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THURSDAY, MARCH 21, 1872

THE HISTORY OF THE ROYAL INSTITUTION*

NO other Institution has been so closely associated with the greatest discoveries of Chemical and Physical Science during the present century as that which has its abode in the well-known building in Albemarle Street. The names of Rumford, Banks, Young, Davy, Faraday, Tyndall, will always add lustre to its annals; nor will it be forgotten that in its laboratory were made the most famous discoveries of Davy and Faraday. Dr. Bence Jones gives us in this very interesting volume a sketch of the history of the Institution, derived from its own record of proceedings, interspersed with biographical notices of its founder, Count Rumford, and its most eminent professors, Garnett, Young, and Davy. Of Faraday we hear comparatively little, Dr. Bence Jones having sketched his life in a separate biography; and with regard to the eminent men whose present connection with the Institution is adding fresh popularity to its courses of lectures, he is altogether silent.

Probably few of the visitors who now attend the lectures at the Royal Institution, or who crowd to its fashionable Friday evening *réunions*, are aware of the object with which it was originally founded, as shown in the prospectus drawn up by Count Rumford in 1799, from which the following are extracts:—

"Proposals for forming by subscription, in the metropolis of the British Empire, a public Institution for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life:—

"The two great objects of the Institution being the speedy and general diffusion of the knowledge of all new and useful improvements, in whatever quarter of the world they may originate, and teaching the application of scientific discoveries to the improvement of arts and manufactures in this country, and to the increase of domestic comfort and convenience, these objects will be constantly had in view, not only in the arrangement and execution of the plan, but also in the future management of the Institution.

"As much care will be taken to confine the establishment within its proper limits as to place it on a solid foundation, and to render it an ornament to the capital and an honour to the British nation.

"In order to carry into effect the second object of the Institution, namely, 'Teaching the application of science to the useful purposes of life,' a lecture-room will be fitted up for philosophical lectures and experiments, and a complete laboratory and philosophical apparatus, with the necessary instruments, will be provided for making chemical and other philosophical experiments."

This basis was adhered to, and these eminently practical objects were steadily kept in view, as long as the management remained with the original founders of the Institution; but it soon passed into the second stage of its existence. Count Rumford had fixed his residence abroad during the latter years of his life, the eminent men whom he had collected around him, headed by his intimate friend and ally, Sir Joseph Banks, withdrew from its active management, and its control passed into the hands of others, whose chief aim was to recruit its exhausted funds by making the Royal Institution one of the most fashionable places of resort in London. In this they succeeded; but their success was mainly due to the extraordinary interest which centred round the remarkable discoveries of young Davy which signalised the early years of the century. When we read the history of these discoveries, following one another in quick succession—the determination of the true constitution of the alkalies and alkaline earths, potassa, soda, lime, magnesia, the decomposition of ammonia—each a link in the chain of investigation which produced a complete revolution in chemical philosophy, we are disposed to query whether future diligent workers in the fields of science will ever again be rewarded by discoveries of similar gigantic importance.

The sketch of the life of Sir Benjamin Thompson, Count Rumford of the Holy Roman Empire, as presented by Dr. Bence Jones, shows a character full of strange contradictions. A native of North America, during the War of Independence an ardent Royalist, and throughout his life imbued with aristocratic principles of the strongest tinge, he yet spent all his energies in physical discoveries and mechanical inventions calculated to ameliorate the condition of the masses, and to promote the health and comfort of their lives. It was indeed for the purpose of forwarding this object mainly, as we have seen, that he projected the establishment of the Royal Institution. A man of the warmest affections, he yet compelled his second wife (Lavoisier's widow), to seek relief from domestic unhappiness in a judicial separation. With a remarkable power of attracting around him, and moulding to his views, the most eminent men in various branches of science, there were yet few whom he did not estrange from him by his morbid jealousy, and by the eccentricity of his conduct. The littlenesses of his character will, however, be forgotten in the noble aims and great results of his life.

We are glad to have recalled to us in this volume the career of so disinterested a student of Science as Dr. Thomas Young, and to find a full recognition of his eminent position as the *avant-courier* of Davy and Faraday. Born in Somersetshire in 1773, he showed in his school-boy days that precocity of intellect and power of acquiring knowledge in almost any subject presented to him, which does not always mark the future genius. After spending the years from fourteen to nineteen as a private tutor, he became in 1793 a student at St. Bartholomew's Hospital, presented during the same year a paper to the Royal Society on the "Structure of the Crystalline Lens," and in 1794, at the age of twenty-one, was elected a Fellow of that body. From 1799 to 1801 Dr. Young was carrying on his remarkable series of experiments on Sound and Light, and in the latter year was appointed Professor of Natural Philosophy to the Royal Institution. His lectures however were not considered sufficiently popular for the audiences that then frequented it, and his connection with it terminated in 1803. During the next twenty years of his life he practised as a physician in London, being connected with St. George's Hospital. In 1818 he was appointed

* "The Royal Institution: Its Founders and its First Professors." By Dr. Bence Jones, Honorary Secretary. (London: Longmans and Co. 1871.)

superintendent of the "Nautical Almanack" and secretary of the Board of Longitude, and in 1827, on the resignation of Sir Humphry Davy, was spoken of as a probable successor to his office of President of the Royal Society, Davies Gilbert, however, being chosen. He died in 1829, at the age of 56, and his character was thus drawn by his intimate friend Sir Humphry Davy:—"A man of universal erudition and almost universal accomplishments. Had he limited himself to any one department of knowledge, he must have been first in that department. But as a mathematician, a scholar, and a hieroglyphist, he was eminent; and he knew so much that it was difficult to say what he did not know."

Sir Humphry Davy's brilliant career, and especially that portion of it which contributed so greatly to the fame and success of the Institution with which he was connected, is drawn in detail by his biographer; and the failings in his character and in his life which obscured its lustre to his contemporaries are in no way concealed. The following contrast of the characters of Davy and of his pupil and successor, Faraday, will be read with interest:—"Whenever a true comparison between these two nobles of the Institution can be made, it will probably be seen that the genius of Davy has been hid by the perfection of Faraday. Incomparably superior as Faraday was in unselfishness, exactness, and perseverance, and in many other respects also, yet certainly in originality and in eloquence he was inferior to Davy, and in love of research he was by no means his superior." As early as 1804, when Davy was only twenty-six, Dr. Dalton consulted him as to the best mode of preparing his lectures, and described him as "a very agreeable and intelligent young man, the principal failing in whose character as a philosopher is that he does not smoke;" and within two or three years from that time he had made the discoveries which have immortalised his name.

Dr. Bence Jones does not carry down the history of the Royal Institution beyond 1814, when it became as closely associated with Faraday's career as it had previously been with Davy's. We have seen what were the primary objects for the promotion of which the Institution was founded; and we know also the great work which it effected during the first ten years of its existence. These special purposes soon gave way to the effort, as our author expresses it, after striving to be fashionable; and the fashionable element has continued to be the most prominent feature in its subsequent life to the present day. Something is, no doubt, gained by making scientific subjects one of the ordinary topics of conversation in West End *salons;* the continuation of the History of the Royal Institution, which will have to be written twenty years hence, will show whether this object is compatible with the carrying on of original investigations which will add to the sum of our knowledge of the laws of Nature.

OUR BOOK SHELF

Une Expérience relative à la Question de la Vapeur Vésiculaire. Par M. J. Plateau. (Brussels: F. Hayez.)

THE elder Saussure, and after him De Luc, considered it to be an established fact that clouds are formed of little hollow globules, which Saussure designated vesicular vapours, or vesicles. These vesicles, having a structure similar to the soap bubble, were assumed to be capable of floating in the atmosphere and of remaining suspended in it so long as their physical condition was unaltered. When they became resolved into drops of water they formed rain. The same structure was assigned to the cloud formed by the condensation of the vapour of boiling water in air colder than itself. M. Plateau has endeavoured to put this view of the vesicular constitution of vapour to the test of experiment. With this view he has taken advantage of a method devised by M. Duprez, for inverting a wide tube (20mm. in diameter) full of water, so that the water may remain suspended in the tube. By means of a narrow tube drawn out at one end, so as to present an orifice of 0·4mm. in diameter, he succeeded in obtaining small hollow globules of water of less than a millimetre in diameter, and transporting them under the free surface of the water, suspended in the wide tube. As soon as contact was established with that surface, the little bubble became detached, and the air which it contained penetrating into the liquid, mounted through it. The experiment, on being several times repeated, gave always the same result. M. Plateau has applied this method to the cloud formed when water is boiled in free air. "Let us imagine," he says, "that at a certain distance from the surface of the water suspended in the wide tube, a current of visible vapour of water arises. If this vapour is composed of vesicles, each of them which comes into contact with the liquid surface must introduce into the water a microscopic bubble of air, which will immediately begin to ascend, so that the whole will form in the water of the tube a cloud which will rise slowly in it, and alter its transparency." In making the experiment, no cloud was produced, and M. Plateau concludes, in conformity with the view now generally held by physicists, that the vesicular state of vapour has no real existence. He discusses objections which may be raised to his experiment, such as the possible solution of the bubbles of air in the water, the bursting of the bubbles at the surface of the water and the escape of the air contained in them, or their rolling under the surface of the water till they reach the margin of the tube and thus get away; and shows satisfactorily that these objections do not invalidate the result at which he has arrived.

Chemical Notes for the Lecture Room, on Heat, Laws of Chemical Combination, and Chemistry of non-Metallic Elements. By Thomas Wood, Ph.D., F.C.S. Pp. 181. (London: Longmans, Green, and Co.)

ON reading this volume the author's intention is plainly manifest; the book has been written principally for the use of students preparing for the matriculation examination at the University of London. It has been written as concisely as possible, rendering the task of "cramming" the subject more easy of attainment. For such a purpose we certainly can recommend this book; but for beginners who wish to study chemistry we think it has several faults. One of them is that such a comparatively large amount of the book is devoted to the subsidiary subject, Heat, almost a quarter of the text being thus occupied. The article on thermometers, for instance, occupies no less than nine pages, which strikes us as being rather out of proportion to the remainder of the book. A second fault is the almost complete absence of any such details as would enable a student to repeat the experiments mentioned in the text. This we think is a fault which would tend to make the beginner get up his subject parrot-like, a method which is certainly not to be desired. The chemistry of the non-metallic elements only occupies eighty-five pages of this volume; the definitions and laws of chemical combination occupy another thirty-eight pages. The explanations, in the majority of instances, are clearly expressed, the facts of the case being stated in as few words as possible. A few of the definitions can scarcely be considered good; one, in particular, is "that a compound of any non-metal with a metal is a salt of a metal." This would, of course, include such bodies as antimonetted and arsenetted hydrogen, hydride of copper, and so on. The definitions of acids and bases, too, are weak. It may almost be inferred that such is the case, by the manner in which the author uses the term acid; N_2O_3 is called nitrous acid; I_2O_5 iodic acid, and, in the same line, $HBrO_3$ bromic acid; B_2O_3 boracic acid, and so on. There is one thing which the author tells us which is a curiosity in chemical history. On page 38 it is stated "some few of the elements receive their symbols *from the names given to them* by the ancients—*e.g.* Iron (Fe.) from *Ferrum*, Sodium (Na.) from *Natrium*." We certainly were under the impression that Sodium was discovered in 1807 by Sir Humphry Davy. A number of questions are appended to the book which will be found very useful to those employed in teaching.

LETTERS TO THE EDITOR

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

Ocean Currents

SURELY Mr. Ferrel must have misapprehended my arguments, or he would not have advanced the case of the tides against me. Undoubtedly the ocean will sink to its old level when the lifting force of the moon is withdrawn, even though the height to which the waters are raised may not exceed an inch. I agree also with what he says in regard to the improbability of ocean currents being caused by the heaping up of the waters by the winds. I believe that this erroneous view of the matter has done more real mischief to the wind theory than all the arguments advanced by the advocates of the gravitation theory put together. The notion that because the winds are applied to the surface of the ocean they can produce only surface drift is an error of a similar character.

I shall shortly refer to an important point bearing on the influence of rotation overlooked both by Dr. Colding and Mr. Ferrel. In my last paper in the *Phil. Mag.*, October 1871, p. 266, there is a trifling mistake to which I shall also refer.

Edinburgh JAMES CROLL

Science Stations

ALLOW me to say a few words in reply to your editorial of Feb. 29. It does seem to me to be a pity to "run the risk of spoiling a good work" by multiplying suggestions and urging counter claims. It is not quite fair that when biologists start a proposal for obtaining a necessary but costly aid to their studies, the devotees of other sciences should exclaim, "Oh, we must have one, too!" If all speak at once in this way no one will be heard, and we shall get no stations of any sort. Probably the writer of the article is not aware of the expense and requirements of a zoological station, otherwise he would not propose to increase the difficulty by thrusting a meteorological and astronomical observatory on the backs of its promoters, and then observe that "the outlay need not be heavy." It is notorious that there are meteorological and astronomical observatories in almost every part of the globe; but there is nothing of the kind for zoology. Under these circumstances it is to me a disappointment that the suggestion for zoological stations meets with what looks like a somewhat selfish criticism, in place of unqualified support, at the hands of physicists.

As to the station in England, I do not gather from Dr. Dohrn's article that he proposes to separate teaching entirely, or even partially, from the stations. He leaves it alone. "Teaching" can come or go just as those who deal in it may please; but that instruction in rudimentary zoology should be a chief object of the station is a proposal of the same nature as would be that to make use of Greenwich Observatory for giving lessons in the outlines of astronomy, and is not entertained by him for a moment. It no doubt would be a very good thing that students from Cambridge and Oxford and London should spend some time in a zoological station; and it would also be good for others of them to work in a lead or copper mine, or pass a few nights in an astronomical observatory; but we cannot urge the wants of these particular students as any reason for the maintenance of these three things. The primary object for which zoological stations will be erected—one for which it is to be hoped that the Universities, as well as scientific societies and private individuals, will be ready to subscribe money—is the prosecution of science.

We claim for biology now a place of far higher importance in the scheme of human knowledge than she has occupied hitherto. She has proved her claim to the respect and most serious attention of men by the discovery of the principles and detailed laws of evolution—a discovery which has more widely influenced human thought than has any other product of modern science, and must continue long so to do. We are no longer content to see biology scoffed at as "inexact," or gently dropped as "natural history," or praised for her relations to medicine. On the contrary, biology is the science whose development belongs to the day. At this moment she is deserving of more attention, more material aid, more assistance in her young growth, than any other human science. Her youthful performances, her hopeful stride onwards, promise more abundant results from pecuniary aid given to her than can be hoped for from her older sisters, who have "settled in life." If biology requires "stations," she ought to be gladly supplied with them.

I must protest against the notion—urged in your article only, I imagine, as a joke—that without "teaching" (whatever that may mean) there would be danger of a zoological station becoming the home of a narrow zoological clique. The connection is not explained, and I do not think any of your readers will see it. Are observatories the homes of narrow astronomical cliques? Are telescopes without professors liable to become the resort of ambitious young persons, anxious chiefly to discover hydrogen flames where nobody had found them before? I do not believe a bit in the narrow clique suggestion. Teaching bodies breed them much more rapidly and naturally than do working bodies. And as to the privat-docent, anxious to discover a notochord, or the amateur astronomer hunting for hydrogen flames, I would most gladly see them multiplied exceeding abundantly. Would that we could obtain the institution of "privat-docents" in English Universities; by simply erecting a zoological station, would that we could infuse some of their kind of ambition—one of the best a man can have—into English students.

Naples, March 4 E. RAY LANKESTER

[*** The article to which our correspondent refers was written by a distinguished biologist.—ED.]

The Etymology of "Whin."

