by others would prove interesting to the Society. In speaking of the optical properties of chlorophyll, he called particular attention to the observations made on this branch of the subject by Professor Stokes; observations which had disproved the old theory that chlorophyll could be separated into two primary substances of a yellow and blue colour (the xanthophyll and cyanophyll of M. Frémy). He dwelt also upon the fact that Mr. H. L. Smith's careful comparison of the spectrum of the endochrom of diatoms with that of chlorophyll went far to prove the two substances to be identical. Chlorophyll had been formerly supposed to be a product of the vegetable kingdom only; but more recently a green colouring matter, closely allied to chlorophyll if not identical with it, had been detected in many of the lower forms of animal life. These discoveries illustrated in a striking manner how the supposed gaps between the two kingdoms were filled up.

AT Clare College, Cambridge, a scholarship, value 50*l.*, tenable for three years, will be given for proficiency in natural science. The examination, commencing March 30, 1870, will be in chemistry, chemical physics, comparative anatomy, physiology, and geology. Excellence in one or two of these subjects is preferred to a less perfect acquaintance with a greater number. Further particulars can be obtained from the tutor of the college.

THE *Pall Mall* announces the publication of the seventeenth volume of the Report of the Schools Inquiry Commission. It comprises reports on the schools in what the Commissioners have defined as the north-western district—namely, the counties of Lancashire and Cheshire.

WE understand that it is not the intention of the Government to fill up the vacancy in the curatorship of the Botanic Gardens at the Mauritius, caused by the death of Dr. Meller, but to promote the head-gardener to the highest post of authority.

DR. MCQUILLEN has exhibited in the Microscopical Department of the Academy of Natural Sciences at Philadelphia, slides of blood corpuscles of men and the lower animals, to which chloroform and nitrous oxide had been administered, to show that there was no morphological change in these bodies after administration of anæsthetics, as stated by certain physiologists in England. He showed specimens also in which, the blood corpuscles having been brought into actual contact with chloroform and ether, disintegration had taken place.

ON the same occasion, Mr. W. H. Walmsley called attention to the very great merits of glycerine jelly as a medium for the preservation of every description of objects, animal or vegetable. With this the most delicate tissues can be perfectly seen and examined; it preserves the colours, is very tenacious, and "its refractive powers are sufficient to render all inert structures transparent; while even the delicate lines on the scales of a mosquito's wing are as distinctly visible as if mounted dry." The formula for the preparation of this valuable jelly is thus set forth:—Take one package of Cox's gelatine, wash repeatedly in *cold* water, then place in a vessel and cover with *cold* water. Allow it to soak an hour or two, pour off superfluous water, add a pint of *boiling* water, place vessel on fire, and boil for ten or fifteen minutes; remove from fire, and when cool, but still fluid, add the white of an egg well beaten, replace on the fire, and boil until the albumen of the egg coagulates. Strain while hot through flannel, and add an equal portion by *measurement* of Bower's pure glycerine, and fifty drops of carbolic acid in solution: boil again for ten or fifteen minutes, and again strain through flannel; place in water bath, and evaporate to about one half; then filter (through cotton) into 2 oz. broad-mouthed phials. When thus made, the jelly is to be used in the mounting of objects as follows:—Place the stock bottle in a small jar of boiling water; when it becomes fluid, a sufficient quantity must be removed to the slide (previously warmed) with a glass rod; the object (previously soaked for some hours in equal parts of glycerine and distilled water, with a few drops of alcohol) is to be placed in the drop of fluid jelly, a cover applied, and a light weight placed upon it to exclude superfluous jelly. When cold, clean off the slide with a knife, wash in cold water, and finish with a ring of gold size or shellac varnish.

THE volume of the Memoirs of the Geological Survey of England and Wales, just published, consists of an important monograph on the Geology of the Carboniferous Limestone, Yordale Rocks, and Millstone Grit of North Derbyshire and the adjoining parts of Yorkshire, explanatory of sheets 81 N.E. and S.E., and 72 N.E. of the Survey Map. The work is by Messrs. A. H. Green, C. Le Neve Foster, and J. R. Dakyns; and contains an elaborate description of the geology of the district, illustrated with numerous important sections and a few views. Mr. Etheridge has contributed an Appendix and tabular list of fossils, with indications of the localities in which they occur.

ASTRONOMY

Spectroscopic Observations of the Sun

PROFESSOR C. A. Young, of Dartmouth, U.S., has communicated to the October number of the *Journal of the Franklin Institute* the following important observations of solar protuberances, which entirely endorse the work done by Mr. Lockyer in this country. We are enabled to place them thus early before our readers by the kindness of Professor Morton.

September 4th, 1869.—Prominences were noted on the sun's limb at 3 p.m. to-day in the following positions, angles reckoned from North point to the East:—

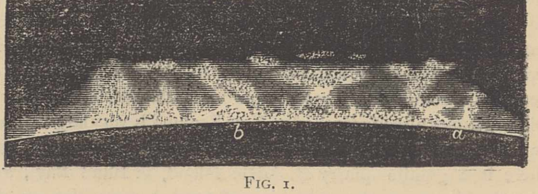


FIG. 1.

1. + 70° to + 100°, very straggling, not very bright.
2. − 10°, large and diffuse.
3. − 90°, small, but pretty bright.

September 13th, 1869.—The following protuberances were noted to-day.

1. Between + 80° and + 1100, a long straggling range of protuberances, whose form was as in Fig. 1. I dare not profess any

very extreme accuracy in the drawings, not being a practised draughtsman, but the sketch gives a very fair idea of the number, form, and arrangement of the immense cloudy mass, whose height was about 50″ and its length 330″ (22,500 miles by 1,350,000). The points *a* and *b* were very bright.

2. + 135° small, but very bright at the base, of this form (Fig. 2).

3. − 85° of this form (Fig. 3).

The dark spot, marked *c*, was very curious, reminding one strongly of the so-called fish-mouth in the nebula of Orion. I saw no change in it for 20 minutes. On the other hand, the first

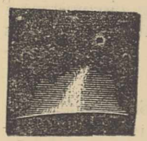


FIG. 2.

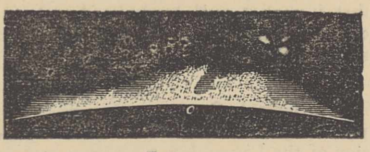


FIG. 3.

series mentioned were changing rapidly, so that at five o'clock the sketch which was drawn at two was quite inapplicable, only the general features remaining unaltered.

4. − 128°, about 20″ high, forked, as in Fig. 4.

The structure was *cirrus* in every one but No. 3, which seemed more like a mass of cumulus.

FIG. 4.

