THURSDAY, FEBRUARY 4, 1875

BOTANICAL PROBLEMS *

SUCH is the title of an article by Prof. Cohn on the history of botany in the new German periodical, the *Deutsche Rundschau.*

Circumstances seem to have determined the direction of the researches of English botanists of the present period, who, almost without exception, have devoted their whole time to descriptive botany. On the other hand, continental botanists have pursued vegetable physiology and anatomy with great assiduity. This separation of what should be inseparable branches of the same science is in all probability only temporary. The great demand for descriptive works on the vegetation of our various colonies, and the immense mass of undescribed plants in our herbaria, have, doubtless, influenced in no small degree the direction of the labours of our botanists. In return, poverty in herbarium specimens and books renders it impossible for many continental botanists to pursue successfully systematic botany. Apart from its importance from an economic point of view, descriptive botany is of relatively little absolute value, and must be extremely unsatisfactory to minds labouring to prove the immutability of species on the one hand, or their variability within certain defined limits on the other. Whether we follow Jordan, with his 200 species of Draba (*Erophila*), the result of the dismemberment of *D. verna;* or Regel, who combines *Vitis vinifera*, *Labrusca*, *vulpina*, &c., we should equally drift into an utterly impracticable and useless system, and one of no utility whatsoever in the solution of problems which we may reasonably hope to unravel.

This brings us to a consideration of Cohn's article, professedly written to show the importance and popularise the study of botany, more particularly in its biological bearings. Naturally we may look for some tolerably sharp criticisms of systematic botany studied alone, and the writer is to some extent justified in more especially singling out England. Nevertheless, we think that its importance is underrated by some continental botanists. Prof. Cohn is a great admirer of the Aristotelian school, and to the great master and his pupil, Theophrastus, he gives the credit of having initiated the scientific study of plants, which after their time declined and lay dormant for upwards of 2,000 years. The discoveries of the last two centuries he consequently looks upon as a revival of this science, and as so many solutions of problems propounded, though, as he admits, not answered, by Theophrastus. We certainly should assign a more modest share of credit to these early philosophers, and Cohn's quotation from Goethe, "when we consider the problems of Aristotle we are astonished at the great powers of observation and universal perception of the Greeks; but they are too hasty, passing at one step from the phenomena to their interpretation, hence their conclusions are often inadequate and theoretical," does not strengthen his position. After all, this is a question of little moment. It is quite true that nothing approaching a philosophical study of plants was resumed before the seventeenth century.

Prof. Cohn gives a sketch of the history of botany, hastily disposing of the "root-grubbers and collectors of simples," from Dioscorides and Galen down to the herbalists of the seventeenth century. To Erasmus he traces the impulse given to this and other branches of learning in the Netherlands and North-western Germany. The fact that the dwellers on the Rhine did not find the same plants described by Dioscorides, may be said to have offered the first lesson in phytogeography, which was rapidly developed by the spirit of travel and discovery which soon set in.

Naturally one of the first things to impress itself on the minds of those engaged in the study of plants as their numbers increased, was the necessity for some system of classification and nomenclature. The history of binominal nomenclature and the sexual system of Linnæus, and the natural system of A. L. de Jussieu, are too well known to need repetition, and Cohn does not attempt to trace the gradual growth of knowledge which led up to the development of these ideas. In fact, he appears to attach so little importance to systematic botany, that he goes on to say: "Under the dominating influence of Linnæus, botany seems to have stagnated more and more, whilst a new spirit had been infused into the study of other sciences." He then refers to the philosophical teachings of Bacon, which fell upon a well-prepared soil and eventually bore fruit. Botanists began to make experiments and study the laws of nature. Hales was the first to investigate some of the phenomena of plant life in their physical aspects. Du Hamel, Bonnet, Ingenhousz, Priestley, Saussure, and others followed, and raised the study of vegetable physiology and chemistry to a level with the exact sciences. The solution of other botanical problems is given in outline, and where only a few names could be given it is not to be wondered at that Germans figure more prominently than would be the case in a detailed history. The merit of solving a particular botanical problem can in few instances be claimed for one man alone. Discovery is progressive, and a complete insight into many of the processes of plant-life have been gradually unfolded. Goethe's solution of the morphological problem is naturally dwelt upon at some length, and no one will gainsay its importance in systematic botany. Grew and Malpighi initiated vegetable anatomy, and it is a noteworthy fact, says Cohn, that the papers of these two fathers were handed over to the Royal Society of London on the same day, Dec. 29, 1671. But a hundred years elapsed before their labours were appreciated and continued.

In the revival of this branch of botany Prof. Cohn has a strong array of German names, many of them of world-wide fame. The conceptions of Darwin and their importance are barely mentioned, though in no country have they exerted a more fundamental influence than in Germany. Passing into the region of unsolved problems, Cohn cites the unconquerable vitality of the potato fungus, and the uncertainty existing respecting the presence and signification of minute fungi in cholera and other diseases.

In conclusion, Prof. Cohn rejoices in the fact that botany has freed itself from the fetters which formerly

* "Botanische Probleme," von Prof. Cohn (*Deutsche Rundschau*, Heft 1).

limited its field of operation and discovery. "It has already furnished us with a clue to many of the mysteries of life, and we look to it for many more: what is life? what is death?" This last quotation will show that he puts no limit to the phenomena to be considered in the investigations of the biologist; but when man has solved all these problems, he will be as wise, if not as powerful as the gods.