THE following is from Jamieson:—"*Quhyn, Quhin-Stane*, s. i. Green-stone; the name given to basalt, trap, &c. . . . Isl. *hwijna*, resonare, *hwin*, resonans, q. 'the resounding stone.'" "Whin, whinstane, *s.* Ragstone or toadstone."

Whin or gorse, the name given to *Ulex europæus*, common furze, is from a different root, being traced to Welsh *ehwynyn* = weed. A. HALL

YOUR correspondent, Mr. W. R. Bell, will find a derivation given for "Whin" in Jamieson's "Scottish Dictionary," where, under the name *Quhyn* or *Quhin*, it is referred to the "Islandic *hwijna*, resonare," "*hwin*, resonans, q. the resounding stone," probably from the resonance emitted on its being struck. It is in all likelihood the same as the word *whine*, and the root is present in both Celtic and Teutonic tongues, *e.g.*:—

Welsh	*Cwyno*, to complain
Irish	*Cuinead*, mourning (?)
Islandic	*hwijna* (as above)
Danish	*hvine*, to whistle
German	*weinen*, to weep

Compare also the Latin *hinnio*, to neigh.

F. DE CHAUMONT

Oakland, Woolston, March 15

WEBSTER, in his Dictionary (9th edition, 1862), says in explaining this word, which is known all over England, that it means *weeds, gorse, furze, waste growth*, from the Welsh *Chwyn*. That it is "a provincial name given to basaltic rock, and applied by miners to any kind of dark coloured and hard unstratified rock which resists the pick."

There is also "*whin-axe*," an instrument for extirpating whin from land.

The Scotch form of whin is *quhyn*.

March 16 JOHN JEREMIAH

The Aurora of February 4

THIS Aurora was seen throughout Europe, including Russia and Constantinople, in Egypt, in the Mauritius, and in India.

May not all auroras pervade the atmosphere around the entire globe and be visible wherever night prevails with a sufficiently clear sky? And so may not the southern and northern aurora belong to one and the same universal aurora?

GEORGE GREENWOOD

Alresford, March 16

I SEE notices in the English papers of a great aurora seen in all parts of Scotland, England, and even as far south as Alexandria in Africa. It may be interesting for your readers to know that it was visible here on the same evening—Sunday, February 4. I saw it first at 6.30 P.M., and at various times after that until 10.30, after which I did not look out of doors. There were no streamers, and the peculiarity of the appearance was that it was in all directions, and less in the north than in the west and east. It presented the appearance of a dull red fog, in shifting masses, and more like the haze I observed here in 1861, when the earth was said to have passed through the tail of the comet of that year. Auroras are very rare in this latitude, but we have had four or five displays in fifteen months: one so bright as to excite the alarm of fire, and to call out the fire department.

GEORGE S. BLACKIE

Nashville, Tennessee, U.S., Feb. 27

Barometric Depressions

BY the introduction of parenthetical sentences between words, which do to some extent represent my meaning, though they are not mine, as the inverted commas would imply, and by the omission of the main point of his own argument, Mr. Ley has presented as mine certain propositions which may well appear to him and to every one who reads them, not only irreconcileable, but sheer nonsense. As these parenthetical interpolations are Mr. Ley's own, and as the point in his argument to which I took exception was not the application of Buys Ballot's Law, but his proposition—shortly stated—that revolving storms are caused by heavy rain, I conceive that his version of my views, which may be funny but is certainly incorrect, is scarcely worth the serious attention of any one.

As to the rest, it is a great thing, in any branch of science, to establish points beyond the reach of further argument or doubt. The depression of the barometer in summer over a great part of Asia has hitherto seemed one of the most curious and difficult problems in Physical Geography. We now know all about it. There is no more room for doubt. It is "really due" to the rarefaction of the air. Mr. Ley says so. What, how, why, when, or where, are details far too commonplace for him to enter upon.

The whole subject of barometric changes, and their relation to strong winds or storms, is one of extreme difficulty; and, in the present state of our knowledge, we can do little more than guess at or discuss the probable solution of the many questions that arise out of it. From the off-hand way in which Mr. Ley disposes of them, or wishes them disposed of, it would appear that he has not yet arrived at even an appreciation of their difficulty. This is the real point on which we are at issue; the range of his study has been too confined. A more general application of his industry will, I hope—should he again meet me in my capacity of critic—relieve me of the necessity of making remarks unpleasant for him to read, or for me to write.

J. K. L.

The Meteor of March 4

I HAVE been looking out for some corresponding notice of a meteor seen here on March 4, but hitherto in vain. At first I hoped that the interesting accounts from Ireland, published in the last number of NATURE, might have referred to the same phenomenon; but I soon found that the dates were discordant, and I now beg to forward the following brief notice of the earlier one:—

On the above-mentioned evening, about 7h. 40m. P.M. railway time, a brilliant meteor was noticed by my gardener Thomas Wood. According to his account it appeared about 20° or 30° above the N. horizon as a ball of red fire passing rapidly from W. to E., about one-third as large as the full moon, with a tail seven or eight times its diameter in length, the portion nearest the head being reddish; but changing at about one-third of its length to green, which was especially distinct towards its tapering point. The head seemed to be surrounded by some sparks. It threw such a light upon the ground as to show all the growing wheat in the field through which the spectator was passing. The course was rather descending, and it went out suddenly without coming down to the horizon. I have heard of only one other person in the neighbourhood who saw the light cast by the meteor, and who described it as extremely brilliant. It is singular that it has not been more generally noticed. The especial interest attached to it is the fact that, in common with the one observed only four days later in Ireland, its course was in the unusual direction of the earth's motion.

Hardwick Vicarage, Hay, March 18 T. W. WEBB

THEODOR GOLDSTÜCKER

FOR the following particulars of the career of the late Prof. Goldstücker we are indebted mainly to the *Academy* and *Trübner's Oriental Record*:—

By the death of Theodor Goldstücker, at the early age of fifty-one, philology has lost one of its greatest scholars, and society, what it can still less afford to lose, one of the noblest and most disinterested of men. Born at Königsberg, in Prussia, he began the study of Sanskrit, for the profound knowledge of which he has since become so famous throughout the world, under Prof. Peter von Bohlen, at the University of that town. He continued this study under Profs. August Wilhelm von Schlegel and Christian Lassen at Bonn. He afterwards resided for some time at Paris, where he enjoyed the friendship of men of the greatest distinction, such as Burnouf, Letronne, &c. He then resided at the University of Berlin, where he began soon to display great scholarly activity. Alexander von Humboldt formed already at that time a very high estimate of the capacities of the young scholar, whose aid, in several very difficult questions of Indian philosophy, he gratefully acknowledged in his "Kosmos."

After the reaction of 1848-9, Goldstücker came over to England for the purpose of assisting Prof. Wilson in the preparation of a new edition of his Sanskrit Dictionary. For this new edition no material whatever existed save the dictionary itself in its printed form. Goldstücker, nevertheless, undertook its revision single-handed; and the immense proportions which under his hand the first six parts assumed (480 pp. without getting to the end of the first letter) rendered the completion of the work by one man or in one generation impossible. Many thousands of notes and references for this and other works, the result of an unremitting study of the MSS. treasures at the India House, &c., are left behind; and we are glad to learn from the *Academy* that the report in some of the newspapers that the deceased had left directions in his will for their destruction is without foundation.

The earliest work undertaken by Goldstücker was the translation into German of the "Prabodha Chandrodaya," a theologico-philosophical drama, by Krischna Miçra, to which Professor Rosenkranz wrote a Preface. In 1861 he published, as an Introduction to a Fac-simile Edition of the "Manava-Kalpa-Sutra," an investigation of some literary and chronological questions, which may be settled by a study of Panini's work, under the title of "Panini, his place in Sanskrit literature." Goldstücker also edited the text of the "Jaiminîya-nyâya-mâlâ-vistara," of which work 400 pages in large quarto are in type.

For the last two years he has been engaged in carrying through the press, for the Indian Government, a photolithographic edition of the "Mahâbhâshya," of which 300 pages still remain to be done. By his decease, what may be called the "traditional" school of Vedic criticism, which gives to the interpretations of native tradition the preference over those derived from comparative philology, ceases to have a European representative. His manuscript of a Sanskrit grammar has long been finished, and it is hoped that this work, which is likely to revolutionise the teaching of Sanskrit in many respects, may be allowed to see the light. The great psychological value as an educational instrument which he attached to the Sanskrit language, if properly taught, was well known to his friends; and it was through his advocacy that a committee of the professors of University College, London, was appointed to report on the desirableness of making Sanskrit an integral part of all the degree examinations in the University of London.

Of the philosophical literature of India, the "Mîmânsa," from its close connection with grammatical researches, engaged his chief attention; some fruit of his labours in this field is a nearly finished edition, prepared for the Sanskrit Society, of Mâdhava's "Jaiminîya-nyâya-mâlâ-vistara" (1865).

It was however Goldstücker's thorough familiarity with the legal and ceremonial literature of the Hindus which rendered his advice of so much value to the Indian Government. A paper recently published by him "On the Deficiencies in the Present Administration of Hindu Law" (Trübner, 1871), contains an exposure of the frequent failures of justice arising from the misunderstandings of native codes, which disgrace our Indian administration.

Besides some papers in the *Reader* and the *Athenæum*, Goldstücker contributed an excellent essay on the "Mahâbhârata" to the *Westminster Review* in April 1868; and among his papers will be found a copy of the great Eastern epic collated with the best European MSS. His library is, we are glad to hear, to be kept together.

Dr. Goldstücker was Professor of Sanskrit in University College, London, President of the Philological Society, a member of the Council of the Asiatic Society and of the Association of the Friends of India.

REPORT OF THE ASSOCIATION FOR THE IMPROVEMENT OF GEOMETRICAL TEACHING

At the Second Annual Meeting of this Association, held at University College, London, on January 12, Dr. Hirst, the president of the association, delivered the following address:—

In opening the proceedings of this, the Second Annual Meeting of the Association for the Improvement of Geometrical Teaching, I am glad to be able to congratulate you on the decided progress which has been made during the past year towards the realisation of your views. The discussions recorded in English journals, and the reception given to recently published text-books on geometry, unquestionably indicate that public opinion is far more inclined now than it was a few years ago to entertain the notion of an improved exposition of the elements of geometry. We are no longer warned that to touch that edition of Euclid to which, for more than a century, we have paid such literal homage, would be to ruin the teaching of geometry. On the contrary, it is now generally admitted that, without departing from the admirable exactitude and geometrical purity of Euclid's elements, we ought to be able, by judicious revision and extension, to bring them more into harmony with the scientific methods and the habits of thought of our own day. I alluded last year to the retrograde step that had been taken in Italy on this question of the teaching of geometry. The announcement excited much interest in England, though the true purport of the Italian movement was, I fear, slightly misunderstood. I have, therefore, thought it my duty to procure original documents, to make inquiries into the success of the Italian movement of 1867, and also to ascertain the present aspect of geometrical instruction in that country. I hold in my hand the historically interesting document which was issued by the Italian Government in 1871. It contains instructions and programmes relative to the teaching of mathematics in their *Ginnasi* and *Licei*.* Before quoting it I may observe that the *Ginnasio* is essentially a classical school, mathematics being studied only in its fifth or highest class, and then only for five hours a week; and that in the *Liceo* the instruction is still to a great extent classical, though less exclusively so. Here, as the pupil advances through its three classes, mathematics, physics, natural history, and philosophy become more and more prominent as subjects of study. The instructions, as already observed, relate solely to the teaching of mathematics in these classical schools; nevertheless, the following introductory remarks on the objects of mathematical study are, I venture to think, applicable to all schools in which the foundation of a truly liberal education is to be secured: "Mathematics should not be looked upon as a mere collection of intrinsically useful propositions or theorems of which boys ought to acquire a knowledge in order to be able to apply them subsequently to the practical purposes of life. The study should be regarded principally as a means of intellectual culture, directed towards the development of the faculty of reasoning, and to the strengthening of that just and healthy judgment which serves as the light whereby we distinguish truth from that which has but the semblance thereof."

After describing the course of instruction in arithmetic and algebra best suited to the end in view, the document before me proceeds thus:—"In order to give to the instruction in geometry its maximum intellectual efficacy, and at the same time to bring the subject-matter within reasonable limits, it will suffice to follow, in our schools, the example of English ones by returning to the elements of Euclid, universally admitted to be the most perfect model of geometrical rigour." It would be a grave error to suppose that it was the good results on geometrical teaching of our adherence to the elements of Euclid that induced the Italians to return to them. Although England is made, in some measure, responsible for the step taken, we know from sources alluded to in my address last year that the main object in taking it was to purge from Italian schools the many worthless books which private enterprise had succeeded in introducing, and by no other means than the one adopted could the Italian Government, in the opinion of their advisers, have achieved this end with sufficient promptitude and impartiality.

The real motive of the order issued in 1867 is a little more apparent in the following passage from the Instructions, wherein allusion is made to the practice, then prevalent, of striving after a deceptive facility of treatment by the introduction of algebraical processes in place of geometrical reasoning: "The instruction in geometry is to extend to the first six, and to the eleventh and twelfth, books of Euclid, and to be followed by lessons on the most essential propositions of Archimedes relating to the measure of the circle, of the cylinder, of the cone, and of the sphere. Taught by the method of the ancients, geometry is easier and more attractive than the abstract science of number; hence, instead of postponing geometry to algebra, one part of the subject (the first book) is assigned to the fifth class in the *Ginnasio*, and another (the second and third book) to the first class of the *Liceo*. The teacher is recommended to adhere to the method of

* Instruzione e Programmi, per l'Insegnamento della Matematica nei Ginnasi e nei Licei, approvati con R. Decreto, 10 Ottobre, 1867.

Euclid, as the one best fitted to establish in the youthful mind the habit of thoroughly rigorous reasoning; above all, he is not to impair the purity of the ancient geometry by transforming geometrical theorems into algebraic formulæ, that is to say, by substituting in place of concrete magnitude—such as lines, angles, superfices, volumes—their respective measures; on the contrary he is to accustom his pupils to reason always on the magnitudes themselves even when their ratios are under contemplation. It is only after the propositions of Euclid and of Archimedes, mentioned in the programme, have been mastered that formulæ are to be deduced for practically determining the areas of rectilineal figures, the area of the circle, the length of its circumference, and the magnitudes of the surfaces and volumes of prisms, pyramids, cylinders, cones, and spheres."

The measures taken by the Italian Government in 1867 have, I am informed, fully answered the expectations of the mathematicians who recommended them. A taste for rigorous and purely geometrical methods has been revived, and the ground has been cleared for further advances. That such advances were contemplated from the first is obvious from the following passages, with which the Professors Betti and Brioschi—two of the most distinguished mathematicians of Italy—concluded their preface to the new edition (based on that of Viviani) of the Elements of Euclid, with which classical schools were supplied in 1867 · "Profoundly convinced that it is only through the eminent qualities of precision and clearness which distinguished Euclid's Geometry that we can hope, in seeking to promote the intellectual development of our youth, to secure those results at which all civilised nations aim when they give to geometrical instruction so important a place in public instruction, we have undertaken the publication of an edition of the elements with the fixed intention of improving it whenever new foreign publications and the experience gained in our own schools shall have shown that improvements are desirable. We trust that professors in *Licei* will help us in this work. We shall gratefully accept their observations and suggestions."