To-day, for the first time, I saw b_1 reversed in the chromosphere when the slit was tangent to disc; 1474 was easy; the new line at 2602 cannot be detected as yet.

At 2.25, while examining the spectrum of a large group of spots near the sun's western limb, my attention was drawn to a peculiar double *knobbishness* of the F line (on the sun's disc, not at the edge), represented by Fig. 5, *a*, at the point *e*. In a very few moments a brilliant spot replaced the knobs, not merely interrupting and reversing the dark line, but blazing like a star near the horizon, only with blue instead of red light; it remained for about two minutes, disappearing, unfortunately, while I was examining the sun's image upon the graduated screen at the slit, in order to fix its position, which was at − 82½, about 43″ from the edge of the limb, about 15″ inside of the inner edge of the spot-cluster. I do not know, therefore, whether it disappeared instantaneously or gradually, but presume the latter. Fig. 5, *b*, attempts to give an idea of the appearance. When I returned to the eye-piece, I saw what is represented at Fig. 5, *c*, &c. On the upper (more refrangible) edge of F there seemed to hang a little black mote, making a *barb*, whose point reached nearly to the faint iron line just above F. As given on Angström's atlas, the wave-length of F is 486·07, while that of the iron line referred to is 485·92 (the units being millionths of a millimetre). This shows an absolute change of 0·15 in the wave-length, or a fraction of its whole amount, represented by the decimal 0·00030, and would indicate an advancing velocity of about 55·5 miles per second in the mass of hydrogen whose absorption produced this barbed displacement.

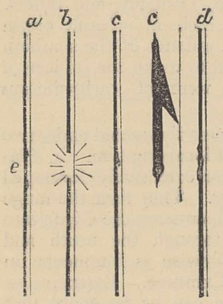


FIG. 5.

The barb continued visible for about five minutes, gradually resolving itself into three small lumps, one on the upper, and two on the lower line, Fig. 5, *d*. In about ten minutes more, the F line resumed its usual appearance. I did not examine the C line, as I did not wish to disturb the adjustments and risk losing some of the curious changes going on under my eye.

After the close of this strange phenomenon, I examined, with our large telescope of 6-inch aperture, the neighbourhood in which this took place, and found a very small spot exceedingly close to, if not actually *at*, the place. This was at 2.45. At 5.30 it had grown considerably.

Undoubtedly, the phenomenon seen was the same referred to by Mr. Lockyer when he speaks of often seeing the bright lines of the prominences not only at the sun's limb but on his disc. It is the only time I have had the good fortune to see it as yet.

GEOLOGY

Structure of Eophyton

THE *Geological Magazine* for the present month contains a paper by Mr. Henry Hicks, describing the structure of a fossil, from the Lower Arenig rocks of Ramsey Island, near St. David's, which he considers to be an *Eophyton*, resembling *E. Linnæanum* of Torell. The rocks in which this fossil occurs rest conformably upon Upper Lingula flags, and underlie rocks of the Skiddaw or Tremadoc series.

Mr. Hicks describes and figures the fossil under the name of *Eophyton* (?) *explanatum*. He describes it as a moderately convex stem, about four lines broad, jointed, and ribbed throughout its whole length. At one joint in the specimen described, the ribs bend outwards, as if to form a branch. The stem is covered by a very thin cortical substance, within which it is composed of minute tubular columns, lying close together, and running the whole length from one joint to another.

The *Geological Magazine* also contains papers by Mr. Ruskin on Banded and Brecciated Concretions, illustrated with a plate and several woodcuts; by Mr. Poulett Scrope, on the pretended raised Beaches of the Inland Slopes of England and Wales, severely criticising Mr. D. Mackintosh's recent volume on Geology and Scenery; by Prof. Harkness, on the middle *Pleistocene* deposits of Britain; by Mr. R. Tate, on additions to the list of British *Brachiopoda* of the secondary rocks, including a table showing the distribution of the British *Liassic Brachiopoda*; and by Mr. W. H. S. Westropp, on the occurrence of "albite" in the granite of Leinster. Lord Enniskillen contributes a catalogue of the type specimens of fossil fishes in his collection. The number also contains the usual notices, reviews, and abstracts of the proceedings of societies, correspondence, &c.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, December 2.—Dr. A. W. Williamson, F.R.S., in the chair. Sir Roderick Murchison, Bart., F.R.S., Messrs. M. H. Cochrane, Edward Smith, T. Walton, M.R.C.S., G. M. Hopwood, John Wiggin, Thomas Gibb, and George Harrison were elected Fellows. A paper on some points of the Chemical Nomenclature of Salts by Mr. H. G. Maden was read. The author advocated the use of the prefixes "proto" and "per" instead of the terminations "ous" and "ic" in the nomenclature of salts, and expressed his preference for the systematic names formed from English words, as "copper sulphate." Dr. Attfield recommended an adherence to trivial names like "calomel" and "corrosive sublimate," when possible, as changes in theory necessarily led to inconvenient alterations in nomenclature. Dr. Williamson objected to Mr. Maden's proposal to revert to the use of the prefixes "proto" and "per," on the ground that they had formerly produced great confusion, particularly in the nomenclature of the chlorides of mercury. He advocated an extension of the use of the terminations "ous" and "ic," which indicated the places of compounds in a series without binding chemists to particular views of constitution. He thought Mr. Maden's preference for English words might be carried too far and produce such terms as "brimstonic acid" and "charcoalic oxide." Mr. Vernon Harcourt expressed his general concurrence with the author. Dr. Odling pointed out that in certain names, such as "ferricyanide of iron," it was advantageous to use both English and Latin names. Dr. Voelcker thought that the employment of different names for the same substance familiarised chemists with different views of constitution. A communication from Mr. J. Hunter on the analyses of sea-water from different depths was read. The author gave the results of observations made during the recent scientific expedition of the *Porcupine*.