SOUTH AMERICAN TRAVEL *

II.

Travels in South America, from the Pacific Ocean to the Atlantic Ocean. By Paul Marcoy. Illustrated by 525 engravings and ten maps. Two vols. (London: Blackie and Son, 1875.)

The Amazon and Madeira Rivers: Sketches and Descriptions from the Note-book of an Explorer. By Franz Keller, Engineer. With sixty-eight illustrations on wood. (London: Chapman and Hall, 1874.)

Two Years in Peru, with Exploration of its Antiquities. By T. J. Hutchinson, M.A.I. With map and numerous illustrations. Two vols. (London: Sampson Low, 1873.)

MR. KELLER'S work is a much more business-like and compact production than that of M. Marcoy, noticed in last week's number. While the beautiful illustrations which enrich the book show that the author has a high power of artistic reproduction, and while this may have led him to throw over the scenes he endeavours to reproduce a little touch of glamour, a little of "the light that never was on sea or land," one feels on reading Mr. Keller's narrative that he is in the hands of a thoroughly earnest and trustworthy observer. He has, however, committed the sin of publishing a narrative of exploration without a map. We should mention also that not one of the three books we are noticing contains an index, a want which will considerably impair their usefulness to the student.

Mr. Keller's work is almost entirely concerned with the Madeira, the largest tributary of the Amazon from the south. His journey from the time of his departure from, till his return to Para was accomplished between November 1867 and December 1868, a period of thirteen months, during which, including vexatious delays, he ascended the Madeira as far as Trinidad, on the Mamore, in Bolivia. If our readers look at a map, they will see that Mr. Keller could not have been idle during the time, especially when it is remembered that his purpose was to make a careful hydrographical inspection of the Madeira, in order to report upon the possibility of utilising it as a navigable highway for commerce.

The river, as far as Santo Antonio, seems capable of being rendered quite navigable, but above this the rapids are so numerous and formidable that it seems hopeless to expect that the upper river can ever be made available for anything but boats. The only means, therefore, by which the treasures that exist in the interior of South America can be made accessible by the Madeira route is by a railway from Santo Antonio upwards. It would seem that some such project is in contemplation. The construction of railways, we learn from Mr. Hutchinson's work, is being carried out rapidly in Peru on a very extensive scale, mainly under the superintendence of Mr. Henry Meiggs, who has difficulties of the most formidable kind to contend with in piercing the Andes; in a short time, however, we may expect to see all parts of this country easy of access. In Brazil the mere engineering part of the work would seem to present no difficulties whatever.

Before any such scheme is carried out, ere the whole of this primeval region be devirginated by swarms of white men, we hope that its natural history and ethnology will be fully if not exhaustively investigated. In this respect such works as those of Marcoy and Keller are of great value.

Mr. Keller made excellent use of the short time he spent in the interior; for while he most faithfully and successfully accomplished the mission with which he was entrusted, he at the same time made a series of really valuable observations on all that he saw that was worth noting. His narrative is not, however, arranged in the same method as that of M. Marcoy, who recounts each day's experience as he proceeds, and in whose case, therefore, the want of an index is peculiarly felt. Mr. Keller has systematised the results of his journey, and in a series of chapters gives a clear and well-written summary of his observations. In an introductory chapter he gives a brief account of what is known of the physical and social condition of Brazil and of its political history. He then, in two chapters, gives a sort of itinerary of his expedition up the Madeira, with occasional observations on the inhabitants and the natural history of its banks, and a very clear and full account of the difficulties attending his attempt to navigate the river, so studded with rapids, past every one of which his fleet of boats had to be carried. The region seems to be very sparsely peopled, though its natural resources are superabundant. The material of the hills over the whole region of the rapids he found to be the same; "gneiss, with mostly a very pronounced stratification, and always the same run. He examined it very closely," he states, "expecting to find, according to theory of Agassiz, numerous erratic boulders of different composition lying on the regularly formed rock. But neither there nor higher up in Bolivia could we discover any trace of these 'foundlings,' even as Agassiz himself was unable to discover, in the environs of Rio de Janeiro, the *roches strie̍es* and *roches moutonnées* of Switzerland, which testify to an ice-period with its immense glaciers."

In the chapter headed "Canoe and Camp Life," Mr. Keller gives a graphic account of the daily life of an expedition such as his; and in another, on "Hunting and Fishing," he gives a pretty full idea of the larger fauna to be met with on the route he traversed. In the succeeding one he describes the vegetation of the virgin forest of the Madeira and Amazon, devotes considerable space to the Caoutchouc Tree which so abounds here, and to an account of the process by which its sap is converted into the indiarubber of commerce. He also gives a list of the other principal plants which are utilised for commercial purposes, in the shape of medicines, oils, resins, dye-stuffs, ropes, &c.; and it strikes one that it would certainly be worth while to make a region so superabundantly stored with animal and vegetable life of such great practical utility to man, easily accessible to the merchants of the world.

* Continued from p. 245.