Experience, however, has gone further than was here anticipated; already there appears to be a demand for something beyond a revision of Viviani's edition of Euclid's Elements. In the *Gazzetta Ufficiale* of the kingdom of Italy, published at Rome, I find that on the 2nd of December last an announcement was made by the authority of the Minister of Public Instruction, to the effect that in 1873 a prize of 2,500 lire (about 100*l*) would be given to the author of the best "Treatise on Elementary Geometry which shall adhere rigorously to the method of Euclid, and contain, besides the subject-matter in the programme of 1867, those portions of the science, developed since Euclid's time, which are now to be found in all elements of geometry adopted as text-books in the classical schools of the most cultured nations." I forbear to attempt to determine what would be the rank of England amongst cultured nations if she were judged by this standard of the introduction of post-Euclidean matter into school text-books. I prefer to see in the announcement merely an encouragement to proceed with our self-imposed task of endeavouring to bring up the teaching of geometry and the text-book we employ to the level of the science of our day. In Italy this can be done more promptly than in England. Our Government cannot, with a stroke of the pen, alter the entire character of the instruction given in English schools. With us improvements are of slower growth, and it is by operations less surgical in their character that obstructions to their growth have first to be removed. It is, in fact, the function of associations like our own to endeavour to remove unreasonable prejudices against changes in the English habit of teaching geometry by bringing prominently forward the defects which we find to exist, and the improvements which we desire to see introduced. Let me now turn, therefore, to the work done by this association during the past year. You will recollect that members were invited to prepare programmes and syllabuses of text-books on geometry in accordance with their own views. The primary object in making this request was to ascertain what amount of unanimity at present prevails amongst teachers. The invitation was accepted by many, and the syllabuses received were referred to two committees, one meeting at London and the other at Rugby. Although the occupations of many of us, and our distances asunder, rendered it very difficult to secure concerted action, a report has at length been prepared, and will be this day submitted to you. With respect to the resolutions and recommendations embodied in this report, I will for the present confine myself to the statement that the main object they are intended to further is a practically useful degree of conformity amongst teachers during the present transitional state of matters. No attempt has been made to prepare any detailed scheme or programme of elementary geometrical study. This last difficult task, however, although postponed, is not, as you will hereafter see, abandoned.

Although the assertion may partake of the character of a truism, it cannot be too often insisted upon, that however necessary it may be to have good text-books, it is far more necessary to have good teachers; that, in fact, good text-books are useful principally by the aid they render in forming good teachers and in furnishing students with an accurate record of what they have been taught. In teaching, one might say, there is *vis viva*—actual energy; whereas in a text-book, however good it may be, the disciplinal energy is at most potential. The text-book, indeed, to be properly used, should always be subordinated to the teaching; but to do this it is absolutely essential that the teacher should, by his own study, have risen not merely up to, but above, the level of the text-book he employs. Until he has so mastered the subject that it has become plastic in his hands, his teaching must necessarily remain defective; for geometrical truth, it must be remembered, has, like all other truth, many sides, and no text-book can present all, or necessarily the one which, to individual pupils, is the most accessible. Alternative methods of demonstration, inquiries into the interdependence of propositions, judicious variation of data, and just discrimination between the contingent and necessary properties of figures; these and numerous other matters, all essential to geometrical culture, can only be properly supplied by the teacher; no text-book could be weighted with them. Above all, it is to him that we must mainly look for the cultivation of that scientific method of inquiry under whose guidance solely problem-solving can be raised in character above what has been termed "exalted conundrum guessing," and acquire its full educational value.

The interdependence of geometrical propositions above alluded to, as one of the subjects to which teachers should habitually direct the attention of their pupils, is mainly logical in character, but nevertheless most essential to geometrical culture. Every one will admit the primary importance of habituating the student to extract its full logical significance from every proposition he establishes, to recognise each proposition readily under different, although logically equivalent forms of enunciation, and thus to discriminate accurately between the cases where mere *logical* deduction from antecedent propositions is requisite, from those which require the introduction of further *geometrical* considerations. Obvious as this may be, it is rarely sufficiently attended to by teachers, and even in approved text-books, ancient as well as modern, we not unfrequently find remarkable instances of the absence of the discrimination to which I refer. The ninth proposition of the third book of Euclid is now a well-known case of the kind. Geometrical apparatus is there employed to demonstrate, indirectly, what had virtually been already proved in the seventh proposition. Having proved that *from a point which is not the centre three equal straight lines cannot be drawn to the circumference of a circle* (Prop. 7), it was wholly unnecessary to prove that *the point from which three equal straight lines can be drawn to the circumference must be the centre of the circle* (Prop. 9).

The two theorems are, in fact, contra-positive forms, one of the other; the truth of each is implied, when that of the other is asserted, and to demonstrate both geometrically is more than superfluous; it is a mistake, since the true relation between the two is thereby masked. There can be no better proof of this than the fact that the above defect in exposition remained undetected for centuries. Another, though less striking, example of the same kind is presented by the 16th and 27th propositions of the first book. Few intelligent boys fail on first reading the 27th to note the oddity of giving to two parallel lines a dagger-like shape in order to prove indirectly that "if a straight line falling on two other straight lines make the alternate angles equal to each other, these two straight lines shall be parallel." It is certain, however, that few of them ever discover that the proposition has virtually been proved before, that it is in fact the contra-positive form of the 16th, since the latter is obviously susceptible of being thus enunciated: "If two straight lines meet one another, a straight line falling on them will not make the alternate angles equal."

The late Prof. de Morgan, to whose keen penetration we owe the detection, not merely of the above defects in Euclid, but of many others, strongly and justly insisted upon the necessity of a more logical study of the elements of geometry.

I do not advocate the introduction of more *formal* logic into elementary geometry, but simply the cultivation of a logically severer habit of thought, and the more frequent application of those simple rules of reasoning by means of which tedious reiteration may be so often obviated, and, as a consequence, clearness of insight promoted. As an instance of such a rule I may mention that very useful one according to which "the converse of each of a series of demonstrated theorems is necessarily true if of their several hypotheses, as well as of their predicates, it can be said that one must be true, and that no two of them can be so at the same time." A conviction of the general validity of this rule is readily imparted, even to your pupils, by first selecting familiar instances and then generalising; and, once imparted, they are put in possession of the instrument whereby converse propositions in geometry are most frequently and satisfactorily established.

In conclusion, I may observe that it is chiefly by the aid of general rules, such as those just alluded to, that the mechanical details of demonstration become sufficiently subordinated to allow a complete grasp of the whole subject to be acquired; they serve, in fact, as the thread on which the isolated propositions of geometry, like beads, have to be strung before they can be properly viewed.

THE YELLOWSTONE PARK

THE following, reprinted from the "Reports to Congress" of the United States, will serve to show the zeal displayed by the American Government for the improvement of the people. We regret that we are unable to reproduce the accompanying maps:—

"The Bill now before Congress has for its object the withdrawal from settlement, occupancy, or sale, under the laws of the United States, a tract of land fifty-five by sixty-five miles, about the sources of the Yellowstone and Missouri Rivers; and dedicates and sets it apart as a great national park or pleasure-ground for the benefit and enjoyment of the people. The entire area comprised within the limits of the reservation contemplated in this Bill is not susceptible of cultivation with any degree of certainty, and the winters would be too severe for stock-raising. Whenever the altitude of the mountain districts exceed 6,000ft. above tide-water, their settlement becomes problematical unless there are valuable mines to attract people. The entire area within the limits of the proposed reservation is over 6,000ft. in altitude, and the Yellowstone Lake, which occupies an area 15 miles by 22 miles, or 330 square miles, is 7,427ft. The ranges of mountains that hem the valleys in on every side rise to the height of 10,000ft. and 12,000ft, and are covered with snow all the year. These mountains are all of volcanic origin, and it is not probable that any mines or minerals of value will ever be found there. During the months of June, July, and August, the climate is pure and most invigorating, with scarcely any rain or storms of any kind; but the thermometer frequently sinks as low as 26°. There is frost every month of the year. This whole region was in comparatively modern geological times the scene of the most wonderful volcanic activity of any portion of our country. The hot springs and the geysers represent the last stages—the vents or escape-pipes—of these remarkable volcanic manifestations of the internal forces. All these springs are adorned with decorations more beautiful than human art ever conceived, and which have required thousands of years for the cunning hand of nature to form. Persons are now waiting for the spring to open to enter in and take possession of these remarkable curiosities, to make merchandise of these beautiful specimens, to fence in those rare wonders so as to charge visitors a fee, as is now done at Niagara Falls, for the sight of that which ought to be as free as the air or water.

"In a few years this region will be a place of resort for all classes of people from all portions of the world. The geysers of Iceland, which have been objects of interest for the scientific men and travellers of the entire world, sink into insignificance in comparison with the hot springs of the Yellowstone and Fire-Hole Basins. As a place of resort for invalids it will not be excelled by any portion of the world. If this Bill fails to become a law this session, the Vandals who are now waiting to enter into this wonderland will, in a single season, despoil beyond recovery these remarkable curiosities which have required all the cunning skill of nature thousands of years to prepare.

"We have already shown that no portion of this tract can ever be made available for agricultural or mining purposes. Even if the altitude and the climate would permit the country to be made available, not over fifty square miles of the entire area could be settled. The valleys are all narrow, hemmed in by high volcanic mountains like gigantic walls.

"The withdrawal of this tract, therefore, from sale or settlement takes nothing from the value of the public domain, and is no pecuniary loss to the Government, but will be regarded by the entire civilised world as a step of progress and an honour to Congress and the nation.

Department of the Interior,
Washington, D. C., January 29, 1872

Sir,—I have the honour to acknowledge the receipt of your communication of the 27th instant relative to the Bill now pending in the House of Representatives dedicating that tract of country known as the Yellowstone Valley as a national park.

I hand you herewith the report of Dr. F. V. Hayden, United States geologist, relative to said proposed reservation, and have only to add that I fully concur in his recommendations, and trust that the Bill referred to may speedily become a law.

Very respectfully, your obedient servant,
C. DELANO, Secretary.

Hon. M. H. Dunnell, House of Representatives.

"The committee therefore recommend the passage of the bill without amendment."

DR. LIEBREICH ON TURNER AND MULREADY

DR. R. LIEBREICH, in a lecture delivered at the Royal Institution on Friday, the 8th inst., "On the effects of certain faults of vision on painting, with special reference to Turner and Mulready," successfully vindicated the title of physical science to extend its researches into the domain of art criticism by applying optical laws to painting. The lecture may be said to consist of three parts, the first of which demonstrates, by the example of Turner, that there are certain conditions of the eye which alter the appearance of nature, whilst they leave the impression a picture produces upon the eye unchanged. The second part of the lecture proves, by the example of a French artist yet living, whose name, therefore, was withheld, that there is another defect of the eye, which produces an incorrect impression of the picture as well as of nature, the error, however, being dissimilar, and affecting the picture and nature in opposite ways. The third part of the lecture shows, by the example of Mulready, that there is yet another disease of the eye affecting colours in such a manner that pigments used in painting are influenced by the disease, whilst natural colours continue unaltered.

I.—TURNER

Surprised at the great difference between Turner's earlier and later works, said the lecturer, he examined one of the great artist's later pictures from a purely scientific point of view, and analysed it with regard to colour, drawing, and distribution of light and shade.

It was particularly important to ascertain if the anomaly of the whole picture could be deduced from a regularly recurring fault in its details. This fault is a vertical streakiness, which is caused by every illuminated point having been changed into a vertical line. The elongation is, generally speaking, in exact proportion to the brightness of the light; that is to say, the more intense the light which diffuses itself from the illuminated point in nature, the longer becomes the line which represents it on the picture. Thus, for instance, there proceeds from the sun in the centre of a picture a vertical yellow streak, dividing it into two entirely distinct halves, which are not connected by any horizontal line. In Turner's earlier pictures the disc of the sun is clearly defined, the light equally radiating to all parts; and even where, through the reflection of water, a vertical streak is produced, there appears, distinctly marked through the vertical streak of light, the line of the horizon, the demarcation of the land in the foreground, and the outline of the waves in a horizontal direction. In the pictures, however, of which I am now speaking (the lecturer proceeded to say), the tracing of any detail is perfectly effaced when it falls in the vertical streak of light. Even less illuminated objects, like houses or figures, form considerably elongated streaks of light. In this manner, therefore, houses that stand near the water, or people in a boat, blend so entirely with the reflection in the water, that the horizontal line of demarcation between house and water or boat and water entirely disappears, and all becomes a conglomeration of vertical lines. Everything that is abnormal in the shape of objects, in the drawing, and even in the colouring of the pictures of this period, can be explained by this vertical diffusion of light.

How and at what time did this anomaly develop itself? Till the year 1830 all is normal. In 1831 a change in the colouring becomes for the first time perceptible, which gives to the works of Turner a peculiar character not found in any other master. Optically this is caused by an increased intensity of the diffused light proceeding from the most illuminated parts of the landscape. This light forms a haze of a bluish colour which contrasts too much with the surrounding portion in shadow. From the year 1833 this diffusion of light becomes more and more vertical. It gradually increases during the following years. At first it can only be perceived by a careful examination of the picture; but from the year 1839 the regular vertical streaks become apparent to every one. This increases subsequently to such a degree, that when the pictures are closely examined they appear as if they had been wilfully destroyed by vertical strokes of the brush before they were dry, and it is only from a considerable distance that the object and meaning of the picture can be comprehended. During the last years of Turner's life this peculiarity became so extreme that his pictures can hardly be understood at all.

It is a generally received opinion that Turner adopted a peculiar manner, that he exaggerated it more and more, and that his last works are the result of a deranged intellect. I am convinced of the incorrectness, I might almost say of the injustice, of this opinion. According to my idea, Turner's manner is exclusively the result of a change in his *eyes*, which developed itself during the last twenty years of his life. In consequence of it the aspect of nature gradually changed for him, while he continued in an unconscious, I might almost say in a naïve manner, to reproduce what he saw. And he reproduced it so faithfully and accurately, that he enables us distinctly to recognise the nature of the disease of his eyes, to follow its development step by step, and to prove by an optical contrivance the correctness of our diagnosis. By the aid of this contrivance we can see nature under the same aspect as he saw and represented it. With the same we can also, as I shall prove to you by an experiment, give to Turner's early pictures the appearance of those of the later period.

After he had reached the age of fifty-five, the crystalline lenses of Turner's eyes became rather dim, and dispersed the light more strongly, and in consequence threw a bluish mist over illuminated objects. In the years that followed, as often happens in such cases, a clearly defined opacity was formed in the slight and diffuse dimness of the crystalline lens. In consequence of this the light was no longer evenly diffused in all directions, but principally dispersed in a vertical direction. At this period the alteration offers, in the case of a painter, the peculiarity that it only affects the appearance of natural objects, where the light is strong enough to produce this disturbing effect, whilst the light of his painting is too feeble to do so: therefore, the aspect of nature is altered, that of his picture correct.

The lecturer proceeded to demonstrate the truth of his remarks by a series of experiments, which showed, for instance, a natural tree, and then, by means of lenses prepared for the purpose, changed it into a "Turner-tree;" likewise the artist's early picture of "Venice" was shown, and, by means of lenses, changed into the "Venice" of Turner's later period.

II.—ASTIGMATISM

The optical state of the eye during its adaptation for the farthest point, when every effort of accommodation is completely suspended, is called its refraction.

There are three different kinds of refraction: firstly, that of the normal eye; secondly, of the short-sighted eye; thirdly, of the over-sighted eye.

1. The normal eye, when the activity of its accommodation is perfectly suspended, is adjusted for the infinite distance; that is to say, it unites upon the retina parallel rays of light. (Fig. 1.)

2. The short-sighted eye has in consequence of an extension of its axis a stronger refraction, and unites, therefore, in front of the retina the rays of light which proceed from infinite distance. In order to be united upon the retina itself the rays of light must be divergent, that is to say, they must come from a nearer point. The more short-sighted the eye is, the stronger must be the divergency; such an eye, in order to see distinctly distant objects, must make the rays from a distant object more divergent, by aid of a concave glass. (Fig. 2.)