Zoological Society, November 25.—Mr. John Gould, F.R.S., V.P., in the chair.—Mr. Sclater made some remarks on the condition of various zoological gardens on the Continent recently visited by him, and on rare animals observed in those establishments. The secretary exhibited on behalf of Mr. John Brazier, C.M.Z.S., the eggs of a megapode (*Megapodius*) from Banks Island, New Hebrides, indicating the existence of a species of this genus in that group of islands. A letter was read from Mr. W. T. Fraser, C.M.Z.S., giving some confirmatory facts respecting the alleged existence of the rhinoceros in Borneo. Mr. R. B. Sharpe exhibited a specimen of *Alcedo grandis*, a rare species of kingfisher from the Terai of Darjeeling. Mr. Andrew Murray exhibited specimens of some articles of food sold in the markets of Old Calabar. These consisted of examples of a frugivorous bat (*Pteropus*) ready trussed, specimens of a rare crustacean (*Callianassa turnerana*), and the larvæ of a Longicorn beetle found in decayed palm-trees. A letter was read from Mr. E. L. Layard, of Cape Town, F.Z.S., containing some remarks as to priority of discovery of the remarkable nesting-habits of the hornbills. Mr. H. J. Elwes, F.Z.S., exhibited a fine pair of horns of the Sinaitic Ibex (*Capra nubiana*), and Mr. H. E. Dresser, F.Z.S., some eggs of the little gull (*Larus minutus*) recently taken in Russia. A communication was read from the Rev. O. P. Cambridge, containing notes on some spiders and scorpions recently collected in St. Helena by J. C. Melliss, Esq. Judging from this collection, which, however, was of small extent, the character of the *Araneidea* of St. Helena appeared to bear a thoroughly European stamp. A communication was read from Dr. O. Finsch, C.M.Z.S., and Dr. G. Hartlaub, F.M.Z.S., on a small collection of birds recently received by the Museum Godefroyanum from the Tonga Islands. The species contained in this collection were eleven in number, one of which was believed to be new to science, and was proposed to be called *Myiolestes Heinei*. A communication was read from Surgeon Francis Day, F.Z.S., containing the second portion of his critical remarks on the fishes in the Calcutta Museum. Two papers were communicated by Mr. J. Brazier, C.M.Z.S., on the localities of certain species of land-shells and volutes found in Australia and the neighbouring islands, and on the species of cones met with in Port Jackson, N.S.W. Mr. R. B. Sharpe read a paper on the birds of Angola collected by J. J. Monteiro, Esq., which were accompanied by the notes of the collector. The present collection contained twenty-nine species, many of which were of great interest. A communication was read from Mr. D. G. Elliot, F.Z.S., containing a monograph of the genus *Pelecanus*. The species of pelicans recognised by Mr. Elliot were nine in number. Mr. Sclater exhibited a specimen of a new species of Mexican wren from the Berlin Museum, which he proposed to describe under the name of *Thryothorus nisorius*. Mr. Sclater also read some notes on the identification of two mammals recently described by Dr. Gray from specimens living in the Society's Gardens. A paper was read by Messrs. Sclater and Salvin on Peruvian birds collected by Mr. Whitely, being the fifth of a series of communications on this subject. Mr. John Gould, F.Z.S., exhibited and described a new species of kingfisher from North-Western Australia, which he proposed to call *Dacelo occidentalis*.

London Mathematical Society, November 25.—Prof. Hirst, and subsequently Prof. Sylvester, V.P., in the chair.—The Rev. James White was admitted into the Society, and the Rev. Percival Frost proposed for election. Dr. O. Henrici exhibited a model of the cubic surface $xyz - (\frac{4}{3})^3 (x + y + z - 1)^3 = O$, which has three biplanar nodes; it was constructed in cardboard to a scale of $2\frac{1}{2}$ inches, as unit. A sufficient number (eleven) of sections $x + y + z - 1 =$ constant, cut out in cardboard, are connected in a horizontal position, and kept at their proper distance by three vertical sections $y = z$, $z = x$, $x = y$, with regard to which the surface is symmetrical. The model contains the central part of the surface with the three nodes, and is bounded by a sphere of 8 inches radius, with its centre at the origin, large enough to show the position of the three straight lines in the surface (each counting for nine), and to give an idea how the surface extends to infinity. The interstices between the cardboard are intended to be filled up with plaster of Paris, so as to form a solid model. Mr. Clifford gave an account of an extension of a theorem of Serret's illustrated by tables, one of which, designated A, is annexed, with its explanation.

Power.	2	3	4	5	6	7	8	9	10
Conic	6	8	11	13	16	18	21	23	26
Cubic.	—	10	12	15	19	21	24	28	30
Quartic	—	—	15	17	20	24	29	31	34
Quintic	—	—	—	21	23	26	30	35	41
Sextic	—	—	—	—	28	30	33	37	42
Septic	—	—	—	—	—	36	38	41	45
Octavic	—	—	—	—	—	—	45	47	50
Nonic	—	—	—	—	—	—	—	55	57

The tables, for convenience, refer to points instead of lines, and curves of given order instead of curves of given class. The meaning of them will best appear from an example. Thus, in the Table A above, opposite the word quartic and under the power 8 we find the number 29. This means that if the eighth powers of the equations of 29 points are connected by a syzygy, the points are all on a quartic curve. There are, moreover, intersections of the quartic by an octavic, which, in virtue of a theorem of Jacobi's, is an additional piece of information. Mr. Clifford also exhibited a second Table B, constructed in a similar manner for surfaces. Mr. Roberts made a statement of a theorem in invariants, which, however, is so mixed up with other considerations and details, that it cannot well be isolated and its limiting circumstances explained without going into further details than the limits of this notice permit.

Edinburgh

Geological Society, December 2.—Mr. Geikie, F.R.S., president, in the chair. The first paper was on the Succession of the Laurentian, Cambrian, and Lower Silurian Rocks on the Shores of Loch Broom, being a letter addressed to the president by Sir Roderick Murchison.

Sir Roderick Murchison, in his paper, after alluding to his previous researches in Scottish geology, and especially to the order which he had been enabled to establish among the rocks of the north-west Highlands, proceeded to give the results of a visit which he had paid last summer to the west of Ross-shire. Along the shores of Loch Broom he found clear sections confirmatory of his previously published views. Among the Summer Isles at the mouth of that loch the Laurentian gneiss is found with its usual characteristic petrographical character. It throws off the dull red or chocolate-coloured sandstones which in one mountain, Ben More, must attain a thickness of several thousand feet. These strata are inclined gently towards the east, and are overlapped unconformably by the quartz rock and limestone which form the lowest portions of the Lower Silurian series. From the upper part of the uppermost quartz rock there is a perfect ascending passage with the upper flaggy gneiss, which rolls eastward over the rest of the Highlands. By this fresh appeal to the natural sections of the north-west Highlands, Sir Roderick had been again able to confirm the now established order of succession among these ancient rocks.—Mr. Geikie, F.R.S., afterwards communicated a series of notes for a comparison of the volcanic geology of central Scotland with that of Auvergne and the Eifel. The author began by alluding to the labours of Boué, Forbes, Scrope, Daubeny, and others. He then sketched the area occupied by rocks of volcanic origin between the Grampians and the silurian uplands of the southern counties. The rocks which he proposed to make the subject of more special remark in this paper were of carboniferous age.