To the wild tribes of the Madeira Valley, the Múras, the Aráras, the Mundrucús, the Perententins, the Caripunas, &c., Mr. Keller devotes a chapter. By the encroachment of white men, and by the ministrations of the Jesuit missionaries, these tribes, like many others in South America, are considerably changed from what they were when the

Fig. 3.—Reeds (Canna) on the Ucayali.—Marcoy.

continent was first discovered, and, as we said in our last number, are much diminished in numbers. If we may trust the individuals who figure in Mr. Keller's illustrations, there must be some splendid specimens of men and women among them. The Indians in this region are, however, far from being tamed, and not unfrequently resent the encroachment of the white man after a very bloody fashion, though wherever they come in contact with the latter "their doom is sealed," as Mr. Keller truly says. He justly cries out upon the sentimentality which laments the extinction of the "noble red race," a race which exists only in the pages of the novelist. The red race of North America must soon become extinct, and leave its hunting-grounds in entire possession of the white man, who will make a better use of them than ever did the aboriginal possessors; and we fear, if the red man of South America proves himself no fitter to survive than his northern brother, he must follow the latter to those "happy hunting-grounds" where no white man is ever likely to intrude. Looked at, as Mr. Keller says, in the broad light of what is the best for the race as a whole, however sorry we may feel for the "poor Indian," and still more so for the race or races that have left so many astounding monuments of their advancement along the west coast of South America and in some parts of North America, it would be useless, if advisable, to attempt to prevent it. There seem to exist evidences in America, as elsewhere, that probably before the advent of any existing people the earth had its human inhabitants, who were compelled to melt away before others of a higher type, who again had to succumb before still stronger brethren. This process has been going on as far back as we can trace, and when it will cease, if ever, who can tell?

Among all the numerous tribes of the interior of the South American continent, Mr. Keller discovers two well-marked types. "One of them, the Guarani, of the widely-spread Tupi tribe, showing the well-known eagle-profile of the North American Indians, first-rate pedlars and fishers, generally keep near the large rivers; while the others, the Cervados, or Ca-en-gangues (forest-men), as they call themselves, more warlike and high-handed, carrying off and enslaving whomsoever they can, do not use canoes at all, and prefer the wooded ravines of the lateral valleys, or the grass-grown ridges of the Campos. . . . . Their oblique eyes, short nose, and high cheek-bones, strongly remind one of the Mongolian type, though by this remark I would not imply their direct Asiatic origin . . . . The Guarani, although their outward appearance and character recall the old Mexican tribes, seem to have come in all probability from the south, and to have spread thence all over the continent." As these statements are given in Mr. Keller's introduction, they may be regarded as not so much the direct results of his own observation, but as to a great extent a statement of the most approved theory of the native American populations. It tallies to some extent with the theory contained in Marcoy's work, and with the conclusions reached on craniological grounds by some of the best existing anthropologists. It seems to us, however, that before any definite conclusion can be reached, much yet remains to be done. Meantime we may say that we consider Mr. Keller's work a valuable contribution to the literature of South American Travel; the illustrations are delightful, and the engraver has done his part in a masterly style.

The chief value of Mr. Hutchinson's work, from our point of view, consists in the detailed account he gives of explorations among the still mysterious ruins which litter the maritime districts of Peru from south to north. But this is not its only value. Mr. Hutchinson was two years in Peru—1871-73—as her Majesty's Consul at Callao, and during that short period his work proves that not only did he find time to explore nearly every important cluster of ruins in the country, but to make himself master of the social, political, and industrial position of the republic. His picture is a somewhat brighter one than that given by M. Marcoy twenty-three years before, and it would seem that the country has really advanced in several respects during that period. By means of several excellent steamship companies it is now in almost daily communication with North America and Europe, and this has led to a considerable development of its resources. As we have already said, railways are in course of construction all over the country, and it is even in contemplation to carry one right through the Andes to the Ucayali, by which the problem of direct communication between the east and west coasts would be solved. Education seems to be claiming some attention, and a Society of Arts has been founded, which we sincerely hope will give early and energetic attention to the prehistoric ruins which enrich Peru, from which so much has yet to be learned concerning their history and their builders. The people, however, have still much laziness to get rid of; but we hope that under the intelligent and vigorous administration of President Pardo, and the stimulus of increased communication with other nations, they may gradually be aroused to healthy exertion.

It is unnecessary to enter into details concerning the Peruvian ruins, the nature of which is known to most of our readers. Colossal walls of adobes, or large sun-dried bricks, the remains of immense buildings whose purpose seems yet doubtful, terraced mounds or hills hundreds of feet in height and covering an area of several acres, aqueducts, huacas, or burial mounds, containing thousands of carefully-buried skeletons, with the knees and hip-joints bent, some of them with the hair and bits of flesh still adhering, with their original wrappings and the articles placed beside them when they were buried; abundant remains of pottery, many of them giving evidence of considerable ingenuity, skill, and taste in the makers; masks, images, and other relics, all affording evidence of a numerous population of great energy and of a civilisation of no mean grade.

The great question in connection with these remains is, who were the original builders? As our readers know, the generally accepted story is that they were built by the Incas, the name given to the race dominant in Peru for some centuries previous to the advent of the Spaniards. This, however, is not the opinion of Mr. Hutchinson, who has no patience with the advocates of this theory, and who has rather a contempt for the Incas as the destroyers of a civilisation much higher than their own. He regards Garcilasso's history as a mere piece of gasconading. His own theory seems to be that the Incas found the buildings whose remains still exist, when they made their advent in Peru, and forced upon the people whom they conquered the worship of their great deity the Sun. The real builders were the Yuncas, who dispossessed the Chinchas, the latter themselves finding upon their arrival an aboriginal race, some relics of whom Mr. Hutchinson believes have been found sixty-two feet deep under the guano deposit on the Chincha Islands. When we consider the slowness with which these droppings of birds must have accumulated, it carries back the first advent of man in South America to a time which must be measured by thousands of years.