3. The over-sighted (hypermetropic) eye, on the contrary, has too weak a refraction ; it unites convergent rays of light upon the retina ; parallel or divergent rays of light it unites behind the retina, unless an effort of accommodation is made. (Fig. 3.)

Hypermetropy, the lecturer explained, does not essentially influence painting, and is easily corrected by convex glasses. Short-sightedness, on the contrary, generally influences the choice of subject as well as its manner of execution.

Sometimes the shape of the eye diverges from its normal spherical form, and this is called astigmatism. This has only been closely investigated since Airy discovered it in his own eye. Figure to yourself meridians drawn on the eye as on a globe, so that one pole is placed in front; then you can define astigmatism as a difference in the curvature of two meridians, which may, for instance, stand perpendicularly upon each other; the consequence of which is a difference in the power of refraction of the eye in the direction of the two meridians. An eye may, for instance, have a normal refraction in its horizontal meridian, and be short-sighted in its vertical meridian. Small differences of this kind are found in almost every eye, but are not perceived. Higher degrees of astigmatism, which decidedly disturb vision, are, however, not uncommon, and are therefore also found among painters.

I observed a very curious influence of astigmatism upon the works of a portrait painter. He was held in high esteem in Paris, on account of his excellent grasp of character and intellectual individuality. His admirers considered even the material resemblance of his portraits as perfect ; most people, however, thought he had intentionally neglected the material likeness by rendering in an indistinct and vague manner the details of the features and the forms. A careful analysis of the picture shows that this indistinctness was not at all intentional, but simply the consequence of astigmatism. Within the last few years the portraits of this painter have become considerably worse, because the former indistinctness has grown into positively false proportions. The neck and oval of the face appear in all his portraits considerably elongated, and all details are in the same manner distorted. What is the cause of this? Has the degree of his astigmatism increased? No; this does not often happen ; but the effect of astigmatism has doubled, and this has happened in the following manner :—An eye which is normal as regards the vision of vertical lines, but short-sighted for horizontal lines, sees the objects elongated in a vertical direction. When the time of life arrives that the normal eye becomes far-sighted, but not yet the short-sighted eye, this astigmatic eye will at short distance see the vertical lines indistinctly, but horizontal lines still distinctly, and therefore near objects elongated in a horizontal direction. The portrait painter, in whom a slight degree of astigmatism manifested itself at first only by the indistinctness of the horizontal lines, has now become far-sighted for vertical lines, therefore he sees a distant person elongated in a vertical direction ; the portrait he paints, on the contrary, being at a short distance, is seen enlarged in a horizontal direction, and thus painted still more elongated than the subject is seen ; so the fault is doubled.

The lecturer proved these remarks by showing a picture which he made to appear in its natural shape or distorted by elongation, in either a vertical or a horizontal direction, by means of a lens which he held at various distances from the optical apparatus.

III.—Mulready

The lens, continued the lecturer, always gets rather yellow at an advanced age, and with many people the intensity of the discoloration is considerable. This, however does not essentially diminish the power of vision. In order to get a distinct idea of the effect of this discoloration, it is best to make experiments with yellow glasses of the corresponding shade. Only the experiment must be continued for some time, because at first everything looks yellow to us. But the eye soon gets accustomed to the colour, or rather it becomes dulled with regard to it, and then things appear again in their true light and colour. This is at least the case with all objects of a somewhat bright and deep colour. A more careful examination, however, shows that a pale blue, or rather a certain small quantity of blue, cannot be perceived even after a very prolonged experiment, and after the eye has long got accustomed to the yellow colour, because the yellow glass really excludes it. This must, of course, exercise a considerable influence when looking at pictures, on account of the great difference which necessarily exists between real objects and their representation in pictures.

These differences are many and great, as has been so thoroughly explained by Helmholtz. Let us for a moment waive the consideration of the difference produced by transmitting an object seen as a body upon a simple flat surface, and let us only consider the intensity of light and colour. The intensity of light proceeding from the sun and reflected by objects is so infinitely greater than the strongest light reflected from a picture, that the proportion expressed in numbers is far beyond our comprehension. There is also a great difference between the colour of light or of an illuminated object, and the pigments employed in painting, and it must appear wonderful that the art of painting can produce by the use of them such perfect optical delusions. It can, of course, only produce optical delusions, never a real optical identity ; that is to say, the image which is traced in our eye by real objects is not identical with the image produced in our eye by the picture.

Returning to our experiment with the yellow glass, we shall find that it affects our eye very much in the same way as a yellow tint of light. The small quantity of blue light which is excluded by the yellow glass produces no sensible difference, as the difference is equalised by a diminution of sensibility with regard to yellow. In the picture, on the contrary, there is found in many places only as much blue as is perfectly absorbed by the yellow glass, and this therefore can never be perceived, however long we continue the experiment. Even for those parts of the picture which have been painted with the most intense blue the painter could produce, the quantity of blue excluded by the yellow glass will make itself felt, because its power is not so small with regard to pigments as with regard to the blue in nature.

With aged people we often find the crystalline lens to be of a yellowish tint. In pictures painted after the artists were over sixty, therefore, the effect of the yellow lens can often be studied. As a striking example, the lecturer mentioned Mulready. It is generally stated that in his advanced age he painted too purple. A more careful examination shows, however, that the peculiarity of the colours of his later pictures is produced by an addition of blue. Thus, for instance, the shadows on the flesh are painted in pure ultramarine. Blue drapery he painted most unnaturally blue. Red of course became purple. If we look at these pictures through a yellow glass all these faults disappear ;—what formerly appeared unnatural and displeasing is at once corrected ; the violet colour of the face shows a natural red ; the blue shades become grey ; the unnatural glaring blue of the drapery is softened. It happens that Mulready has painted the same subject twice, first in the year 1836, when he was fifty years of age and his lens was in a normal state, and again in 1857, when he was seventy-one and the yellow discolouring had already considerably advanced. The first picture was called when exhibited "Brother and Sister ; or, Pinching the Ear ;" the second was called "The Young Brother." If we look at the second picture through a yellow glass, the difference between the two almost entirely disappears, as the glass corrects the faults of the picture. The smock of the boy no more appears of that intense blue which we may see in a lady's silk dress, but never in the linen smock of a peasant. It changes into the natural tint we find in the first picture. The purple face of the boy

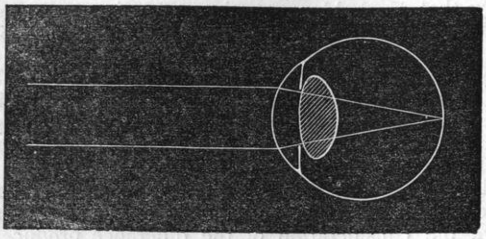


FIG. 1

also becomes of a natural colour. The shades on the neck of the girl and the arms of the child, which are painted in a pure blue, look now grey, and so do the blue shadows in the clouds. The grey trunk of the tree becomes brown. Surprising is the effect upon the yellowish green foliage, which, instead of appearing still

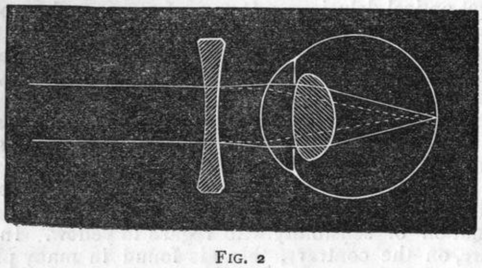


FIG. 2

more yellow, is restored to its natural colour, and it shows now the same tone of colour as the foliage in the earlier picture. This last fact is most important to prove the correctness of my supposition. The endeavour to explain this fact became for me the starting-point of a series of investigations to ascertain the optical qualities of the pig-

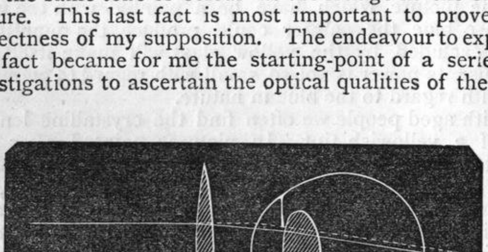


FIG. 3

ments used in painting, and thus to enable us to recognise them by optical contrivances when the vision of the naked eye does not suffice to analyse the colours of a picture.

If it is the dispersion of light which, as in Turner's case, alters the perception of nature, it can be partly rectified by a kind of diaphragm with a small opening (Donder's sthenopeical spectacles).

In cases of astigmatism, the use of cylindrical glasses will completely correct the aspect of nature, as well as of the picture. Certain anomalies in the sensation of colour may also be counteracted to some extent by the use of coloured glasses; for instance, by a blue glass, when the lens has become yellow, as was the case with Mulready.

If science aims at proving that certain works of art offend against physiological laws, artists and art critics ought not to think that, by being subjected to the material analysis of physiological investigation, that which is noble, beautiful, and purely intellectual would be dragged into the dust. They ought, on the contrary, to make the results of these investigations their own. In this way art critics will often obtain an explanation of the development of the artist, and artists will avoid the inward struggles and disappointments which often arise through the difference between their own perceptions and that of the majority of the public. Never will science be an impediment to creations of genius.

Dr. Liebreich's lecture will appear *in extenso* in the April number of *Macmillan's Magazine.*

THE NATURAL HISTORY OF EASTERN THIBET

DR. CAMPBELL, Superintendent of Darjeeling, has recently published a series of valuable papers on Eastern Thibet in *The Phœnix*, a monthly magazine for China, Japan, and Eastern Asia, ably edited by the Rev. James Summers, Professor of the Chinese Language in King's College. As a journal of this kind must naturally have only a limited circulation, and is not likely to be in the hands of many of our readers, we have no hesitation in abstracting from Dr. Campbell's contributions the following notes on the Zoology and Mineralogy of a country that at the present time is of special interest, both in a geographical and a commercial point of view. The following is a list of the animals of Eastern Thibet, the native name being attached to each :—*Goa*, an antelope; *Gnow*, the *Ovis ammon*; *Rigong*, the hare; *Kiang*, the wild ass; *Lawa*, the musk-deer; *Shaoo*, a large deer, *Cervus affinis*; *Cheu*, *Antelope Hodgsoni*; *Dong*, the wild yak of Thibet; *Pegoo*, the yak; A small cow, whose native name is not given; *Sauh*, cross between cow and yak; *Ba Sauh*, produce of female yak by bull; *Look*, sheep; *Peu Ra*, Thibet goat; *Phák*, the pig; *Cha*, the common fowl; *Damjhar*, the duck; *Damjhar Cheemoo*, the goose (besides the duck and goose there are numerous wild fowls, swimmers and waders, which migrate from India in March, and return in October); *Chungoo*, a reddish wild dog; *Koong*, a mottled civet; *Sik*, the leopard; *Tagh*, the tiger; *Somb*, the bear (a red and a black species); *Nehornehu*, a large sheep, goat, or antelope of various colours, four feet high, with enormous horns four feet long, sloping backwards, and a tail fifteen inches in length.

This completes Dr. Campbell's list of the indigenous mammals and birds. With regard to the *Dong* or wild yak of Thibet, he observes that it is the fiercest of all known ruminants, and will rarely allow a man to escape alive if it can come up with him. It is generally hunted on horseback, the great aim being to detach one from the herd. The horns of the full-grown buck are said to be three feet long, and the circumference must be enormous. They are used by the Grandees at marriage and other feasts as gigantic drinking cups, and handed round to the company. The horns so used are finely polished, and mounted in silver or gold and precious stones. A stuffed "Dong" is common in Thibetan Lamaserais, standing in front of the image of Mahákkáli, at whose shrine the animal is thus figuratively sacrificed.

Of *Look* or sheep there are four principal varieties—1st, Chang Look or northern sheep, very large, with fine wool; flocks of from 400 to 1,000 tended by one man. 2nd. Sok Look, rare, but greatly praised; it is a heavy-tailed sheep, coming from the province of Sok, east of Lassa; wool not very fine. 3rd. Lho Look, a very small sheep indeed, generally white but sometimes black, bred about Lassa; wool very fine and like the shawl wool. 4th. Changumpo Look, abundant about Geroo and in Dingcham, generally very large; the white wool very fine and soft. The flesh of all these sheep is fine-grained and good.

Of the *Phák* or pig there are two varieties, the southern pig, which is similar to the Indian village pig, and the small Chinese pig. There are no wild hogs in Thibet. The Chinese butchers at Lassa blow their pork so as to give it a deceptively fine appearance.

Ducks and geese are not eaten by the Thibetans, but are greatly used by the Chinese, for whom they are specially bred in Lassa.

The lakes of Thibet are full of fish, of which only one kind, named *Choolap*, is described; it grows to the weight of 8lb., and is a coarse food. It is, however, caught and preserved largely; the fish being gutted, split up, the tail put in the mouth, and dried, without salt, in the open air. Thus prepared they will keep for a year. The mode of catching them is singular; when the lakes are frozen over, a hole is made in the ice, to which they rush in such abundance that they are pulled out by the hand.

There are no leeches or mosquitoes in Thibet, nor are maggots or fleas ever seen there; and in Dingcham or Thibet Proper there are no bees or wasps.

Dr. Campbell gives us some very interesting information regarding the food of the Thibetans. During the summer months they use very little fresh meat. They do not like it boiled, and are not partial to it raw, unless it has been dried. In November there is a great slaughter, and a wealthy man, who has perhaps 7,000 sheep, will kill 200 at this time for his year's consumption. The animal after being killed is skinned and gutted and then placed on its feet in a free current of air. In a couple of days it becomes quite hard and is then ready for eating. It is kept in this way for more than a year without spoiling, even during the rainy periods. When long exposed to the wind of Thibet it becomes so dry that it may be rolled into powder between the hands. In this state it is mixed with water and drunk, and used in various other ways. The Thibetans eat animal food in endless forms, and a large portion of the people live on nothing else. The livers of sheep and other animals are similarly dried or frozen, and are much prized, but to strangers they are very distasteful for their bitterness and hardness. The fat is dried, packed in the stomachs, and then sent to market or kept for home use.

With regard to edible vegetables, it is stated that wheat, barley, and buckwheat sown in April or May and irrigated, are reaped in September, barley in Thibet taking the place of potatoes in Ireland, four-fifths of the population living on it. Besides these, the other crops are composed of peas, turnips, and a little mustard. The grain is ground in water mills. The bread is all unleavened, and cooked on heated stoves or gridirons. The sweet pure farinaceous taste of the fine flour equals the best American produce. The staple food of the country is *champa*, called *suttoo* in India; it is finely-ground flour of toasted barley. It is much eaten without further cooking; mixed up with hot tea it is called *paak*, and when prepared with tepid water it is known as *seu*. If any of our readers wish to enter upon "pastures new" in the breakfast department, they may try *Tookpa*, which, to be properly appreciated, should be taken at daybreak before any matutinal ablutions. It is a sort of broth made with mutton, champa, dry curds, butter, salt, and turnips.

Goats are also reared in considerable flocks, but for their milk rather than their flesh. The milk of yaks, cows, sheep, and goats is used alike for making dried curds and the various preparations of milk used by these people. Mares' milk is not used in Eastern Thibet.

We now proceed to notice the mineral wealth of this remarkable country.

Pen, a carbonate of soda, is abundant south of the Yaroo; it appears in a whitish powder on the soil, never in masses underground. It is not used for soap-making or otherwise in the arts, but is always put into the water when tea is made, and is much employed medicinally.

Chulla, borax, is only obtained north of the Yaroo, whence it is imported to other parts of Thibet, to India, *viâ* Nepaul, Sikkim, and Bootana, and thence to Calcutta and Europe.

Sicha, saltpetre, is abundantly manufactured in the Cara Thibetan sheep-folds, where composts of sheep's dung and earth are found to produce it.