They were capable, he said, of being broadly treated under two groups—1st, plateaux; and 2d, points of local eruption. 1. Plateaux of carboniferous volcanic rocks are extensively developed in the western part of the midland valley. They form the range of the Campsie and Kilpatrick fells, and, crossing the Clyde into Renfrewshire, sweep for many miles through the north and north-east of Ayrshire. They occur likewise as fragments on the Clyde islands, Arran, Bute, and Cumbrae. Extensive as the present area of these rocks is, there can be no doubt that it once covered a much greater surface, and that one great plateau of lavas and tuffs stretched from the Ochil Hills to the south of Cantyre. Throughout the wide district where the rocks still remain they retain a remarkable horizontality. They consist of various porphyrites, melaphyres, and tuffs, arranged in beds, which are placed over each other with great regularity. Hence the hillsides wear a terraced appearance from the alternation of harder and softer beds. This feature characterises the Campsie fells and the hills south-westwards to Ardrossan, but it is most conspicuously displayed in some of the valleys at the south end of Bute. One of the distinguishing features of these plateaux is the comparative infrequency with which any vent or true point of eruption can now be detected. Occasionally such a vent is found as a boss of coarse volcanic agglomerate, or of porphyrite or melaphyre; but, as a rule, all the foci of eruption are now buried under the materials which they emitted. Another feature which runs through the plateaux is the apparent continuity of the several beds. Viewed from a little distance, the terraces of trap seem each perfectly continuous for long distances. A closer examination often shows that though the terrace may run on, the rock of which it consists is formed of different sheets, which, though lying on the same plane, have proceeded from different vents. Mr. Geikie then pointed out the structure of some of the volcanic plateaux of central France as illustrative of those features of the Scottish plateaux to which he had referred. (2) While the western half of the Scottish carboniferous area is characterised by the wide extent of its volcanic plateaux, the eastern half is as strikingly distinguished by the abundance of its points of local eruption. Traces of these independent but closely segregated vents are scattered over almost the whole extent of Fife and the Lothians. They belong as a whole to the lower division of the carboniferous formation. The evidence by which their position can now be ascertained consists of masses of stratified tuff, frequently associated with contemporaneous outflows of melaphyre. The number of the vents in some parts of the country must have been very great. During the deposition of the lower carboniferous rocks, the area of Linlithgowshire and great part of Fife and East Lothian was dotted over with little volcanoes, each throwing up its cone of ash, or here and there emitting also a short current of lava. In some places the vents were so closely placed together, that their ejections formed in the end one long volcanic bank, such as the Garlton Hills and the range of heights between Bathgate and Linlithgow. The vents were singularly local in their development. Thus, while they continued in activity throughout Linlithgowshire and Fife, as well as in Haddingtonshire, the intervening area of Edinburghshire remained almost without them. Their long continuance in the districts where they had once broken out is remarkable. During the time represented by the deposition of many hundred feet of strata, the area of Linlithgowshire continued to be the theatre of a wonderful volcanic activity, new cones breaking out as the old ones were washed down. Yet the county of Edinburgh, only a few miles to the east, remained during that long period almost wholly unaffected by any volcanic action. Reference was then made at some length to the extinct volcanoes of Auvergne and the Eifel, and it was shown that in their form and distribution, their small size, the nature of their products, and the protracted period during which they had been in activity, they enable us to realise vividly what was the condition of a great part of central Scotland during the earlier ages of the carboniferous period. The concluding portion of the paper dwelt upon the denudation of the volcanic rocks of Auvergne and of Scotland. Mr. Scrope had shown conclusively that the wide and deep valleys of the Loire, the Dordogne, and other streams of central France had been carved out of volcanic rocks and fresh-water strata by subaërial erosion alone. The form and structure of these valleys were compared with those of valleys which have been excavated out of volcanic rocks in Scotland, and it was argued that the similarity of result was in all probability due to a similarity of cause. In the Scottish valleys the influence of ice, and perhaps, in some cases, also of the sea, had come into play to augment or modify that of the subaërial forces. Yet there was every reason to believe that in Scotland, as in France, the main share of the work had been done by rains, frosts, and streams.

DUBLIN

Royal Irish Academy, November 30.—The Earl of Dunraven, F.R.S., V.P., in the chair. The minutes of the former meeting, having been read and approved of, were signed. The chairman briefly expressed his regret and that of the Academy at the resignation of their former president, Lord Talbot de Malahide, and stated that he was ready to receive the names of any candidates for the vacant office. The Rev. Dr. Lloyd, F.R.S., Provost of Trinity College, proposed that Professor Jellett should be elected president. Among all the members of the Academy he knew of none save one (Rev. Dr. Salmon, F.R.S.), who, in his opinion, from his great scientific attainments, was so eligible for this important post; and his friend Dr. Salmon had announced his determination to withdraw his claims in favour of Mr. Jellett's. Mr. Jellett was distinguished not only for his knowledge of the higher branches of mathematics, but also for his knowledge of their application, a combination not often to be met with in the same individual. He felt sure that Mr. Jellett's presidency would be as distinguished as that of any of his predecessors. Dr. Stokes, F.R.S. (in the absence of the Rev. Dr. Russell, President of the Royal College of Maynooth), seconded Mr. Jellett's nomination. He reminded the Academy of the importance of having for its president one who was well versed in its affairs, and Mr. Jellett, when secretary of the council of the Academy, had acquired this knowledge. He would not refer to Mr. Jellett's position as a man of science, but he would remind that large and influential section of the Academy, the antiquaries, how much assistance they could have, and were constantly having, from science. Archæology was intimately connected with the natural sciences. Even the laws relating to the flow and ebb of the tides were shown by Professor Haughton to be thus connected, for he had calculated the hour of low tide in the Bay of Dublin on the day of the battle of Clontarf, and his hour absolutely coincides with that named in the written record as translated by the late lamented Dr. Todd. Sir William Wilde said that the provost had spoken of Mr. Jellett's position as a man of science, and Dr. Stokes had spoken of his general attainments and knowledge of the Academy's affairs; but he wished to speak of him as a colleague with whom he had been associated for many years, and as an honest, straightforward man, who, irrespective of all party feeling, did what he considered right without fear, prejudice, or favour. The Academy had had "antiquarian" presidents; it was now time to have one scientific president, and so win back many scientific wanderers. He felt sure Mr. Jellett would never forget the interests of the antiquarian party in the Academy, and he looked forward to a bright career for the Academy under Professor Jellett. Dr. Stewart, as a very old member of the Academy, supported Mr. Jellett's claims. There being no other candidate proposed, the ballot was opened and scrutineers appointed. The chairman announced that there appeared, for Professor Jellett, 55 votes; for Sir R. Kane, 1. He therefore declared Mr. Jellett duly elected as president. The chairman then, with a few graceful remarks, in which he congratulated the Academy on its choice, resigned the chair to the new president.—Sir W. Wilde exhibited a number of antiquities found in the counties of Dublin, Londonderry, and Queen's County, among which were a spirally twisted gold torque, either used as a finger ring or a head ornament, three bronze mammillary brooches, some fragments of bronze rings and bracelets, and a semicircular brooch of beautiful decoration and unique form. The remainder of the collection was chiefly of iron, and consisted of three very fine swords with hilts. Sir William also exhibited a collection of antiquities and casts from North and South America.—Professor Apjohn, M.D., read a paper "On a new step in the analysis of sugar." He stated that crude sugar and syrups generally contained three varieties of saccharine matter, and in the case of such a mixture, the method hitherto in use only accomplished the estimation of one of these, that usually known under the name of Cane Sugar. The means of obtaining its amount, by the optical saccharometer alone, or by Barreswil's solution, each being applied before or after conversion, he then briefly explained, pointing out at the same time that neither the optical nor the chemical method could give any information in relation to the amount of inverted sugar or of grape sugar (crystallised glucose) which might happen to be present. This problem, however, he thought could be completely solved by a combination of the processes adverted to, and this he demonstrated by drawing attention to two equations—the one expressing the result of an observation with the saccharometer, the other that obtained by operating on the solution of copper with the syrup both before and after its inversion. These equations involved three unknown quantities, but one of the three (the cane) might be determined by a preliminary observation with the saccharometer, and as by this contrivance the number of unknown quantities would be reduced to two, the problem admitted of a complete solution. This method of analysis he had recently applied to several saccharine substances, and with satisfactory results.