It seems to us a herculean task to attempt to unravel the ethnology of Peru, which we suspect can only be adequately done in connection with that of the whole American continent; but it is a task which is well worth attempting. A vast amount has been written on the subject, and there exists a great wealth of material; it seems to us that

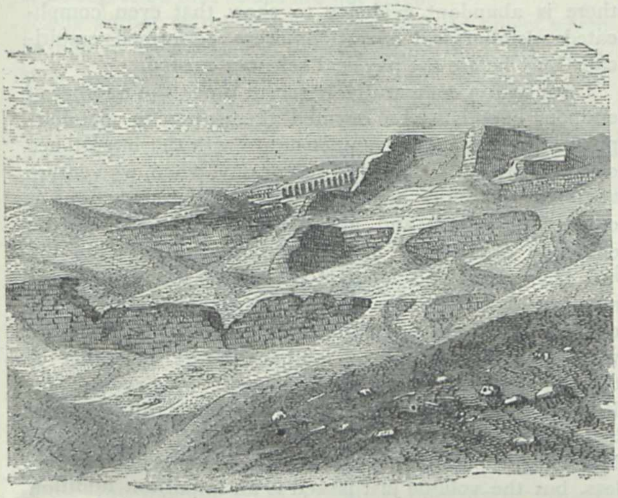


FIG. 4.—Ruins of Reputed Temple of the Sun at Pacha-cámac.—Hutchinson.

what is now wanted is a man possessed of the necessary wide grasp of mind and extensive knowledge to set himself to collect, arrange, and sift this material and investigate on strict scientific principles the bearing of the results. From such a process, we believe, some definite

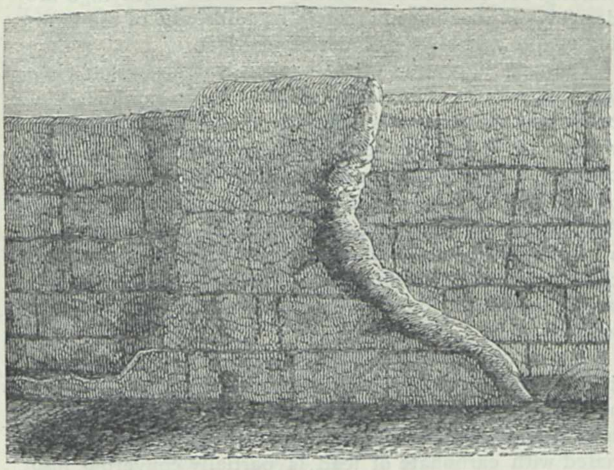


FIG. 5 —Part of Ruins of Double Wall of Temple of Rimac.—Hutchinson.

and valuable conclusions would be arrived at, as definite, perhaps, though not nearly so comprehensive, as those which have been reached concerning the Indo-European peoples; for there still remains much material to bring together, and no time should be lost in setting about the work. Mr. Hutchinson suggests that if some one would do for the remains in Peru what Schliemann has done for those of Troy, and George Smith has done for those in Assyria, the results would be of higher value than any yet achieved. Let some one with the patience, enthusiasm, and knowledge of Dr. Schliemann, devote the necessary time to the careful excavation and study of the mounds and clay-covered buildings, and we are sure the results will well repay the labour. Let us hope that the present Peruvian Government will be patriotic and generous enough to inaugurate and bear the expense of the work, and thus gain for themselves the admiration and thanks of the civilised world. Talking of Dr. Schliemann, Mr. Hutchinson points out some very remarkable coincidences between the buildings and relics which that explorer has unearthed, and those which Mr. Hutchinson himself has found in Peru. Whether this be more than a coincidence it would be rash at present to conjecture.

Mr. Hutchinson's work must be regarded as one of the most important contributions that have been made to the archæology of Peru, and we hope that though no longer resident in the country, he will continue to investigate the subject and help to reduce its present confusion to something like order. We think, however, he might have a little more patience with the theories of other investigators, and not hastily cast them aside as unworthy of notice; the labours of all competent and earnest workers should be seriously studied, for thus only can the full truth be arrived at; even in the legends of Garcilasso he might find some speck of valuable truth.

WATSON'S "DESCRIPTIVE GEOMETRY"

A Course in Descriptive Geometry. By William Watson, Ph.D. 4to. double columns, pp. xi., 147, with thirty-two plates and three double plates of stereoscopic views. (Boston: Osgood and Co. London: Longmans, Green, and Co., 1874.)