Lencha, common salt, occurs in commerce in three forms, viz.: *Sercha*, white and best; *Châma*, reddish and good; and *Pencha*, yellowish and bad, containing soda or magnesia and earthy matter. All the salt used in Eastern Thibet is the produce of the lakes and mines north of the Garoo, or comes from Lache, a district between Digarchi and Ladak. According to the best information, all the salt is the produce of lakes, while some assert that it is dug out of the earth. It is certain that the salt-producing districts are all but inaccessible, and can only be traversed by men and sheep; and that their elevation prevents the working from being carried on except in the warmer part of the year, from April to November. Thousands of sheep are employed in carrying the salt to places accessible to yaks, the former animals carrying a load of 20lb. to 24lb. on open places, or of 8lb. to 10lb. in the rugged vicinity of the deposits, whose elevation is not less than 22,000 feet, while the latter are capable of bearing a load of 160lb.

Ser, gold, is found in the sands of a feeder of the Garoo, on its northern side, but the name of the river could not be ascertained by Dr. Campbell. The Garoo itself does not yield any gold washings. Most of the gold of Thibet is the produce of mines or diggings.*

Pabea, the yellow arsenic of commerce, is found west of Lassa, near the borders of China.

There are no mines of iron, silver, copper, quicksilver, lead, or coal in Thibet; the latter substance is, however, imported from China.

The turquoise, real or artificial, is universally worn in rings, necklaces, &c., and large, amber-like beads are a favourite ornament; but it is uncertain whether they are natural products of Thibet. The latter are apparently composed of turpentine mixed with some hardening material. Numerous imitations of turquoise are imported from China; and real but not valuable stones are sent, *viâ* Cashmere (but from what locality is not stated). The only test of a real stone that is resorted to by the Thibetans is to make a fowl swallow it; if real it will pass through unchanged.

In conclusion, we may add that Dr. Campbell's articles in *The Phœnix* contain much valuable matter on the geography, the government, and army of Thibet, the personal habits, customs, and ceremonies of the Thibetans, their religious festivals, the seasons, soil, and agriculture of the country, the wages of labour, and the most prevalent diseases. Amongst "Things not generally known," we may mention *Goomtook*, or *The laughing disease*, which consists of violent fits of laughter with excruciating pain in the throat. It equally attacks men and women, and often proves fatal in a few days.

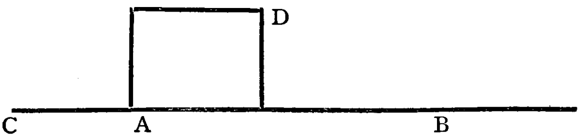
ON THE CAUSE OF FIXED BAROMETRIC VARIATIONS

THE chief difficulty in the way of explaining the annual and diurnal variations of the barometer by the heating and cooling of the air, appears to be the existence of a double maximum and minimum. To show how such a double maximum and minimum might result from the

* Notices of the Thibetan Gold Mines may be found in several recent numbers of the "Proceedings of the Royal Geographical Society."

changes in the temperature of the dry air alone, is the object of the present paper. I commence with the diurnal variation.

Let us suppose an atmosphere of dry air hardly absorbing any heat from the solar rays, and therefore chiefly heated and cooled by contact with the earth. Let us take the moment when the earth first begins to be heated by the sun's rays. (This will probably take place a little before sunrise, in consequence of the large amount of reflected or diffused heat which accompanies the morning twilight.) The earth then becomes heated at A, while at B, a little more to the west, no heat is yet felt. The earth



at A communicates its heat to the air in contact with it, and the latter expands and becomes lighter than the air in contact with the earth at B. (At C of course the earth is more highly heated than at A, and therefore the air in contact with the earth at C is still lighter.) The immediate consequence is that the heavier air at B rushes into the heated space A D (see fig.), driving out the lighter air which occupies it; and A D becoming filled with heavier air than before, the barometer at A rises. The heating goes on however at A, which remains at a higher temperature than B, until the epoch of greatest heat arrives; and consequently during all this time there is a flow of air from B towards A next the earth, with a flow in the contrary direction at a greater elevation. It might at first sight appear that the barometer at A would go on rising all this time. But a moment's reflection will show us that though it does so at first, it could not continue to do so all through. For as at the epoch of greatest cold (with which we commenced) C, A, and B were sensibly at the same temperature, so they will arrive at sensibly the same temperature at the epoch of greatest heat; and immediately afterwards the direction of the under-current will be reversed, C having become colder than A, while B is hotter. It is therefore evident that during the whole time which has elapsed between the epochs of greatest cold and greatest heat, the two currents will have counter-balanced each other, the under-current having carried exactly as much air from B to A as the upper-current has carried from A to B. Making a somewhat rough approximation, we may assume that during the first half of this period the under-current has been in excess, and the barometer at A has risen, while in the latter half the upper-current has been in excess, and the barometer at A has been falling. Immediately after the epoch of greatest heat, the cooler and heavier air at C will displace the air in the space A D, causing the barometer at A to rise. The moment of greatest heat will, therefore, correspond to a minimum reading of the barometer, not a maximum; and after it the barometer will go on rising until half way between it and the moment of greatest cold, when it will again fall until the latter moment. The barometer will, therefore, attain its minimum height at the hours of greatest heat and greatest cold, while the maximum heights will occur at about halfway between these epochs. Now this result appears to conform exactly to observation. It must be recollected that the minimum of temperature occurs not more than half an hour before sunrise, while the maximum is generally not reached for two or three hours after noon. This will explain why the morning barometric maximum seems to be nearly an hour earlier than the evening one. Indeed observation corresponds so exactly with the results arrived at, that I think it will appear that they cannot be seriously modified by the presence of aqueous vapour.

The mean of barometric pressures at different latitudes confirms these results. If the trade-winds extended to the poles—which they probably would do were it not that the parallels of latitude become so narrow before reaching them—on the same principles we might expect a minimum of pressure at the equator and the poles with a maximum at a latitude of about 45°. For the second of these minima we must evidently substitute the limit of the trades, or rather perhaps of the anti-trades, since the latter seem ultimately to become the under-currents; and our maximum will be situated about halfway between this limit and the equator. This agrees with observation. The phenomena of the tides too are analogous. There is low water where the moon's attraction is strongest and where it is feeblest, while high water corresponds to the mean attraction. Putting heat for attraction and the sun for the moon, the diurnal variations of the barometer follow the same law.

This law, however, does not appear to hold so well for the annual barometric changes. We can hardly trace in this case a double maximum in May and November, with minima in January and July. I think, however, that this result may be in part at least explained by the northern and southern shifting of the system of trades and anti-trades. For example, if a place in the northern hemisphere be near this limit (which corresponds to a minimum), the southern movement of the system in winter may cause the barometer to rise instead of falling as we approach the coldest day (supposing of course that it lies to the north of it). On the other hand, at a locality a little to the south of the limit, the northern movement of the system in summer may cause the barometer to rise at the time of greatest heat. I should perhaps notice, however, that the results here arrived at suppose the three points A, B, C to be situated on a horizontal plane, and the specific heat and conductibility of the earth at each of these points to be nearly identical. Hence they cannot be expected to hold for very elevated positions, or for places situated on the sea coast, or the shores of a large lake. They will be found most accurate in the interior of continents, where the land is level, and where the amount of aqueous vapour in the air is comparatively small. This anticipation is also verified by observation, so far as my knowledge reaches.

W. H. S. MONCK

*REMARKS ON THE ADAPTIVE COLOURATION OF MOLLUSCA**

NATURALISTS have long recognised the curious cases oftentimes occurring, of the resemblance between the colour of an animal and its immediate surroundings. It had been supposed that climatic influences, or peculiarities of food, or greater or less access to light, had something to do with these coincidences. Mr. Alfred R. Wallace has shown that the varied phases of these phenomena could not be explained by such agents, and in a paper "On Mimicry and other protective resemblances among Animals," published in the *Westminster Review*, July 1867, and since made widely public in his work on "Natural Selection," he shows that the singular resemblances between the colour of animals and their surroundings are mainly brought about by the protection afforded them through greater concealment. Many very interesting examples are then cited from the Vertebrates and Articulates in support of these views. Briefly may be mentioned, as examples, the almost universal sand colour of those animals inhabiting desert tracts; the white colour of those animals living amid perpetual snows; the resemblance seen again and again between the colour of many insects and the places they frequent. Among the hosts of examples cited by Mr. Wallace as illustrating plainly the views he advances, may be mentioned the

* From the Proceedings of the Boston Society of Natural History, vol. xiv., April 5, 1871.

many species of Cicindela, or tiger beetle. The common English species, "*C. campestris*, frequents grassy banks, and is of a beautiful green colour, while *C. maritima*, which is found only on sandy sea shores, is of a pale bronzy yellow, so as to be almost invisible." He then states that a great number of species found by himself in the Malay Archipelago were similarly protected. "The beautiful *Cicindela gloriosa*, of a deep velvety green colour, was only taken upon wet mossy stones in the bed of a mountain stream, where it was with difficulty detected. A large brown species (*C. heros*) was found chiefly on dead leaves in forest paths; and one which was never seen except on the wet mud of salt marshes, was of a glossy olive so exactly the colour of the mud as only to be distinguished when the sun shone, by its shadow. Where the sand beach was coralline and nearly white, I found a very pale *Cicindela*; wherever it was volcanic and black, a dark species of the same genus was sure to be met with."

But little attention has been given to adaptive colouring among the lower invertebrate animals. Darwin, in his last work on the "Descent of Man," calls attention to the statements of Haeckel that the transparency of the Medusæ and other floating animals is protective, since their glass-like appearance renders them invisible to their enemies, though Wallace also alludes to this same feature (p. 258). Mr. Edward Burgess informs me of a species of Acaleph, *Polyclonia frondosa*, on the coast of Florida which lives in the mud, and is brown in colour. Darwin, while admitting that the transparency of these animals unquestionably aids them to escape the notice of their enemies, yet doubts whether the colour of mollusks affords similar protection. He says, "The colours do not appear in most cases to be of any use as a protection; they are probably the direct result, as in the lower classes, of the nature of the tissues, the patterns and sculpture of the shell depending on its manner of growth" (vol. i. p. 316).

In glancing over our New England Mollusca, however, it seems that we do have very clear evidences of protective adaptations among them, not only in their form, but more particularly in their colour. It would seem strange indeed if this were not so, since so many species of Mollusca form an important portion of the food of many fishes,* and also of certain species of birds.

In a general way, we recall the sombre colours of the shells of most species, varying through different shades of yellow, brown, and green, in this respect resembling the sand, mud, and rocks, or seaweed, in or upon which they live, and we then recall by groups the land snails of our woods, with their almost uniform brown tints, like the dead leaves or rotten wood in which they live.

The freshwater snails have similar shades to match their peculiar habitats.

The freshwater mussels, coloured likewise brown, greenish, or black, accord with their places of refuge.

Among the marine forms we notice the adaptive colouration of certain species very well marked. The common *Littorina* of the coast swarms on the bladder weed, the bulbous portions of which are olive brown in colour, or yellowish, according to age. The shells of the *Littorina* found upon it, present in their varieties these two colours, and are limited to these colours, though now and then delicately banded specimens are seen.

Purpura lapillus, which generally hides beneath overhanging ledges, or is concealed under flat rocks, has generally a dirty white shell, with, now and then, a specimen bright yellow, or banded with brown. We are not aware of any fish that feeds upon this species, though in the almost universal white colour of the species an adaptive colour may be secured in resembling the white barnacles which oftentimes whiten the rocks by their numbers.

In pools left at low tide where the rocks are often clothed with the red calcareous algæ we find the little red Chiton. Certain *Mytili* are green. The young of the large *M. modiolus* has a rough coat of epidermal filaments, looking like the aborescent growth of some Alga or Hydroid.

The few species common to the mud flats exposed by the retreating tide are coloured black or dark olive. *Ilyanassa obsoleta* has the shell black, while the soft parts are quite dark. A related form, *Nassa trivittata*, lives in more sandy places, and has a similarly coloured shell. *Rissoa minuta*, inhabiting mud flats, has a shell dark olive, or nearly black, while other species of *Rissoa* are much lighter in colour. The fronds of the large Laminarian are frequented by *Lacuna vincta* and its variety *fusca*. The first is greenish or purplish horn colour, with darker bands, while the variety *fusca* is uniformly dark brown or chestnut; the colours in both cases quite match the Laminarian upon which they are found. Another species of the same genus, *Lacuna neritoidea*, Mr. Fuller has observed spawning on bladder-weed, and its yellowish tinge accords well with its surroundings. *Margarita helicini* I have found in numbers on the large Laminarian, and on seaweed at low-water mark, and its colour is decidedly protective; while other species of *Margarita*, dredged in deep water on shelly ground, are whitish, pearly, or red.

The protective colouring of certain species is well seen upon stones dredged in deep water, the various mollusks adhering to them closely resembling the calcareous algæ and the stones themselves.

Species similar to sand beaches are of various sand-coloured shades, as for example *Machæra*, *Mactra*, *Cochlodesma*, *Cyprina*, the little *Solenomya*, and *Solen*. On muddy ground we notice certain *Tellinas* and other species with white shells. It has been supposed that those species hidden from the light were generally white, and this would seem to be the case when we recall *Mya*, certain species of *Teredo*, *Tellina*, *Pholas*, and other species. Yet we do have cases where the shell is oftentimes conspicuously banded or marked. It might appear that in those species living buried in the mud or sand, the shell was protected by a very thin epidermal layer, and that this layer was eroded, thus exposing the white shell; there are certain species, however, living buried in the mud or sand, which have an epidermal coat, very thick, and dark brown or black: such examples are seen in *Solenomya borealis* and *Glycymeris siliqua*.

It has been noticed that the same species occupying different stations are differently coloured. Dr. A. A. Gould noticed this in regard to *Astarte castanea*; those thrown up from deeper water are darker coloured than those found in quiet sandy places. In his "Report on the Invertebrate Animals of Massachusetts," first edition, p. 78, speaking of the shells found in the sandy harbour of Provincetown, he says: "The colour of all the shells in that harbour is remarkably light."

A very evident case of protective colouring is seen in the three species of *Crepidula* found on our coast. *Crepidula fornicata* is drab, variously rayed and mottled with brown, and it lives attached to stones near the roots of the large Laminarian, or upon stones clothed with algæ of similar colours, or attached to the large *Mytilus*. *Crepidula convexa*, a much smaller species, lives on the roots of seaweed. Prof. Perkins records its occurrence on the black shell of *Ilyanassa obsoleta*. This *Crepidula* has a very dark brown shell, according well with the dark colour of its various places of lodgment. *Crepidula plana*

* In an inlet near Salem the writer observed a school of minnows swimming along the bottom, and as they approached a certain point jumped right and left in great alarm. For some time the disturbing cause could not be found. On closer examination, however, a Cottus was seen to open his large mouth and take in several of the little fishes. The Cottus was so perfectly protected by its colours that it was only recognised when the capacious mouth opened, and only then were the minnows alarmed. Just beyond in their track was a rusty tin fruit can, the little tin remaining on it reflecting the rays of the sun, and from this harmless object they all turned affrightedly away. In this connection it would be interesting to inquire into the food of fishes in respect to their colours. Those fishes feeding upon Mollusca would certainly not require that protection for concealment as those living upon more active prey.

or *unguiformis* lives within the apertures of larger species of Gasteropods, as *Buccinum*, *Natica*, *Busycon*, and others. The shell of this *Crepidula* is absolutely white.

There are many species that undoubtedly receive protection in allowing foreign substances to grow upon their shells, and these species, oftentimes covered by a dense growth of calcareous or other algæ, are difficult of detection by the experienced collector.

There are also certain species that habitually accumulate foreign substances upon their shells. The little *Pisidium ferrugineum* possibly finds greater immunity from danger in its habit of accumulating a ferruginous deposit on that portion of the shell most conspicuous. *Nucula delphinodonta* has likewise a similar habit. The delicate *Lyonsia arenosa*, with its habit of entangling particles of sand in its epidermal filaments, undoubtedly finds protection in this peculiarity.