Royal Geological Society, November 10.—Dr. W. Stokes, F.R.S., in the chair.—Rev. Professor Haughton read a paper on the discovery of crystals of Albite in the Dalkley granite; the mineral was found by Mr. W. H. S. Westropp, in small crystals mixed with crystals of fluorspar. The existence of this felspar in the Leinster granite was predicted by Professor Haughton some years since, but it had not been found in a separate crystalline form until these specimens were discovered. This fact adds a new link to the chain of observations made by Professor Haughton relative to the classification and origin of granites, and shows the connection between the three great granite masses of Mourne, Leinster, and Cornwall, in all of which now the presence of albite has been distinctly ascertained. —Dr. Macalister exhibited some human and canine bones brought by Mr. H. Ormsby, Esq., Geological Survey, India, from the celebrated cave Uaimh Fraing, Island of Eigg, the remains of some of the Macdonald clan, who were smothered there in the sixteenth century.—Dr. Foot exhibited human bones from the cave of Dunmore, county Waterford, the remains of an Irish tribe suffocated there in the tenth century.—Specimens of the gold-bearing quartz of South Australia were sent for exhibition by Mrs. Gray, of Nareebnareeb, and of the gold-bearing quartz of the Rocky Mountains by Dr. Trevor, of Mentena.—Mr. Harte, County Surveyor of Donegal, exhibited some specimens of polished red granite from that county, which were of great beauty, similar in appearance to that of Peterhead, Aberdeenshire.

Natural History Society, December 1.—Mr. W. Andrews, V.P., in the chair. Dr. A. W. Foot read a paper entitled "Notes on Irish Lepidoptera collected during the past summer." These notes were chiefly records of a pleasant summer's excursion in which no very great rarities were met with. *Colias edusa* was found abundant in the County Kilkenny, and *Vanessa polychloros* was mentioned on the authority of a friend as having been seen in the County Wicklow. Mr. Williams, Mr. F. W. Kirby, Mr. Montgomery, and Dr. Haughton made remarks on the interest of many of the facts recorded in these notes. Mr. W. Andrews, the chairman, stated that it was a mistake to call *Chrysophanus dispar* the scarce copper; that *C. virgaureæ* was the scarce copper. He asserted that *C. dispar* was not rare in England, and that he had met with it in Kerry. He also said that the *Limenitis* which he had exhibited some years ago as from Tarbert, was neither *L. sibilla* nor *L. camilla*, but something quite different from either; and that those who thought it was *L. camilla* were quite wrong. He said he would bring all these facts before the society at another time. [Perhaps some of our entomological readers will enlighten us on these points. Is it possible that *C. dispar* is not a scarce butterfly? Is not *C. virgaureæ* a continental insect? If the *Limenitis* referred to is not, as competent authorities assert, the *L. camilla* of the Continent, what species is it?]

Newcastle-upon-Tyne

Chemical Society, October 28. Annual Meeting.—Mr. I. Lowthian Bell, F.C.S., President, in the chair. After the transaction of the business of the Society, the President read his address, in which he referred to the more important subjects which had engaged the attention of the Society at the evening meetings. He dwelt at length upon Mr. Pattinson's paper on the relations between English and Foreign Alkalimetry and Chlorimetry, which pointed out the fallacious results arising from the retaining of the old atomic weight of soda. He also called attention to the importance of Mr. B. S. Proctor's paper on the Root of the Rhubarb Plant, which exposed the fallacy which had led druggists and the medical profession, for the sake of mere appearance, to reject the portion of the drug richest in the active principle. The following extract from the address, alluding to the relations of science to the public health, is particularly interesting:—"Among the manifold applications of the truths revealed by means of chemical research, there is none more gratifying to the philosopher or to the philanthropist than that whereby chemistry is rendered subservient to the protection and promotion of the public health. It has been reserved almost for our own time to have it demonstrated that the observance of certain so-called sanitary regulations is connected by the closest bonds with the rate of mortality. This has been proved repeatedly in several large cities, at one time conspicuous for the high annual death-rate among their inhabitants, but which, by the authorities dealing with the causes of offence, now escape from the penalty which never fails to attend on the transgression of any great natural law. We need not, indeed, go far for an example in illustration of the doctrine I am enforcing, for in the very town in which we are now assembled, the rapid increase of population had outgrown as it were some of those means and appliances which must accompany the crowding together of a vast number of human beings on a small area of ground. The municipal authorities of Newcastle were no sooner properly impressed with the gravity of their position, and convinced that the remedy and responsibility rested in their own hands, than the most vigorous measures were resorted to in order to grapple with the evil, and we have, in consequence, to congratulate ourselves on a remarkable alteration in the death-rate of this town. It may not be unworthy of mention that the first quarter of 1866 exhibited a mortality corresponding to 48·4 for every thousand of the inhabitants, and that the average for the whole of that year was a mere fraction within 40, viz., 39·7. Taking 10 years, ending with 1860, it was 35·4 per 1000. It cannot be otherwise than satisfactory to compare this with the three quarters of the present year, which is only 26·2, and for the last quarter the deaths only amounted to 23·3 per 1000; in short, from having held a most unenviable position among the most unhealthy towns of the empire, we are now conspicuous among those in which the mortality is the lowest. I am glad to be able to state that the condition of our atmosphere, as affected by the burning of coal and the emission of objectionable vapours, is now engaging the attention of a Committee, with the Mayor at its head, appointed to inquire into the subject. I trust, now that the public mind has been directed to the evil of a smoke-obscured sky, or poisoned air, before long, the inhabitants will experience a happy change from the result of the labours of those charged with the investigation. It is only, however, due to our chemical manufacturers to state that they are fully alive to the importance of not permitting any unnecessary escape of vapours, having an actual value to themselves, and very inconvenient to others when set at large, and therefore, that they do not intend to rest content with the occasional visit of the Government inspector, or of their own superintendents, but are making arrangements for the permanent and continuous sampling of the gases after they have passed their condensing apparatus. Their observations in this direction, will, I feel assured, be much lightened by a very ingenious aspirator, constructed by one of our members, Mr. Swan, now on the table, to which I would invite inspection. I have, myself, been engaged for some time in an examination of the state of combustion experienced by the fuel in our blast-furnaces, and I am so satisfied that a proper study of the phenomena attending it involves considerations of the utmost importance to the iron-smelter, that I intend availing myself largely of the facilities which the apparatus of Mr. Swan is capable of affording." The officers of last year were re-elected by a large majority.