DESCRIPTIVE Geometry affords the practical means of dealing with geometry in three dimensions, in the same manner that Practical Geometry, that is to say, the intelligent use of drawing and of graphical methods, deals with plane geometry. If, in solid geometry, we concerned ourselves only with points and with lines, whether straight or curved, we might say that descriptive geometry was simply the science of plan and elevation. As regards the point and the line, it is nothing more. But what distinguishes descriptive geometry, as it was published to the world in Monge's celebrated treatise, from what was already known to every intelligent builder or carpenter, is the means of *indicating* surfaces, whether plane or curved, as well as of *representing* points or lines. We use the terms *indicating* and *representing* advisedly, as carrying with them a real distinction, which, we regret to see, is not always brought prominently forward in the treatises, and sometimes fails to be perceived by the student until he has wasted valuable time in groping after a misapprehension. It is indeed evident that a surface cannot be represented in the same sense that a point and line are, for its plan and elevation would be simply two black patches, the contours of which would give the boundaries of the surface in certain directions, but would fail to represent the surface itself. Now, the method published by Monge regarded a surface, whether plane or curved, as completely indicated so soon as its geometrical law of generation was described and the position and aspect of its principal elements indicated on the paper.* Its indication was then complete, and the representation of any points or lines upon it was then reduced to the devices of practical geometry. The principle simply was that a surface might be regarded as completely known when we had indicated a method of taking an infinite number of sections of it. In the simplest case, these would be parallel plane sections, as in the ordinary drawings of a ship, but Monge's method was not trammelled by this restriction.

Like most large subjects, it is one which it is very difficult to know how to treat with advantage to the student. An exhaustive treatise is out of the question for any learner who is not prepared to make it an exclusive or principal study, and it is a matter of very nice judgment what to select and how much to present to the pupil; and this is the more emphatically so, inasmuch as it is really the only good introduction to a practical insight into the geometrical properties of space.

Viewed in this light, the treatise before us is an exceedingly good one. With great clearness and precision, it covers a considerable extent of ground, and that by no means baldly; and yet it is not too long. It has, moreover, a very valuable adjunct, and one which, we believe, is quite new—a series of stereoscopic drawings exhibiting the actual construction *in solido* of thirty-six of the principal problems. To the ordinary student this will be of immense assistance; for it is well known to teachers of geometry and of mechanics, that want of imagination on the part of the student is one of the principal obstacles they have to deal with in endeavouring to impart to him accurate conceptions of space and of motion. These drawings have been very clearly and judiciously executed by Prof. Saint Loup (of Paris), and slight colouring has been introduced in some of the examples of intersection with marked advantage and success.

We notice some peculiarities of language in which English usage is slightly departed from, as in writing *warped* surfaces instead of skew surfaces, in spelling the word *directer* with two *e's* instead of "director," and in the use of the word *raccord* to express that two surfaces have a line of contact. Some of these, having regard to the unsettled English nomenclature of an imported subject, are not blemishes, and none of them detract from the really high value of the book.

Some account is also given of the leading spherical projections, especially the orthographic and the stereographic. These are important additions to the treatise, and although we would gladly have seen some others described, particularly the gnomonic projection, we think the author has done wisely in not unduly extending this part of his treatise.

The book is of convenient size, clearly printed, and well arranged, with a good table of contents. Altogether, we think it one of the best books upon the subject which we have yet seen, especially in English, and we think it does the highest credit to the distinguished American professor who is its author.

* It is certain that Monge did a great deal to systematise and complete the method; but some of its principles were certainly known, although carefully kept secret, in some of the higher French schools. In consequence of this secrecy, it will probably never be known exactly how much is due to Monge; but we may well believe that Monge did for this science what Newton and Leibnitz did for the infinitesimal calculus.

PHILLIPS' "ELEMENTS OF METALLURGY"

Elements of Metallurgy: a Practical Treatise on the Art of Extracting Metals from their Ores. By J. Arthur Phillips, M. Inst. C.E., F.G.S., F.C.S., &c. (London: Charles Griffin and Co., 1874.)

OF all the sciences, Metallurgy is the one whose history extends into the most remote antiquity, and there is abundant evidence to show that even complicated metallurgical operations were performed empirically long before the physical sciences existed.

Until within comparatively recent times the number of eminent chemists who devoted themselves to metallurgical work was more commensurate with the importance of the subject than at the present day, when, we venture to think, too many are lured away by the attractions of organic chemistry and abstract speculations as to the existence of matter. Notwithstanding this, within the last few years the science of metallurgy has made great advances, but the works on the subject published in this country have been singularly few; Dr. Percy's admirable work is still incomplete, and, with the exception of the translation of Kerl's "Metallurgy" by Crookes and Röhrig, there is no work which is even fairly comprehensive. The edition of Mr. Phillips' "Manual of Metallurgy" published in 1858 has become almost useless, but the volume just issued is an important addition to this branch of literature.

The physical properties of metals are fully and carefully treated, and eighty pages are devoted to the consideration of fuel. The description of iron ores is very good, the author having closely followed Bauerman, and no pains have been spared to render the portion of the work which treats of iron as complete as possible. Among the numerous carefully executed engravings are drawings of roasting and calcining kilns, and of the blowing engine and blast cylinder at Dowlais.

The next important metal, copper, is discussed at some length, and the description of the "wet methods" of extracting this metal is specially valuable, as the author writes from long experience of operations which have been conducted under his own direction. It is interesting to note that processes such as those carried on at Widnes, Alderley Edge, and Jarrow-on-Tyne, are applications, on a manufacturing scale, of methods ordinarily used by the chemist in his laboratory, and, as such, they afford singularly important evidence of the progress of metallurgical science.

Lead is treated at some length, special attention being devoted to the extraction of this metal by means of reverberatory furnaces. Excellent drawings are given of those employed in the works at Couëron, where galena associated with carbonate of lead is partially converted into oxide and sulphate by roasting, which subsequently react, at a more elevated temperature, on the undecomposed sulphide in the charge, producing metallic lead.