It was not the intention to go outside of New England species in citing these examples, but in this connection I cannot forbear mentioning the tropical genus *Phorus*. The species are said to frequent rough bottoms, and to scramble over the ground, like the Strombs, and not to glide evenly. This peculiar manner of moving would render them very conspicuous, and it is curious to observe that most of the species attach foreign substances to the margins of their shells as they grow, so that when a shell has attained its growth, it is almost completely concealed by fragments of shells large and small, spines of Echini, bits of coral, and stones.

These few observations are offered (and they might be multiplied) with the belief that if there is any truth in the theory of protective colouring, as advanced by Wallace, the various colours of Mollusca in many cases can be explained, and the occurrence of varieties in colour are also accounted for by the same theory.

EDWARD S. MORSE

SCIENCE AT THE LONDON SCHOOL BOARD

PROF. J. J. SYLVESTER has issued his address as candidate for election to the London School Board for Marylebone in the room of Prof. Huxley. The importance of having at least one representative of Science on the Board induces us to print his Address in full. It must be obvious that many subjects will come before the Board wherein the opinion of a man of Prof. Sylvester's scientific training will be of the highest value; and we heartily wish the Board may be fortunate enough to obtain the additional strength which will be secured by his election.

"LADIES AND GENTLEMEN,—An influential body of ratepayers have appealed to me as a man of science, to offer my services on the London School Board.

"It has been represented to me, as the wish of your great constituency, that Prof. Huxley should be replaced by one who, like himself, has made the scientific part of education the chief business of his life. On this ground I have ventured to place myself in your hands.

"My University career at Cambridge, added to my experience both as Professor of Natural Philosophy at University College, London, and subsequently as Government Professor of Mathematics during a period of fifteen years at the Royal Military Academy at Woolwich (from which I have recently retired), have given me considerable knowledge of educational matters in England. My position as Corresponding Member of the Institute of France, as Corresponding Member of the Royal Academy of Science of Berlin, as Foreign Member of the Royal Academy of Science of Naples, and other learned corporations, gives me an early and accurate knowledge of what is passing in the chief intellectual centres of the Continent. I have ample leisure for the work that is to be done, not only in attending the ordinary meetings of the Board, but also the various sub-committees on which the general working of the Act devolves, as well as the divisional and district committees, on the efficiency of which the local benefit of that Act depends.

"If you send me to the London School Board, I shall be prepared, while looking forward to the gradual adoption of a National system of Education, to adhere to that wise and moderate compromise by which, without violation of principle, you may obtain the use of existing school machinery.

"I have the honour to be, Ladies and Gentlemen, your obedient servant,

"J. J. SYLVESTER, LL.D., F.R.S.

"Central Committee Room,
25, Great Quebec Street, Marylebone Road, W."

Dr. Sylvester has already received the promise of the support of the following scientific men:—Sir Chas. Wheatstone, D.C.L.; Prof. Sharpey (Sec. Royal Society); Prof. Busk, Pres. Royal Col. Surgeons; Phillip H. Calderon, R.A.; William Heywood, C.E.; E. H. Lawrence, F.S.A.; J. Norman Lockyer, F.R.S.; J. Gerstenberg, F.R.G.S.; J. Gwyn Jeffreys, F.R.S.; Nicholas Trübner, M.R.A.S.; Prof. T. Hewitt Key, F.R.S.; Dr. Wilson; David Forbes, F.R.S.; H. W. Bates, Sec. Royal Geog. Society; Henry Holiday; Henry Watts, F.R.S.; Dr. Pick; Thomas Woolner, A.R.A.; Professor Williamson, F.R.S.; Charles Brooke, F.R.S.; Sir Henry Thompson; Colonel Stuart Wortley; Dr. Forbes Winslow, F.R.S.; Joseph Durham, A.R.A.; C. Murchison, M.D., F.R.S.; Prof. Henry Charlton Bastian, F.R.S.; William Perkins; Noel Humphreys, F.S.A.; T. Spencer Cobbold, M.D., F.R.S.; A. W. Bennett, F.L.S.; Sir Julius Benedict; Prof. W. Warington Smyth, F.R.S.; George Cruickshank; Prof. J. Percy, F.R.S.; George Harley, M.D., F.R.S.; Nevil S. Maskelyne, F.R.S.; W. S. Dallas, Sec. Geol. Soc.; Prof. G. C. Foster, F.R.S.; William Chaffers, F.S.A.; J. J. Stevenson, F.R.G.S.; and J. H. Pepper.

NOTES

WE congratulate the Science and Art Department on a resolution at which they have just arrived, in consequence of applications from science schools, to form collections of such specimens, models, diagrams, &c., as are best adapted for teaching the various branches of science which the Department aids by grants. It is proposed that collections shall be sent on loan for short periods to the local schools, to assist them in furnishing themselves with the necessary apparatus. The specimens and apparatus already in the Educational Department of the South Kensington Museum have been arranged for examination under the different subjects of instruction, and a letter has been forwarded to all the Examiners of the Department, requesting them to inspect the collections, with the view of advising what portion of them they consider may with advantage form part of the proposed travelling collections; what additions should be made, so as to give the science schools an idea of what they would require for a complete outfit; and what are the best and cheapest forms of apparatus, &c., for them to provide themselves with.

A FEW months ago we noticed the expedition to Moab which, by the aid of the British Association, was organised by Dr. Ginsburg and Dr. Tristram. We have now to announce the safe return of Dr. Ginsburg, and hope soon to be able to state some of the results of the expedition, which we have reason to believe are both numerous and interesting.

THE Society for the Encouragement of Arts, Manufactures, and Commerce is about to organise examinations in the science and technology of the various arts and manufactures of this country, which shall be conducted by a Board of Examiners, capable of testing the practical knowledge and skill required in the application of the scientific principles involved in each art or manufacture. We heartily commend this movement on the part of the Society of Arts, and may probably recur to the subject at some future time.

THE Geologists' Association has made the following excursion arrangements for March and April :—Thursday, March 21, a visit to the Museum of Practical Geology, under the guidance of Prof. Morris. Tuesday, April 2, an excursion to Maidstone, under the direction of Mr. W. H. Bensted and Prof. Tennant. Upon arriving at Maidstone the party will visit the Charles Museum, and afterwards the fine sections of the Lower Greensand, exposed in the "Iguanodon Quarries." The Kentish Rag is here well seen *in situ*. Subsequently the party will proceed to Aylesford, crossing the Medway at Allington Lock, and the Gault, Lower Greensand, and Valley Deposits yielding Mammalian Remains, there exposed, will be inspected. Saturday, April 13, an excursion to Watford and Bushey, under the leadership of Mr. John Hopkinson. The special object of interest will be the sections of the Chalk, the Woolwich and Reading Series, and of the London Clay (Basement Bed). Saturday, April 27, excursion to Hampstead, directed by Mr. Caleb Evans and Mr. S. R. Pattison. The party will visit the shaft of the Midland Railway Tunnel, and afterwards proceed to Hampstead Heath to observe the sections of the Bagshot Sands here exposed, as well as the Physiography of the District. The Annual Report of the Association for 1871 furnishes satisfactory evidence of the prosperity and progress of this useful institution. We have from time to time given so full a report of its proceedings that we need not do more than congratulate the Society on its success.

THE Board of Directors of the Edinburgh School of Art have appointed Dr. Robert Brown to the newly-created Lectureship on Geology and Palæontology, viewed more especially in the relation of the science to landscape painting, sculpture, architecture, and other fine arts and industries.

A LECTURE will be delivered for the Society of Telegraph Engineers at the Institution of Civil Engineers, 25, Great George Street, Westminster, on Wednesday, March 27, at 7.30 P.M., by Captain P. H. Colomb, R.N., on "Telegraphing at Sea."

A LECTURE will be delivered at the London Institution, Finsbury Circus, this evening (March 21) at 7.30 P.M., on "How Plants are Fertilised," by Mr. A. W. Bennett.

MESSRS. SAMPSON LOW AND CO. have in the press Captain Butler's account of his connection with the Red River Expedition in 1869-70, and of his subsequent travels and adventures in the Manitoba country and across the Saskatchewan Valley as civil agent for the Government.

ONE of the best papers on local geology which we have recently come across was read by Mr. Thos. Beesley at the Annual Meeting of the Warwickshire Naturalists' and Archæologists' Field Club on March 5, "On the Geology of the neighbourhood of Banbury." Mr. Beesley gave a detailed account of the various strata represented in the neighbourhood, and the fossils found in them, and he ably sustained the view, in opposition to that held by Prof. Phillips, that the Inferior Oolite extends far into Oxfordshire.

THE *Traveller*, which has now been in existence nearly a year, continues to contain excellent articles on travel and geographical research, of special interest to English and Americans.

WE have received the seventh Annual Report of the Massachusetts Institute of Technology. It was established on the principle that all the studies and exercises of the first and second years should be pursued by the whole school. At the beginning of the third year, each student selects one of the following special courses of study :—1. A course in Mechanical Engineering; 2. Civil and Topographical Engineering; 3. Geology and Mining Engineering; 4. Building and Architecture; 5. Chemistry; 6. Science and Literature; 7. Natural History. These courses differ widely, but certain general studies are common to them all. It is intended to secure to every student, whatever his special course of study, a liberal mental development and general culture, as well as the more strictly technical education which may be his chief object. The course in Science and Literature, and the course in Natural History, differ from the others in having a less distinctly professional character. The former offers a sound education, based on the sciences and modern literature, and furnishes, with its wide range of elective studies, a suitable preparation for any of the departments of active life, or for teaching science. The course in Natural History affords an appropriate general training for those whose ulterior object is the special pursuit of Geology, Mineralogy, Botany, Zoology, or of Medicine, Pharmacy, or Rural Economy.

SINCE the days of its foundation, the Federal School at Zurich has, according to the *Mining Magazine and Review*, not only fulfilled its object, but has even surpassed the most well-founded hopes. In fact, each year the number of students has increased; the most distinguished professors have been happy to accept the offer of a chair in a college so flourishing; and it has already produced a number of distinguished pupils, whose reputation has placed it among the first establishments of the kind in Europe. The Swiss pupils are surpassed in number by students drawn from all the other nations of Europe, but chiefly from Russia, Poland, and Hungary, while there is a fair proportion both of Americans and Asiatics. All the cantons, however, are well represented, and the French and Italian cantons, in spite of the difference of tongue, send a very good contingent of their children. So many candidates presented themselves for admission in 1871, that it was not possible to accommodate them all; and this has again brought to the surface the idea of a Federal University, which will no doubt be speedily realised.

THE *British Medical Journal* says that the people of Rome are very much interested just now in the fate of a poor fellow, Cipriani, who has swallowed a fork in public, prongs downwards, and who is now suffering, in consequence, agonies which are the subject of daily bulletin. Some comfort may be derived by his friends from the record lately published of Mr. Lund's patient at Manchester, who survived swallowing a dessert knife six inches long; and from the perusal of a recent article in the *Journal de Médecine et de Chirurgie*, in which instances are cited where the alimentary canal has safely supported the most unexpected foreign bodies—among others, lizards, a file, a tea-spoon, a bat; and, finally, from the whimsical but melancholy instance of a man who, to amuse himself, swallowed successfully and safely a five-franc piece, a closed pocket-knife, and a coffee-spoon, but killed himself at last in the vain effort to digest a pipe.

THE *Medical Times and Gazette* of March 16 contains some interesting remarks on Prof. Laycock's Lecture on Ears delivered in Paris in 1862, a subject of special interest in connection with the recent Tichborne trial. The woodcuts with which the article is illustrated show the remarkable similarity between the square lobeless ear, met with in cases of dementia, and the ear of the chimpanzee.

DURING the last few days of December 1871, Adelaide, in South Australia, was visited, according to the *Gardener's Chronicle*, by dense clouds of locusts. Dr. Schomburgk describes the visitation as a very remarkable one. He says the air was quite darkened with them. They came from the north, and devoured everything looking green. Nothing remained of the fine lawns in the Botanic Garden but the bare brown earth.

A RICH instance of the mode in which the phenomena of nature present themselves to certain minds is furnished by the following extract from the *Prophetic News* for March 1872, published by G. J. Stevenson, 54, Paternoster Row:—"St. John in the Apocalypse has described his vision of the descent of 'the city of the New Jerusalem' into the air. . . . The Royal city may at first appear as a comet, which astronomers may be unable to understand, for its luminosity and stationary position in the eastern hemisphere may at first be but just discoverable. The news may then flash all over the globe by means of the telegraph. The unusual brilliancy of the aurora borealis seems a fitting harbinger, together with the spots *which appear* in the sun, of the approaching climax (Luke xxi. 25, 26), for through the prophetical telescope alone can we realise the intention of these wonderful phenomena. I shall be glad if some of your correspondents who may have given their thought to these points would avail themselves of the *Prophetic News* to help others to a better understanding of so important a subject."

IN the last year there was exported from Nicaragua 100 dols. worth of the waters of Nejapa, reported to have the virtue of curing drunkenness. This may be recommended to the Liquor League as better than a Maine Liquor Law. In the neighbouring State of Columbia, it is asserted by natives and Europeans, that there is an Indian cure for drunkenness.

ON the 16th of January two slight shocks of earthquake were felt at Valparaiso at 10·20 P.M. The weather was intensely cold.

ON the night of the 10th of January several shocks of earthquake were felt in Arequipa, in Peru, but no damage was done. It was observed they occurred a few hours after the new moon, and coincided with one of the highest tides of the year.

ON the 31st of January a severe shock of earthquake was felt at Patna, in Bengal.

IN the month of January there were frequent shocks of earthquake at Broossa, in Asia Minor.

ON Jan. 14 and 15 three shocks of earthquake were felt in the English hill-town of Darjeeling, in the Himaláyas.

A SLIGHT shock of earthquake was felt in the middle of October at Memeodsbad, in the Ahmedabad Collectorate, Bombay Presidency.

ON the 23rd Jan. there was an earthquake at Guayaquil, in Ecuador.

IN January the heaviest fall of snow known for years took place in the hills of the Deyrsh Dhoon.

LARGE deposits of coal have been discovered at Cobquecura, in the province of Itata, Chile.

FURTHER important mineral discoveries are officially reported from Bolivia, which are expected to produce great results. In the Chaco on the road from La Paz to Fungas silver ore has been found yielding 12,000 ounces per ton, or half silver. A hundred claims were at once taken up. On the Llisa and Condormanana hills, near San Andres de Mochaca, veins of gold have been found, as well as in Vilaquil, eighteen miles from La Paz, where ancient winnowing grounds have been recognised.

ACCORDING to a report made by the Rev. Father Wolf to the Government of Ecuador, there are extensive fossil remains of the Tertiary and Quaternary epoch on the coast of Manabi and near Punin. Besides the mastodon the fossil horse is found, showing that in pre-historic times such animals were found there, though they became extinct, and the present race was introduced by the Spaniards.

IN Bolivia has been discovered an ancient mine, known as the Narango, twelve miles S. of Antofogasta, in the Mejillones district, near the Pacific. The vein is reported as composed of ochre-coloured ore, backed by a stratum, 2½ in. thick, of copper studded with gold, and containing about 20 per cent. of this precious metal.

A CORRESPONDENT of the *Ceylon Times* draws attention to the circumstance that that island is, as he believes, on the eve of an important change of climate, depending on the great cycle of thirty or thirty-three years. The past thirty years have, he maintains, shown a complete contrast to the previous thirty years, with manifestly different effects on animal and vegetable life, from the much smaller amount of rain. The next cycle of thirty years will be, he thinks, above the average, wet.