Norwich

Geological Society, November 11, Anniversary Meeting.—The Rev. John Gunn, F.G.S., President, in the Chair. The President and Hon. Secretaries (Mr. J. E. Taylor, F.G.S., and Mr. John King) were re-elected. In his opening address Mr. Gunn alluded to the death of one of the hon. members of the Society, Mr. Bernard B. Woodward. Referring to a paper by Mr. Harmer, F.G.S., on the Chillesford clay and the crag containing *Tellina balthica*, he stated that he had himself published a diagram of the coast and inland sections of Norfolk, and a description of what seemed to him a downthrow of Chillesford clay, or an upthrow of the chalk. He had also instituted a series of measurements of the various levels at which this bed appeared above the water, with a view to determining the amount of disturbance, and had found the heights ranging from fourteen to thirty-two feet. He thought that the difference between the coast and inland sections might be due to this disturbance. Mr. Gunn then noticed an excursion which had been made by the Society to Aldborough, where the Norwich crag had been found near the railway station, associated with undoubted red crag forms. He also adverted to the paper by Mr. Tylor (read before the Geological Society of London) on Valley Gravels. In the discussion which followed the President's remarks, Mr. Harmer gave an outline of the theory he had put forth in his Paper with reference to the bed of shells containing *Tellina balthica*. Both he and Mr. Searles Wood held this to be the base of the lower drift beds, and contended that a great change in the physical geography of the Eastern counties had taken place between the period when the upper and lower Norwich crags had been formed, and the time when the *Tellina balthica* bed had been deposited. The former had been deposited in an estuary opening to the south, the latter in a similar one opening to the north. This argued an oscillation of level in the meantime. Mr. Harmer also expressed himself against the theory that so-called valley gravels were of fluviatile origin, and pointed to Lopham Ford, where the height of the ground was only twenty feet above water level; and yet which was the point of departure for two streams whose much higher banks at some distance were covered with valley gravels containing flint implements. With regard to the opinion that many of the flint implements had been rolled down or transferred to the lower levels, Mr. J. E. Taylor stated that at Sainton Downham these implements were found in their most perfect and totally unaltered condition at the lowest levels. The chippings and edges were as fresh as when the weapons left the hands of their makers. He suggested that the vicinity of Lopham Ford might have been denuded by atmospherical action since the origin of the present rivers. Mr. Taylor then gave an account of a recent visit to Chillesford, in Suffolk, where he had studied the typical section, and taken an inventory of the commonest fossils and their mode of occurrence. The crag intercalated between the Chillesford clay contained great quantities of *Mactra solida*. This was the shell found so abundantly at Arminghall, near Norwich, in a bed resting on a portion of the Chillesford clay. The usual beds which, in the neighbourhood of Norwich, were found underlying this clay, were absent at Arminghall, so that the clay rested on the solid chalk. He had no doubt, therefore, that the intercalated crag at Chillesford was represented at Arminghall by the *Mactra solida* bed.

PARIS

Academy of Sciences, November 29.—The following mathematical papers were read:—On a potential of the second kind which solves the equation with partial differences of the fourth order, expressing the interior Equilibrium of elastic, amorphous, non-isotropic substances, by M. de Saint-Venant, and a note on a certain class of differential equations of the second order by M. Laguerre. A note found among the papers of the late M. Léon Foucault on the construction of the optical plane was read. It gave a description of the method adopted by M. Foucault to obtain a perfectly plane surface of glass, and was supplemented by some remarks of M. A. Martin on his experience in the employment of the same method.—M. P. Gervais presented a note accompanying preparations relating to the anatomy of the Great Anteater.—M. Melsens communicated a memoir on the Passage of Projectiles through Resisting Media, in which he treats of the conveyance of air by projectiles moving through it, and the effect of the compression of the air upon the course of the projectile.—M. Scoutetten presented a note on the Preservation and Improvement of Wines by Means of Electricity. He stated that by the application of a current of electricity generated by a battery, and passed into the wine by means of platinum electrodes, its quality is greatly improved.—M. A. Gerardin remarked upon the unhealthy conditions produced by the discharge of the water of starch manufactories into rivers, and maintained that he had restored some rivers into a healthy condition by causing the water containing albuminous and other organic refuse to be discharged upon well-drained arable land. A paper on a very simple system of floodgates with a constant yield under variable pressure, by M. Maurice Lévy, was communicated, as also a note by the same author on a peculiar system of skew-bridges. MM. P. Desains and E. Branly communicated some investigations on solar radiation. They have found that the calorific action of the sun increases in intensity with the altitude of the place of observation, but that the transmissibility of the rays through water diminishes with the altitude. The transmissibility of the solar heat through water and alum was found to be greater in the morning than at noon, but this was not so strikingly the case in October as in August. The authors stated that their spectroscopic observations were in accordance with the preceding results. A paper by M. J. Moutier on the expansion of gases was presented, as also a note on molecular actions in chlorine, bromine, and iodine, by M. C. A. Valson. In the latter the author described his experiments to ascertain the amount of molecular action in chlorine, bromine, and iodine, by determining the height to which solutions of precisely equivalent quantities of their salts would rise by capillary action. From his results he inferred that if chlorine and iodine could easily be brought into a liquid state, the capillary elevations of the three bodies above-mentioned in a tube 1 millimetre in diameter would be respectively 6, 5·5, and 5 millimetres. The author suggested that the capillarity of substances may be made available in chemical analysis, and remarked that in its physical properties bromine stands nearly midway between chlorine and iodine. MM. Odet and Vignon presented an account of a new method of preparing anhydrous nitric acid, founded upon that proposed by Gerhardt for obtaining the anhydrous monobasic organic acids. They prepared chloride of azotyle by the action of oxychloride of phosphorus upon nitrate of lead or silver. The vapours of this chloride of azotyle were directed upon dry crystals of nitrate of silver at a temperature of 140°—158° F; the products of the reaction were conveyed into a tube immersed in a mixture of ice and common salt, where they furnished colourless prismatic needles presenting all the properties described by H. Sainte-Claire Deville. The authors described a simplified form of apparatus in which the acid may be produced without the preliminary preparation of chloride of azotyle, and indicated the reactions which take place. M. J. Roussin communicated a paper on the preparation of hydrate of chloral and on its characters when pure. His process consisted in submitting the crude crystalline mass obtained by passing dry chlorine through absolute alcohol to strong pressure until it is quite dry, then placing it in a retort with a little powdered chalk and distilling it. M. Dubrunfaut presented a paper on inverted sugar, in which he declared the results lately communicated to the Academy by M. Mauméné to be erroneous.—A memoir by M. E. Van Beneden on the mode of formation of the ovum and the embryonic development of the *Sacculinæ* was read; to this we shall probably advert elsewhere.—M. Marié-Davy presented a third note on lunar radiation, containing the results of his observations on this subject during the month of November. The following papers were also communicated:—On a new means of diagnosis and extraction of iron projectiles and leaden projectiles with an iron nucleus, by M. Milliot; on a new electrical explorer for detecting foreign (especially metallic) substances in the tissues of the human body, by M. Trouvé; on a system of aërial navigation (title only), by M. A. Vaillant; a description of clinical experiments upon the therapeutic effects of bromide of morphine and atropine, and bromide of digitaline (title only), and an indication of a mode of curing stings by cauterisation (by the use of phenic and sulphuric acids), by M. Delagrée; and a note on the supposed influence of subterranean marshes in the development of intermittent fevers, by M. Colin.