The articles on silver and gold are condensed from the author's well-known work on the mining and metallurgy of these metals, some new matter being added; they leave little to be desired, but the forms of apparatus for assaying which are described, are not in all cases the most perfect.

Fifteen metals are treated in the work, and these are by far the most important commercially; nevertheless, we could have wished to find brief accounts of such metals as manganese, magnesium, cadmium, palladium, potassium, and sodium.

We have already referred to the excellence of certain drawings, and it is only necessary to add that throughout the volume the illustrations are of very high merit. They are evidently drawn from actual measurement, but it is to be regretted that scales are not given.

The author states in his preface that the object which he had in view was "to supply, within moderate limits, such practical information on general principles, and typical processes, as may not only afford a comprehensive view of the subject, but also enable the reader to study with advantage more elaborate treatises and original memoirs." Certainly this object has been attained; and we think he has done more, in that he has produced a work which not only fully sustains his reputation, but affords fresh evidence of his having done much scientific work of a kind far too rare in this country.

OUR BOOK SHELF

Descendenzlehre und Darwinismus. Von Oscar Schmidt. (Leipzig: Brockhaus, 1873.)

THIS volume of three hundred pages is one of the "International Scientific Library." It is a moderate exposition of the Darwinian theory of Evolution, intended for general readers, and while free from the eccentricities of Hæckel's Anthropogenie, also lacks the brilliancy and power which redeem its faults. Prof. Schmidt while still at Gratz became a convert to "the new philosophy," and in his *Vergleichende Anatomie* (NATURE, vol. v. p. 228) adopted its conclusions as the basis of his teaching. In a paper read before the "British Association" of Germany two years ago, at Wiesbaden, he stated and defended his change of opinion, and now that he is established as professor in Strassburg University, he puts forward this volume as a fuller exposition of his views—"for here one must show one's colours." It is perhaps undesirable for people to attempt arriving at the results of science by such easy roads as popular treatises, and "The Descent of Man" itself is a better interpretation of Darwinism than the expository treatises of Darwinists; but there is undoubtedly a demand for books of this kind, and if they are to be written, it is well that so competent a hand as Prof. Oscar Schmidt's should do it. There are several woodcuts, a good list of references, and the inevitable genealogical trees.

We also note the appearance of an essay attacking the theory of Evolution, by Prof. Wigand, of Marburg; and a reply to it by Prof. Jäger, of Stuttgart. The former, entitled *Darwinismus und die Naturforschung Newton's und Cuvier's*, is a temperate production, written from the point of view of a botanist. The latter is a more lively rejoinder, and appears as *In Sachen Darwin's insbesondere contra Wigand.* P. S.

The Micrographic Dictionary: a Guide to the Examination and Investigation of the Structure and Nature of Microscopic Objects. By J. W. Griffith, M.D., and A. Henfrey. Third Edition, edited by J. W. Griffith and Prof. M. Duncan, assisted by the Rev. M. J. Berkeley and T. Rupert Jones. (London: J. Van Voorst, 1875.)

WE have from time to time chronicled the progress of this work, and have now the satisfaction of announcing its completion. In a work of this kind, which has been upwards of three years in passing through the press, it is inevitable that minute criticism should detect some discrepancies between the various articles, and some passages in the earlier pages which would not have been written in the light of more recent investigations. It is probable, also, that workers in different fields will place a different estimate on the importance of their own department, and will be disposed to grudge the space devoted to others. The student of Cryptogamic Botany has at all events the lion's share, almost every genus in some groups being described. In the present chaotic state of the classification of Cellular Cryptogams, it is probable that a number of the genera and even groups treated of in this work as autonomic will have ultimately to be abandoned. There is, however, so much that is of the greatest value to every microscopist, that we can cordially recommend the work as indispensable to the student. The plates, some of which are new, and others re-drawn, are of themselves of great and permanent value.

Temperature Chart of the United States, showing the Distribution by Isothermal Lines of the Mean Temperature of the Year. Constructed under the direction of Prof. J. Henry, Secretary, Smithsonian Institution, by Charles A. Schott, Assistant U.S. Coast Survey, in October 1872.

THIS temperature chart, which by the way should have been accompanied with some explanatory remarks, has been issued by the Smithsonian Institution. The isothermals are given for every 4° F., beginning with 36° in Minnesota and the northern shores of Lake Superior, and rising successively to 76° in the extreme south of Florida. The lines have evidently been drawn from mean annual temperatures, uncorrected for height, and are therefore designed to show the actual distribution of mean annual temperature over the surface of the United States. This method of representing the distribution of temperature, which has been employed by Petermann and others, is well suited for various purposes for countries, such as Russia, which consist chiefly of extensive rolling plains; but it is not suited for Scotland, Switzerland, and other mountainous regions. In the mountainous parts of Great Britain, for instance, isothermals so drawn, had we the data to do it, would be neither more nor less than contour lines. The fault of the chart consists in not keeping this distinction in view. Thus, in the Rocky Mountains, the isothermal of 44° passes over Denver, the mean temperature of which, on an average of three years, is 51°·0; and in the Alleghany Mountains, Ashville, N.C., lies within the closed isothermal of 48°, but its mean temperature on an average of four years is 54°. In constructing such charts, mountainous regions should be altogether kept clear of the isothermals. For the vast plains of the States the chart is a valuable one, and the tracing of the influence of the lakes, river basins, and more marked contour lines on the course of the isothermals, is very instructive. After a somewhat minute examination of the lines, we have only to note, in way of criticism, that the isothermal of 44° is drawn too far northward in the region of Lake Ontario; the mean temperature of Toronto being 44°·2 and Kingston 42°·8, showing that it should be drawn nearly along the northern shore of that lake.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Sub-Wealden Exploration