A SUIT has lately taken place in the High Court of Madras respecting a two-mouthed cow, the value of which is estimated at 1,000*l*., as large sums were made by exhibiting it. She had been seized by the sheriff, as is alleged, on wrongful distraint.

THE Ipecacuanha plants in the Neilgherries are flourishing. Two have blossomed, but have yielded no seed. Twelve plants in good condition were received at the Calcutta Botanic Gardens from England in August.

THE English Vice-Consul at Ciudad Bolivar, on the Orinoco River, Venezuela, reports that an old woman had applied an efficacious remedy for yellow fever and black vomit. It is the juice of the leaves of the vervain plant, which is obtained by bruising, and is taken in small doses three times a day. Injections of the same juice are also administered every two hours until the bowels are completely relieved of their contents. The medical men have adopted the remedy, and the number of fatal cases have been much reduced. The leaves of the female plant alone are used.

THE wild elephant which has lately destroyed fifty-six lives in the Central Provinces of India and committed such ravages, was shot on November 15 by two officers of the Government. The night before his death he killed ten persons.

A GOOD deal of attention has been excited among Egyptologists by the comparatively recent discovery in excavations made at Tanis, on the eastern or Pelusiac branch of the Nile, of a trilingual stone, somewhat of the character of the celebrated Rosetta stone, but much more perfect, and believed to be of about two hundred and fifty years' greater antiquity. This, which is now deposited in the Museum of Egyptian Antiquities at Cairo, is a perfect stela, about six feet high, two and a half feet broad, and one foot thick, the summit being arched.

PUCHMURREE or Pachmari, in the central provinces of India, is now to be marked on our maps as a town; this hill site having been successfully established as a sanitarium for English soldiers in 1870.

A SHOWER of stones is reported from Rosario, in December. A great tempest was felt, ending in a shower of stones from N.W. to S.W., and doing much damage. The shower lasted ten minutes, and the stones were abundant and large, weighing from a nut in size to a pigeon's egg. The corn fields have severely suffered. It is remarked the like occurrence had not been seen for many years, so it is to be inferred such a phenomenon is not unknown. As the Bernstadt colony was affected some European observations may be received.

TWO new discoveries of gold are announced, the one in the Transvaal district near Natal, where the gold is stated to exist in large quantities, and the other in Manitoba, in Canada.

THE STUDY OF NATURAL HISTORY

A LECTURE under this title delivered at the Royal Artillery Institution, Woolwich, by the Rev. Canon Kingsley, has just been published, containing some admirable remarks on the relation between the soldier and the naturalist, from which we cannot forbear making the following extracts.

After some introductory matter, he proceeded:—

"It seemed to me, therefore, that I might, without impertinence, ask you to consider a branch of knowledge which is becoming yearly more and more important in the eyes of well-educated civilians—of which, therefore, the soldier ought at least to know something, in order to put him on a par with the general intelligence of the nation. . . . .

"Let me, however, reassure those who may suppose, from the title of my lecture, that I am only going to recommend them to collect weeds and butterflies, 'rats and mice, and such small deer.' Far from it. The honourable title of Natural History has, and unwisely, been restricted too much of late years to the mere study of plants and animals; but I desire to restore the words to their original and proper meaning—the History of Nature; that is, of all that is born, and grows—in short, of all natural objects.

"If any one shall say, by that definition you make not only geology and chemistry branches of natural history, but meteorology and astronomy likewise—I cannot deny it: they deal, each of them, with realms of Nature. Geology is, literally, the natural history of soils and lands; chemistry the natural history of compounds, organic and inorganic; meteorology the natural history of climates; astronomy the natural history of planetary and solar bodies. And more, you cannot now study deeply any branch of what is popularly called Natural History—that is, plants and animals—without finding it necessary to learn something, and more and more as you go deeper, of those very sciences. As the marvellous interdependence of all natural objects and forces unfolds itself more and more, so the once separate sciences, which treated of different classes of natural objects, are forced to interpenetrate, as it were, and supplement themselves by knowledge borrowed from each other. Thus—to give a single instance—no man can now be a first-rate botanist unless he be also no mean meteorologist, no mean geologist, and—as Mr. Darwin has shown in his extraordinary discoveries about the fertilisation of plants by insects—no mean entomologist likewise.

"It is difficult, therefore, and indeed somewhat unwise and unfair, to put any limit to the term Natural History, save that it shall deal only with nature and with matter, and shall not pretend—as some would have it do just now—to go out of its own sphere to meddle with moral and spiritual matters. But, for practical purposes, we may define the natural history of any given spot as the history of the causes which have made it what it is, and filled it with the natural objects which it holds. And if any one would know how to study the natural history of a place, and how to write it, let him read—and if he has read its delightful pages in youth, read once again—that hitherto unrivalled little monograph, White's 'History of Selborne;' and let him then try, by the light of improved science, to do for any district where he may be stationed what White did for Selborne nearly 100 years ago. Let him study its plants, its animals, its soils and rocks, and last, but not least, its scenery, as the total outcome of what the soils, and plants, and animals have made it. I say, have made it. How far the nature of the soils and the rocks will affect the scenery of a district may be well learnt from a very clever and interesting little book of Prof. Geikie's on 'The Scenery of Scotland, as affected by its Geological Structure.' How far the plants and trees affect not merely the general beauty, the richness or barrenness of a country, but also its very shape; the rate at which the hills are destroyed and washed into the lowland; the rate at which the seaboard is being removed by the action of waves—all these are branches of study which is becoming more and more important.

"And even in the study of animals and their effects on the vegetation, questions of really deep interest will arise. You will find that certain plants and trees cannot thrive in a district, while others can, because the former are browsed down by cattle, or their seeds eaten by birds, and the latter are not; that certain seeds are carried in the coats of animals, or wafted abroad by winds—others are not; certain trees destroyed wholesale by insects, while others are not; that in a hundred ways the animal and vegetable life of a district act and react upon each other, and that the climate, the average temperature, the maximum and minimum temperatures, the rainfall, act on them, and in the case of the vegetation, are reacted on again by them. The diminution of rainfall by the destruction of forests, its increase by re-planting them, and the effect of both on the healthiness or unhealthiness of a place—as in the case of the Mauritius, where a once healthy island has become pestilential, seemingly from the clearing away of the vegetation on the banks of streams—all this, though to study it deeply requires a fair knowledge of meteorology, and even a science or two more, is surely well worth the attention of any educated man who is put in charge of the health and lives of human beings.

"You will surely agree with me that the habit of mind required for such a study as this, is the very same as is required for successful military study. In fact, I should say that the same intellect which would develop into a great military man, would develop also into a great naturalist. I say, intellect. The military man would require—what the naturalist would not—over and above his intellect, a special force of will, in order to translate his theories into fact, and make his campaigns in the field and not merely on paper. But I am speaking only of the habit of mind required for study; of that inductive habit of mind which works, steadily and by rule, from the known to the unknown—that habit of mind of which it has been said:—'The habit of seeing; the habit of knowing what we see; the habit of discerning differences and likenesses; the habit of classifying accordingly; the habit of searching for hypotheses which shall connect and explain those classified facts; the habit of verifying these hypotheses by applying them to fresh facts; the habit of throwing them away bravely if they will not fit; the habit of general patience, diligence, accuracy, reverence for facts for their own sake, and love of truth for its own sake; in one word, the habit of reverent and implicit obedience to the laws of Nature, whatever they may be—these are not merely intellectual, but also moral habits, which will stand men in practical good stead in every affair of life, and in every question, even the most awful, which may come before us as rational and social beings.' And specially valuable are they, surely, to the military man, the very essence of whose study, to be successful, lies first in continuous and accurate observation, and then in calm and judicious arrangement.

"Therefore it is that I hold, and hold strongly, that the study of physical science, far from interfering with an officer's studies, much less unfitting for them, must assist him in them, by keeping his mind always in the very attitude and the very temper which they require. . . . .

"I should like to see the study of physical science an integral part of the curriculum of every military school. I would train the mind of the lad who was to become hereafter an officer in the army—and in the navy likewise—by accustoming him to careful observation of, and sound thought about, the face of nature—of the commonest objects under his feet, just as much as of the stars above his head; provided always that he learnt, not at second-hand from books, but where alone he can really learn either war or nature—in the field, by actual observation, actual experiment. A laboratory for chemical experiment is a good thing, it is true, as far as it goes; but I should prefer to the laboratory a naturalists' field club, such as are prospering now at several of the best public schools, certain that the boys would get more of sound inductive habits of mind, as well as more health, manliness, and cheerfulness, amid scenes to remember which will be a joy for ever, than they ever can by bending over retorts and crucibles, amid smells even to remember which is a pain for ever.

"But I would, whether a field club existed or not, require of every young man entering the army or navy—indeed, of every young man entering any liberal profession whatsoever—a fair knowledge, such as would enable him to pass an examination, in what the Germans call *Erd-kunde* (earth-lore)—in that knowledge of the face of the earth and of its products for which we English have as yet cared so little that we have actually no English name for it, save the clumsy and questionable one of physical geography, and, I am sorry to say, hardly any readable school books about it, save Keith Johnston's 'Physical Atlas'—an acquaintance with which last I should certainly require of young men.

"It does seem most strange—or rather will seem most strange 100 years hence—that we, the nation of colonies, the nation of sailors, the nation of foreign commerce, the nation of foreign military stations, the nation of travellers for travelling's sake, the nation of which one man here and another there (as Schleiden sets forth in his book, 'The Plant,' in a charming ideal conversation at the Travellers' Club) has seen and enjoyed more of the wonders and beauties of this planet than the men of any nation, not even excepting the Germans—that this nation, I say, should as yet have done nothing, or all but nothing, to teach in her schools a knowledge of that planet, of which she needs to know more, and can if she will know more, than any other nation upon it. . . .

"Thus much I can say just now—and there is much more to be said—on the practical uses of natural history. But let me remind you, on the other side, if natural history will help you, you in return can help her; and would, I doubt not, help her, and help scientific men at home, if once you look fairly and steadily at the immense importance of natural history—of the knowledge of the 'face of the earth.' I believe that all will one day feel, more or less, that to know the earth *on* which we live, and the laws of it *by* which we live, is a sacred duty to ourselves, to our children after us, and to all whom we may have to command and to influence; ay, and a duty to God likewise. For is it not an act of common reverence and faith towards Him, if He has put us into a beautiful and wonderful place, and given us faculties by which we can see, and enjoy, and use that place—is it not a duty of reverence and faith towards Him to use those faculties, and to learn the lessons which He has laid open for us? If you feel that, as I say you all will some day feel, you will surely feel likewise that it will be a good deed—I do not say a necessary duty, but still a good deed and praiseworthy—to help physical science forward, and add your contributions, however small, to our general knowledge of the earth. And how much may be done for science by British officers, especially on foreign stations, I need not point out. I know that much has been done, chivalrously and well, by officers, and that men of science own them, and give them hearty thanks for their labours; but I should like, I confess, to see more done still. I should like to see every foreign station, what one or two highly-educated officers might easily make it—an advanced post of physical science, in regular communication with our scientific societies at home, sending to them accurate and methodic details of the natural history of each district—details $\frac{99}{100}$ of which might seem worthless in the eyes of the public, but which would all be precious in the eyes of scientific men, who know that no fact is really unimportant, and more, that while plodding patiently through seemingly unimportant facts, you may stumble on one of infinite importance, both scientific and practical.

"There are those, lastly, who have neither time nor taste for the technicalties, the nice distinctions, of formal natural history; who enjoy Nature, but as artists or as sportsmen, and not as men of science. Let them follow their bent freely: but let them not suppose that in following it they can do nothing towards enlarging our knowledge of Nature, especially when on foreign stations. So far from it, drawings ought always to be valuable, whether of plants, animals, or scenery, provided only they are accurate; and the more spirited and full of genius they are, the more accurate they are certain to be; for Nature being alive, a lifeless copy of her is necessarily an untrue copy. Most thankful to any officer for a mere sight of sketches will be the closet botanist, who, to his own sorrow, knows three-fourths of his plants only from dried specimens; or the closet zoologist, who knows his animals from skins and bones. And if any one answers, 'But I cannot draw,' I rejoin, you can at least photograph. If a young officer, going out to foreign parts, and knowing nothing at all about physical science, did me the honour to ask me what he could do for science, I should tell him, learn to photograph; take photographs of every strange bit of rock formation which strikes your fancy, and of every widely-extended view which may give a notion of the general lie of the country. Append, if you can, a note or two, saying whether a plain is rich or barren; whether the rock is sandstone, limestone, granitic, metamorphic, or volcanic lava; and if there be more rocks than one, which of them lies on the other; and send them to be exhibited at a meeting of the Geological Society. I doubt not that the learned gentlemen there will find in your photographs a valuable hint or two, for which they will be much obliged. I learnt, for instance, what seemed to me most valuable geological lessons, from mere glances at drawings—I believe from photographs—of the Abyssinian ranges about Magdala.

"Or again, let a man, if he knows nothing of botany, not trouble himself with collecting and drying specimens; let him simply photograph every strange tree or new plant he sees, to give a general notion of its species, its look; let him append, where he can, a photograph of its leafage, flower, fruit, and send them to Dr. Hooker, or any distinguished botanist, and he will find that, though he may know nothing of botany, he will have pretty certainly increased the knowledge of those who do know.

"The sportsman, again—I mean the sportsman of that type which seems peculiar to these islands, who loves toil and danger for their own sakes; he surely is a naturalist, *ipso facto*, though he knows it not. He has those very habits of keen observation on which all sound knowledge of nature is based; and he, if he will—as he may do without interfering with his sport—can study the habits of the animals among whom he spends wholesome and exciting days. . . .

"The two classes which will have an increasing, it may be a preponderating, influence on the fate of the human race for some time, will be the pupils of Aristotle and those of Alexander—the men of science and the soldiers. They, and they alone, will be left to rule; because they alone, each in his own sphere, have learnt to obey. It is therefore most needful for the welfare of society that they should pull with, and not against, each other; that they should understand each other, respect each other, take counsel with each other, supplement each other's defects, bring out each other's higher tendencies, counteract each other's lower ones. The scientific man has something to learn of you, gentlemen, which I doubt not that he will learn in good time. You, again, have (as I have been hinting to you to-night) something to learn of him, which you, I doubt not, will learn in good time likewise. Repeat, each of you according to his powers, the old friendship between Aristotle and Alexander; and so, from the sympathy and co-operation of you two, a class of thinkers and actors may yet arise which can save this nation, and the other civilised nations of the world, from that of which I had rather not speak, and wish that I did not think, too often and too earnestly.

"I may be a dreamer; and I may consider in my turn, as wilder dreamers than myself, certain persons who fancy that their only business in life is to make money, the scientific man's only business to show them how to make money, and the soldier's only business to guard their money for them. Be that as it may, the finest type of civilised man which we are likely to see for some generations to come, will be produced by a combination of the truly military with the truly scientific man. I say, I may be a dreamer: but you at least, as well as my scientific friends, will bear with me; for my dream is to your honour."