BERLIN

Academy of Sciences, October 11.—Professor Magnus read a paper on the alteration of the radiation of heat by roughening of the radiating surface, in which he described a series of experiments made by him to determine the cause of this alteration, and stated that in his opinion the increased radiation of a roughened surface depends essentially upon the refraction which the heat undergoes in issuing from the surface of the radiating body.—Professor W. Peters communicated a notice of a new species of Lizard, *Phyllodactylus galapagensis*, from the Galapagos Islands. He remarked that only five species of reptiles were previously known from these islands—one tortoise, three lizards, and one snake. The last he identified with *Dromicus chamissonis*, which also occurs on the continent of America, and with this Dr. Günther's *Herpetodryas biserialis*, from the Galapagos group, may be synonymous. If it be distinct, the number of reptiles from these islands will only be seven.—Prof. Pringsheim read an elaborate memoir on the conjugation of swann-spores, the morphological primary form of reproduction in the vegetable kingdom, and a communication was presented by Dr. K. Schultz-Sellack on the diathermancy of a series of substances for dark heat. The author stated that he had found that many more substances than is generally supposed allow a considerable amount of the dark heat radiated by lampblack at 212° F. to pass through them. He enumerates binary compounds of chlorine, bromine, fluorine, and iodine, and a number of sulphides, and shows their behaviour in this respect by means of percentage tables.

German Chemical Society, November 12.—The following papers were read:—Otto on Mercuric Phenylide.—Kolbe: Lecture Experiment to demonstrate the increase of weight of burning substances.—Kempf on Carbonate of Phenyl.—Carstanjen on the Action of Oxychloride of Chromium on Hydrocarbons.—Henry on Chlorosulphide of Phosphorus.—Radizewsky on the Wax contained in the Straw of Cereals.—A. W. Hofmann on the Action of Iodine on Thiobenzamide.—Friedel: Paris Correspondence.—Richter: Petersburg Correspondence.

BONN

Natural History Society of Rhenish Prussia and Westphalia.—The autumnal gathering of this society took place on the 11th October, the day so widely observed as the centenary of the birth of Humboldt; and the proceedings were naturally inaugurated by a discourse in commemoration of the great philosopher of whom the Germans are so justly proud. The following are the more important communications submitted to the society:—The veteran Prof. Nöggerath gave an account of the earthquakes, four in number, which since November 1868 have visited the Rhine province, specifying the extent of country subject to their influence, and glancing at the general physical characters of earthquake phenomena. He was followed by Prof. Troschel, who showed the importance of a study of the geographical distribution of animals as indicating the configuration of the earth's surface, and the distribution of land and water at the time of the commencement of the existing period of geological history. The Professor's illustrations were chiefly derived from his investigations of the distribution of sea-fish and land-snails. Professor F. Zirkel, of Kiel, made some communications on the mineralogical constitution of the basalt-lavas of Laacher See and the Eifel. Professor von Rath described a new mineral from Laacher See, which he proposes to call Amblystegite, in allusion to the extreme obtuseness of some of its angles. It is of a reddish brown colour; hardness almost equal to that of quartz; specific gravity 3·454; melts with great difficulty, forming a black glass insoluble in hydrochloric acid. In composition it is allied to hypersthene, but is distinguished from that mineral by the absence of the characteristic cleavage. Extracts from a paper by Professor Fuhlrott on the caves of Grevenbrück and the Hönnethal were then read; and Professor Schaffhausen availed himself of the opportunity of insisting upon the desirableness of a systematic exploration of the bone-yielding caves in which Westphalia is so rich. We are glad to hear that steps are being taken to raise funds for this purpose among the members of the society. The most important finds in the Grevenbrück cave are coprolites of hyæna, and two human lower jaws of primitive form.