IT must be with great regret that geologists see the announcement made in NATURE, vol. xi. p. 236, that all the efforts to clear the bore-hole at Netherfield have been unavailing, and that it has to be abandoned. But is it advisable, I would ask, that another should be commenced *on the same spot?* When the

1,000 feet were clear, it seemed desirable to go deeper, as no one could tell how soon the Palæozoic rocks would be reached; but surely if it is to be recommenced *de novo*, it would be better to select another site. We already know from the boring nearly all we care to know—that we are not there on the axis of Palæozoic rocks, but in a basin.

The Kimmeridge clay, which is 240 feet thick at Marquise, becomes thicker in a south-westerly direction to 360 feet near Boulogne, and now we know that it reaches some 660 feet at a point six times the distance in a direction W.N.W., which thickening is continued to its outcrop under St. Alban's Head, though it thins again to the west. The coral rag which occurs in the Boulonnais is here gone through; it sets in again near Weymouth, and since this is followed in the former locality by 385 feet of Oxford clay and Lower Oolitic rocks, we may expect at least 600 feet of them at Netherfield before we reach Palæozoic rocks, which will be almost certainly lower than the coal.

The facts so far ascertained by the boring prove, therefore, as much as we could wish to know, except the age of the Palæozoic rock when met with, if that could be discovered from the small core. They show that the spot is to the south of the axis we are seeking, and the thickening of the Kimmeridge clay would tend to throw that axis some considerable distance to the north.

No such Jurassic beds occur at London, Harwich, or Calais; but the Cretaceous beds directly overlie the Palæozoic. The conditions on one side and on the other are therefore very different. To the north the Palæozoic rocks are spread out not so far from the surface, and on this side only have the coal measures been proved; to the south they are scooped, or dip, into a hollow, in the midst of which is the Netherfield boring, and which hollowing out would have removed all coal-bearing strata, even if originally there.

This verification of what might have been argued from facts already known has been given us by the Sub-Wealden boring; what more can it do? It has proved that our interest is in localities further to the north, as Messrs. Godwin Austen and Prestwich supposed it to be. Doubtless no better locality, *near Brighton*, could have been chosen; but if what is essentially another boring is to be made, why not select a locality from which some fresh information might be obtained? A bore at Folkestone would probably pass through little or none of the Jurassic series; but the best place for a new experiment would be somewhere in the neighbourhood of Goring, which would be on the line both of Mr. Godwin Austen's and Mr. Prestwich's supposed range of coal-fields, and would afford a crucial test whether the Palæozoic rocks are really continuous between London and Frome at an accessible depth; and this is what we most want to know.

If a new boring *is* put down at the same place, it would be well to have a third for some small depth, in order to obtain the dip by a comparison of corresponding beds.

Jan. 25 J. F. BLAKE

The Rhinoceros in New Guinea

I AM quite of your opinion that the occurrence of a rhinoceros in New Guinea is *very seriously* to be doubted (see NATURE, vol. xi. p. 248), but I beg leave to mention a report of a *very large quadruped* in New Guinea, which I got from the Papuans of the south coast of the Geelvinks Bay. When trying to cross the country from there to the south coast, opposite the Aru Islands,—in which I did not succeed, but only saw the sea-shore at a great distance from the height of a mountain chain (I afterwards succeeded in crossing the continent of New Guinea from the Geelvinks Bay more to the north, over to the Maclure Gulf),—and when hunting wild pigs along with the Papuans, they told me, without my questioning them, of a *very large pig*, as they called it, fixing its height on the stem of a tree at more than six feet I could not get any other information from them, except that the beast was very rare, but they were quite precise in their assertion. I promised heaps of glass pearls and knives to him who would bring me something of that large animal, but none did. I cannot suppose, so far as my experience goes, that the Papuans are remarkably prone to lies; notwithstanding I seriously doubted the existence of such a large "pig;" and as the sons of that country are very superstitious, and see ghosts and absurd phenomena everywhere, I may just mention as an example, that when I shot, on the same hunting party, a specimen of *Xanthomelus aureus*, that most brilliant gold-orange Bird of Paradise, they said they could not kill this bird, because it would lighten and thunder when they did. I booked that report as an efflux of their lively imagination, though not without discussing in my diary the possibility and significance of the occurrence of a large quadruped in New Guinea.

It is true this statement does not strongly support Lieut. Smith's *aperçu*, but the one gains a grain by the other; I mean, the probability of the existence of a large quadruped in New Guinea increases a shadow.