SCIENTIFIC INTELLIGENCE FROM AMERICA*

A LATE number of the *College Courant*, of New Haven, contains a detailed account of the exploring expedition under Prof. Marsh, which occupied the greater part of the warm season of 1871, and of which we have already furnished occasional notices to our readers. The general plan, as already stated, embraced excursions from several points, exploring as many different fields, with special reference to the examination of regions comparatively little known. The first starting-point of operations was Fort Wallace, and from this post the cretaceous deposits of South-Western Kansas and the region of the Smoky River were investigated. The second proceeded from Fort Bridger in Western Wyoming, to examine the ancient tertiary lake basin previously discovered by Prof. Marsh. Salt Lake City was the initial point of the third exploration, and the party proceeded thence to the Shoshone Falls, on Snake River, and from there to Boisé City, in Idaho; thence they passed over the Blue Mountains to the head waters of the John Day River, and followed down to Cañon City. On the route they made extensive collections of fossil fishes. They also explored two basins, one of the pliocene and the other of the miocene age, and in these remains of extinct animals were found in large numbers; the upper bed containing the bones of the elephant, rhinoceros, lion, &c., with several species of the fossil horse; the lower and older basin was found to contain species of the rhinoceros, oreodon, turtles, &c. From this point the party proceeded to the Columbia, and thence to Portland, Oregon, where they took a steamer to San Francisco. Here the expedition divided, a portion going to the Yosemite and elsewhere, while several, with Prof. Marsh, sailed, *viâ* Panama, for New York, reaching that

* Communicated by the Scientific Editor of *Harper's Weekly*.

city on the 14th of January. We understand that the expedition was thoroughly successful in every respect, securing the collection of large numbers of fossils, as also numerous skeletons of recent animals, together with valuable antiquities, &c. The expense of the exploration amounted to nearly 15,000 dols., exclusive of the value of the services rendered by the Government. This was defrayed entirely by the gentlemen composing the party; and it is understood that the material results are to be placed in the Museum of Yale College, which will thereby be rendered the richest in America in this department of natural history.—According to Dr. Petermann, the peak of Itatiaiossu, the highest mountain in Brazil, was ascended during the past summer and its altitude determined by Mr. Glaziou, the Director of the Imperial Parks in Rio de Janeiro. It proved to have an elevation of 8,899 English feet, being somewhat less than had been previously estimated. Many species of plants were found on the mountain, and what is of great interest, a large number of Alpine species, especially of *Compositæ*, were collected at from three to seven hundred metres below the summit.—The report of progress for 1870 of the Geological Survey of Ohio, under the direction of Prof. J. S. Newberry, has just been published at Columbus, forming a volume of nearly 600 pages, with a number of accompanying maps and sections. The volume contains, besides a report of progress of 1870, a sketch of the structure of the lower coal measures in North-Western Ohio, by Prof. Newberry; the report of labours in the second geological district, by Prof. E. B. Andrews, and on the geology of Highland County, by Prof. Orton; the report of the Agricultural Survey of the State, by Mr. J. H. Klippart; a report of the chemical department, by Prof. Wormley; sketches of the geology of several counties, by Messrs. M. C. Read and E. Gilbert; a sketch of the present state of the iron manufacture in Great Britain, by W. W. Porter; and a sketch of the present state of the steel industry, by Henry Newton. All these subjects are treated with great care, and the whole volume bears ample testimony to the ability of the chief geologist and the industry of his assistants. This volume is intended as simply preliminary to the final report, which Prof. Newberry hopes to have embodied in four volumes—two of them devoted to geology and palæontology, one to economical geology, and one to agriculture, botany, and zoology. The materials for these volumes are in advanced stage of forwardness, and will embrace monographic treatises on the several subjects, which will be of the utmost benefit in ascertaining and developing the resources of the State.—A society was organised in New York some time since under the name of the "Palestine Exploration Society," with the Rev. Dr. J. P. Thompson, chairman, Dr. Howard Crosby, secretary, and James Stokes, jun., treasurer, with a list of members including the principal archæologists of the Eastern States. Its first report was published some time ago, embracing an account of the American explorers in Palestine, and the proceedings of the English Palestine Exploration Society, notices of the late explorations in Jerusalem, the Moabitic stone, &c., and concluding with an appeal to all persons interested for contributions of funds to aid in carrying out the proposed researches of the society. The field of investigation proposed includes the territory east of the Dead Sea and the Jordan Valley, as also Hermon, Lebanon, and the valleys and plains of Northern Syria. A simultaneous prosecution of researches in this field by two such bodies as the American and English societies will probably be productive of very important results, especially if supported with proper official documents from the Turkish Governments. As so much of what is now on record in regard to the geography and condition of Palestine is due to Americans, it is much to be hoped that the work may be continued by them toward a successful completion.

SCIENTIFIC SERIALS

Annalen der Chemie und Pharmacie viii. Supplement band, 3 Heft. Hesse has contributed a lengthy paper on the alkaloids of opium. It is the most exhaustive essay on the rarer alkaloids that has yet been published. He has examined minutely the following:—Pseudomorphin, laudamine, codamine, narcotine, papaverine, nitropapaverine, cryptopine, nitrocryptopine, protopine, laudanosine, and hydrocatarine, and numerous salts of each of the above. The author groups the alkaloids into four classes, the morphine, thebaine, papaverine, and narcotine groups, and gives the distinctive characters with which the members of these groups dissolve in pure concentrated sulphuric acid. Marignac follows with a long communication "On the specific heat, density, and expansion of certain solutions." Bousingault has made some experiments on the freezing of water. He took an exceedingly strong steel cylinder, placed in it a small steel bullet, and filled it entirely with water at 4° C, the cylinder was then closed by means of a cap, so that it was absolutely tight; the cylinder was exposed to a temperature of −24° for some time, but the water inside was not frozen, as was proved by the mobility of the bullet in the interior. Immediately on opening the cylinder and relieving the pressure, the water became a mass of ice.

THE *Geological Magazine* for February (No. 92) opens with some excellent notes on fossil plants by Mr. Carruthers, illustrated with a plate and several woodcuts. The subjects here referred to are the *Palæopteris hibernica*, the presence of sporangia belonging to the *Hymenophylleæ* in coal, *Osmundites Dowkeri*, the genus *Antholites*, a revision of the British forms belonging to which is given, the coniferous wood of Craigleith quarry and *Pothocites grantoni*.—Mr. S. R. Pattison communicates a note on the pyrites deposits in the province of Huelva, in Spain, and Mr. James Geikie the conclusion of his memoir on changes of climate during the glacial epoch. The latter contains a comparison of the glacial deposits of Scotland, Switzerland, Scandinavia, and North America. The other articles in the number are an abstract of the contents of Heer's "Flora Fossilis Arctica," by Mr. R. H. Scott, and an early notice (50 years old) of the occurrence and use of meteoric iron in Greenland.

SOCIETIES AND ACADEMIES

LONDON

Anthropological Institute, March 18.—Dr. Charnock, vice-president, in the chair. M. Letourneur and Dr. Haast were elected corresponding members. Mr. Geo. Harris read a paper on "The comparative Longevity of Animals of different species, and of Man; and the probable causes which mainly conduce to produce that difference." He cited several remarkable instances of longevity both in animals and man, and alluded to the opinions on the subject, both of ancient and modern writers. The influence of climate, air, and food were discussed, and also of domestication and civilisation. The theory of disease in connection more especially with concurrent decay and renovation was inquired into, and some speculations were made as to the effect future scientific discovery, as regards the medical properties both of plants and animals, might have on the question at issue.—Sir Duncan Gibb, Bart., M.D., read a paper on "The Physical Condition of Centenarians." His remarks were founded upon an examination of six genuine examples, in whom he found the organs of circulation and respiration in a condition more approaching to the prime of life than old age. There was an absence of all those changes usually observed in persons reaching 70, and in nearly all the special senses were unimpaired, the intelligence perfect; thus showing, at any rate, the complete integrity of the nervous system. The author's views were opposed to those held regarding the extreme longevity of centenarians.—Dr. Leith Adams exhibited and described a series of stone implements from the island of Fferm; and Col. Fox contributed a note on some stone implements and pottery from St. Brienne, Normandy.

Entomological Society, March 4.—Prof. J. O. Westwood, president, in the chair.—Prof. Westwood exhibited living specimens of the *Acarus* described by him at the last meeting as *Argas reflexus*, from Canterbury Cathedral, and also another species of the genus found by Dr. Livingstone in Central Africa, which enters the feet of the natives between the toes, causing pain and inflammation.—Mr. S. Stevens exhibited an apparently new species of *Phycita* from near Gravesend, remarkable for its pearly colour and *Crambus*-like form.—Mr. F. Smith read an extract from a further communication from Mr. J. T. Moggridge respecting the storing of grain by ants at Mentone. Mr. Moggridge had confined a colony of the ants in a glass vessel so as to observe their habits, and he was now able to state positively that they fed upon the grain. A detailed account of the observations will be furnished by Mr. Moggridge upon his return to England.—Mr. Müller exhibited galls formed by *Acari*, of the genus *Phytoptus*, upon the leaves of *Cinnamomium nitidum*, from Bombay, being the first observation of the occurrence of those creatures in India.—Mr. H. W. Bates exhibited a series of species of *Cara-*

bus from Britain and Eastern Siberia, and remarked upon their affinities. The exhibition represented five British species and five corresponding Siberian forms, which differed totally specifically, though they might be considered representative species. One species only, *C. granulatus*, was common to the two extremities of the vast district comprising Dr. Sclater's Palæarctic Region, though there are at least fifty known European forms, and fifty others from Siberia. One other species was common to Siberia and Western North America. Mr. Bates was inclined to doubt the advisability of separating the Palæarctic and Nearctic Regions, and further he considered the partition of the globe, from a zoological point of view, into great divisions, was, to a considerable extent, based upon arbitrary evidence. He looked rather to the later geological changes, and the present configuration of land and sea, for dates upon which to ground theories of geographical distribution.—Mr. Baly communicated a paper "On new species of exotic *Cassididæ*."—Mr. Kirby communicated notes upon the butterflies described by Jablonsky and Herbst in their "Natursystem aller bekannten Insekten."—Mr. Dunning read an exhaustive memoir on the genus *Acentropus*, and after a review of the writings of the various authors who had treated upon this singular genus, he arrived at the conclusion, now almost universally maintained, that the genus is truly Lepidopterous, and further, that the evidence adduced failed to convince him of the existence of more than one species, for which he retained the name *Acentropus niveus*.

Photographic Society, March 12.—Mr. John Spiller, vice-president, in the chair. Mr. Valentine Blanchard read a paper on "Retouching: its use and abuse." While utterly condemning the frequent and elaborate retouching of negatives, such as one sees every day, Mr. Blanchard pointed out that there were occasionally some instances—for example, the correcting of false lights—where retouching was not only allowable, but really desirable, in order to render the picture more true to nature. The camera was at times at fault in reproducing objects in their true character; and under these circumstances the retouching brush or pencil might be fairly used.

CAMBRIDGE

Philosophical Society, February 12.—"Further Observations on the state of an Eye affected with a peculiar malformation," by the Astronomer Royal. In this paper the author showed by the discussion of numerical results obtained during a period of several years that the astigmatism had changed.—"The Comparison of Measures *à traits* with Measures *à bouts*," by Professor Miller. A method of comparing these measures without sinking cavities in the bars, was described, and the various processes that had been used were commented upon.

February 26.—"On Teichopsia, a form of transient half-blindness; its relation to nervous or sick headache, with an explanation of the phenomena," by Dr. Latham. The author considered the cause of the affection to be contraction of the vessels of the brain (probably the middle cerebral artery), and so a diminished supply of blood, produced by excited action of the sympathetic; and that the subsequent exhaustion of the sympathetic caused dilation of the vessels and consequent headache.—"A Machine for Tracing and otherwise exhibiting curves in connection with the theory of Vibration of Strings," by Mr. S. C. W. Ellis.

PARIS

Academy of Sciences, March 4.—M. de Saint-Venant read a continuation of his memoir on the hydrodynamics of streams.—M. Guibal presented a memoir on a ventilator applied to the aeration af mines.—M. H. Sainte-Claire Deville presented a note by M. D. Gernez on the absorption-spectra of chlorine and chloride of iodine.—M. W. de Fonvielle communicated an explanation of three cases of fulguration in which the lightning-conductors proved to be insufficient.—M. Sainte-Clare Deville presented a note by M. E. H. von Baumhauer on the origin of auroras, in which the author called attention to an explanation of these phenomena given by him in a work "De ortu lapidum meteoricorum," published at Utrecht in 1844. The author ascribes the production of auroras to the penetration into our atmosphere of clouds of uncondensed cosmical matter, the presence of iron and nickel in which, he seems to think, may account for their being attracted towards the magnetic poles of the earth. —A note by M. H. Caron on crystallised or "burnt" iron was read, in which the author treated of the brittle condition produced in a bar of iron when heated to whiteness and allowed to cool in the air. He finds that this effect is not due to an absorption of oxygen as has been supposed. He also states that good iron is not rendered crystalline by exposure to intense cold.—M. Wurtz presented a note by M. G. Bouchardat upon the acetic æthers of dulcite, in which the author describes the following compounds:—diacetic dulcite, diacetic dulcitane, hexacetic dulcite, tetracetic dulcitane, pentacetomonochlorhydric dulcite, and pentacetic dulcite.—M. Wurtz also presented a note by M. Reboul on the hydrobromates and hydrochlorates of allylene, and a note on pyruvine, by M. Schlagdenhauffen. The latter is a glyceride of pyruvic acid obtained by heating glycerine with tartaric acid.—M. Fremy communicated a note by M. E. Landrin, on the reciprocal action of acids and alkaline bases when separated by a porous partition.—M. L. Kessler forwarded a note on a modification of the processes for the determination of nitrogen in a free state in the analysis of organic substances.—M. Decaisne presented a note by M. J. E. Planchon, on *Cratægus aronia* (Spach) and its relations with *C. oxyacantha* and *C. azarolus* of Linné. The author regards *C. aronia* as a cross of the other two forms, which are probably distinct races of the same species.—M. E. Robert accounts for the renewed fermentation of wines at the period of the flowering of the vine, by the abundance of germs of *Mycoderma vini* in the atmosphere at that period.

BOOKS RECEIVED

ENGLISH.—The Year Book of Facts, 1872: J. Timbs (Lockwood and Co.). —An Elementary Treatise on Curve Tracing: P. Frost (Macmillan and Co.). —Monograph of the British Graptolitidæ: H. A. Nicholson (Edinburgh, Blackwood and Sons).

DIARY

THURSDAY, MARCH 21.

ROYAL SOCIETY, at 8.30.—New Researches on the Phosphorus Bases: Dr. Hofmann, F.R.S.—On some Heterogenic Modes of Origin of Flagellated Monads, Fungus-Germs, and Ciliated Infusoria: Dr. Bastian, F.R.S.
SOCIETY OF ANTIQUARIES, at 8.30.—Ballot for the Election of Fellows.
LONDON INSTITUTION, at 7.—How Plants are Fertilised: A. W. Bennett.
ROYAL INSTITUTION, at 3.—On the Chemistry of Alkalies and Alkali Manufacture: Prof. Odling, F.R.S.
LINNEAN SOCIETY, at 8.—On the Geographical Distribution of Compositæ: G. Bentham.
CHEMICAL SOCIETY, at 8.

FRIDAY, MARCH 22.

ROYAL COLLEGE OF SURGEONS, at 4.—On the Digestive Organs of the Vertebrata: Prof. Flower, F.R.S.
ROYAL INSTITUTION, at 9.—On the Results of the last Eclipse Expedition; J. Norman Lockyer, F.R.S.
QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Demonology: M. D. Conway.

MONDAY, MARCH 25.

ROYAL COLLEGE OF SURGEONS, at 4.—On the Digestive Organs of the Vertebrata: Prof. Flower, F.R.S.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

WEDNESDAY, MARCH 27.

ROYAL COLLEGE OF SURGEONS, at 4.—On the Digestive Organs of the Vertebrata: Prof. Flower, F.R.S.
ROYAL SOCIETY OF LITERATURE, at 8.30.—On some Greek and other inscriptions recently procured in the Haurân: W. S. W. Vaux.

CONTENTS

ERRATA.—Page 379, 2nd col., lines 16, 17, should read thus:—

Present River	low water		75
	flood water	8·81	2,400

Line 13 from bottom, for "4·6 per cent." read 4·6 degrees.