VIENNA

Imperial Academy of Sciences, November 18.—Professor Unger communicated a memoir on the anthracite deposits in Carinthia. He stated that nineteen species of plants, chiefly ferns, have been detected in the shales accompanying this deposit. They agree with those of the coal-measures, and eight of them occur also in the anthracite deposits of Styria, Switzerland, and the French Alps. Two undescribed Fern-stems were particularly noticed by the author, who took the opportunity of opposing the ordinary notion that the *Stigmariæ* are the roots of *Sigillariæ*. Of the latter he regarded those species which have not furrowed stems, as ferns.—Dr. C. Jelinek presented a preliminary communication upon the hurricane-like storm which visited Vienna on the 14th November. The greatest velocity of the wind was 46·6 Paris feet per second, about noon; the diminution of barometric pressure continued until 6 P.M., when the mercury had fallen 7·17 lines, the velocity of the wind being 36·5 feet per second.—Director Tschermak communicated a memoir on a new salt from Hallstadt. This mineral, to which the author gives the name of Astrakanite, occurs mixed with common salt, anhydrite, and a mixture consisting chiefly of sodium sulphate in the Christina gallery at Hallstadt. It forms a bluish layer, the colour being due to enclosures containing iron, and the crystals, which are very small and occur in druses, being frequently colourless. Its composition is expressed by the formula, $MgSO_4$, Na_2SO_4, 4aq, so that it is the third natural magnesium-sodium sulphate with which we are acquainted. M. Tschermak also presented a paper by M. P. Hausenschild, giving an account of his microscopic examination of the minerals called Predazzite and Pencatite. By the examination of thin slices of the most homogeneous looking specimens, the author found that two minerals may be distinguished in them with certainty, namely, calcite and brucite.—Dr. Samuel Stern presented a memoir entitled "Contributions to the theory of ordinary (not musical) sounds, as an objective character, with reference to the special requirements of medical diagnosis."—Prof. E. Ludwig presented a paper by himself and Dr. J. Hein upon the synthesis of hydroxylamine, which, they said, may be effected by the direct addition of nascent hydrogen to pure nitrous oxide as follows:—

$$NO + H^3 = NH^3O.^1$$

The process consists in passing nitrous oxide through a mixture of tin and hydrochloric acid, freeing the fluid from tin by sulphuretted hydrogen, evaporating the filtrate from the sulphuret of tin to dryness, washing the residue in cold and dissolving it in hot alcohol, separating the ammonium chloride with platinum chloride, and precipitating the pure hydrochlorate of hydroxylamine by anhydrous ether. The analysis and measurement of the crystals thus obtained proved their identity with Lossen's salt.—The following memoirs were presented, but only their titles are given: By Prof. Hyrtl, "On a præcorneal vascular net in the human eye," and "On an insular intercalated bone in the parietal bone;" and by Prof. B. Lapschin, of Odessa, "On the specific gravity of the water of the Black Sea," and "On the conductibility of cork for heat, and its application to the construction of a barometer." Prof. Julius Wiesner also presented a memoir on the origin and increase of Bactria, the results of which had been communicated to the Academy on the 29th April last.

DIARY

THURSDAY, DECEMBER 9.

ROYAL SOCIETY, at 8.30.—Spectroscopic Observations of the Sun, No. V.: Mr J. Norman Lockyer, F.R.S.—Researches on Gaseous Spectra in relation to the Physical Constitution of the Sun, Note III.: Dr. Frankland, F.R.S., and Mr. J. Norman Lockyer, F.R.S.—On the Successive Action of Sodium and Iodide of Ethyl on Acetic Ether: Mr. J. A. Wanklyn.
SOCIETY OF ANTIQUARIES, at 8.30.—On a Faliscan Inscription: Padre Garrucci, Hon. F.S.A.
ZOOLOGICAL SOCIETY, at 8.30.—On the Fin Whale recently stranded in Langston Harbour: Prof. Flower, F.R.S.—On the Fresh Water Fishes of Burmah: Surgeon Francis Day.
MATHEMATICAL SOCIETY, at 8.—Gauss' Theorems and Napier's Analogies: Mr. Crofton.—On the Order of the Discriminants of a Ternary Form: Mr. S. Roberts.
LONDON INSTITUTION, at 7.30.—Architecture: Prof. R. Kerr.

FRIDAY, DECEMBER 10.

ROYAL ASTRONOMICAL SOCIETY, at 8.
CLINICAL SOCIETY, at 8.30.
QUEKETT MICROSCOPICAL CLUB, at 8.
SOCIETY OF ARTS, at 8.—Indian Conference. On a Gold Currency for India: Mr. A. Cassels.

SATURDAY, DECEMBER 11.

ROYAL BOTANIC SOCIETY, at 3.45.

MONDAY, DECEMBER 13.

SOCIETY OF ENGINEERS, at 7.30.—Annual Meeting.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.
MEDICAL SOCIETY, at 8.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.
ROYAL INSTITUTION, at 2.—Monthly Meeting.
LONDON INSTITUTION, at 4.—Elementary Physics: Prof. Guthrie.
SOCIETY OF ARTS, at 8.—The Spectroscope and its Applications: Mr. J. Norman Lockyer, F.R.S.

TUESDAY, DECEMBER 14.

INSTITUTION OF CIVIL ENGINEERS, at 8.
ROYAL MEDICAL AND CHIRURGICAL SOCIETY, at 8.30.
PHOTOGRAPHIC SOCIETY, at 8.
ANTHROPOLOGICAL SOCIETY, at 8.—Race Affinities of the People of Madagascar: Mr. C. Staniland Wake, F.A.S.L.

WEDNESDAY, DECEMBER 15.

SOCIETY OF ARTS, at 8.—On India-rubber—its History, Commerce, and Supply: Mr. J. Collins.

THURSDAY, DECEMBER 16.

ROYAL SOCIETY, at 8.30.
SOCIETY OF ANTIQUARIES, at 8.30.
LINNEAN SOCIETY, at 8.
CHEMICAL SOCIETY, at 8.
ZOOLOGICAL SOCIETY, at 4.
NUMISMATIC SOCIETY, at 7.
PHILOSOPHICAL CLUB, at 6.
LONDON INSTITUTION, at 7.30.
EDINBURGH GEOLOGICAL SOCIETY, at 8.

BOOKS RECEIVED

ENGLISH.—The Monthly Microscopical Journal, December 1869 (Robert Hardwicke).—Chemistry for Schools: C. Haughton Gill (James Walton).—Burton-on-Trent—its History, its Waters, and its Breweries: W. Molyneaux, F.C.S. (Trübner).—Outlines of Chemistry; or, Brief Notes of Chemical Facts: Dr. Odling (Longmans).—Earth and Sea: Louis Figuier (Nelson and Sons).—The Second Table of the Commandments: Dr. Rowland (Longmans).—Heads and Tails: Adam White (Nisbet).—Romance of Natural History, 2 vols.: P. H. Gosse (Nisbet).—Facts and Dates: Rev. A. Mackay (Blackwood).—Physical Ethics: A. Barratt (Williams and Norgate).—Womankind in Western Europe: J. Wright (Groombridge).

FOREIGN.—Les Pierres Précieuses: J. Rambosson.—Histoire des Météors: J. Rambosson.—Leçons sur la Respiration: P. Bert.—Die Blausäure: W. Preyer.—Landwirthschaftliche Zoologie: Dr. Giebel. (Through Williams and Norgate.)

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

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