The other "fact" mentioned by Mr. Walker (*l.c.*), concerning the skins of a brilliant red Bird of Paradise, which were obtained on the north-east coast, is an interesting *fact* indeed, because it appears to confirm M. d'Albertis' discovery of *Paradisea raggiana* on the south coast. It would be most valuable to compare the skins of the red Bird of Paradise from the north-east and the south coast, or at least those from the first with the coloured figure given by Mr. Elliot in his Monograph of the Paradiseidæ, to become sure of their identity. At all events, if Von Rosenberg maintains (see Noll's "Zoologischer Garten," January 1875), that *P. raggiana* is an "artificial" skin, his assertion is strongly to be repudiated. "Similar frauds" he pretends to have seen in New Guinea, an assertion which is the bolder and the more inconsiderate, as he has not had under his eyes d'Albertis' skins. A. B. MEYER

Dresden, Feb. 1

I WAS no doubt wrong in speaking of the occurrence of the rhinoceros in Papua as a fact without the qualification "if confirmed;" but I wrote in a hurry.

From the details supplied by Mr. Smith, which I annex, I think there is at least a very strong probability that there is a rhinoceros in Papua, and the object of my letter will have been attained if it causes explorers on the north coast of that island to look after it, and at the same time places Mr. Smith's name on record as the discoverer of its indications.

"1. The heap of dung first seen, which was quite fresh (not having apparently been dropped more than half an hour), was so large that it excited Mr. Smith's curiosity, and he called Captain Moresby to see it. Neither of them knew to what animal to assign it. Quantities of dry dung were afterwards seen.

"2. Shortly afterwards, the *Basilisk* being at or near Singapore, Capt. Moresby and Mr. Smith paid a visit to the Rajah of Johore, who had a rhinoceros in confinement. Mr. Smith at once observed and pointed out to Capt. Moresby (who agreed with him) the strong resemblance between the dung of this animal and that they had seen in Papua.

"Seeing there is no animal known in Papua bigger than a pig; seeing also that Mr. Wallace has pointed out the African affinities of many of the animals in the islands he associates with Papua; seeing also that the Sumatran rhinoceros approaches the African in having two horns and no shields or folds in its hide, why should there not be a rhinoceros in Papua approaching still nearer to the African type, or furnishing an additional piece of evidence in favour of Mr. Wallace's hypothesis of a submerged continent connecting New Guinea, &c., with Africa?"

Chester, Feb. 1 ALFRED O. WALKER

Geology and the Arctic Expedition

IN the last number of NATURE, p. 253, it is stated that the appointment of a botanist and zoologist has been recommended by the Royal Society, but it does not appear that anything is being done for geology.

It may be deemed by some an erroneous view of the matter, but I am quite disposed to believe that if the necessary arrangements can be made, geology is more likely to derive important results from this expedition than any other branch of science.

We are continually having additions to the long series of papers on the Glacial Period, but the still more remarkable *warm period* in the extreme north is altogether neglected; no one seems capable of even suggesting a probable explanation. It is quite evident, in the first place, that we want more facts, and there will probably never be a better opportunity of obtaining them than in the course of the new expedition. Carefully conducted researches would probably reveal the existence of a still further extension than has hitherto been suspected of the fossiliferous Miocene beds which have already yielded such valuable results.

Even now, it can hardly be doubted, that just before the advent of the cold period, a magnificent flora, which would require at least as much light and warmth as we now enjoy in England, was flourishing in luxuriance as far north as the 78th parallel. The contemporaneous fauna may now be discovered, and a similar recurrence of vicissitudes of climate may possibly be detected in still earlier periods of the earth's history. These are questions of the highest interest; the forthcoming expedition may do much towards their solution, and it is to be hoped that those now directing the scientific arrangements will not neglect an opportunity of such rare occurrence.

There is nothing to be said against the appointment of a zoologist and botanist, provided geology be not neglected; but if a third addition to the scientific staff should be impracticable, it would appear preferable that a good geologist should be instructed to look after the few small plants which may be added to those already known, than that the opportunity should be lost of throwing light on a subject which is acknowledged on all hands to be shrouded in the greatest obscurity.

Birmingham SAMUEL ALLPORT

Upper Currents over Areas of Frost

HAVING been for many years engaged in the discussion of upper currents, I believe that I can contribute an item of information towards the solution of the question asked by M. De Fonvielle in NATURE, vol. xi. p. 193.

During many of the hardest frosts experienced in the West of Europe, moist southerly winds of mild temperature prevail on the extreme western coasts of the British Isles, and occasionally of France and Portugal; extensive areas of low pressure existing on the North Atlantic, and of high over Western and Central Europe; isobars running nearly S. and N., and gradients being steepest in the W. Under these conditions, often persistent for many days, cirrus-clouds travel almost invariably with upper currents from points between S. and W. in the extreme west, and commonly from points between S.W. and N.N.W. over the whole western portion of the area of frost.

A slight "backing" of the last-mentioned current is *commonly* one of the first *local* premonitions of the change of weather, and may often be detected by the observer before any apparent change has taken place in the atmosphere near the earth's surface, and even when the frost is temporarily becoming more intense.

But this rule is not invariable. I have several examples in which the upper current continued from N. or N.W. until the thaw had commenced; and in those instances the southerly wind, at each station as it reached it, appeared to spring up *first on the earth's surface*, and to be slowly communicated to the higher regions of the atmosphere.

And, on the other hand, the upper currents will occasionally "back," even to S.W. or S., when a local depression is advancing in the S.W. and about to pass to the S. of the observer; when, instead of a thaw, a fall of snow and an increase of frost will probably occur. Without the aid of telegraphic reports it is almost impossible beforehand to distinguish this occurrence from the advance of the general depression in the west.

On Jan. 1, 1875, the cirrus travelled from S.W. in the west, and from W. over England and France. Between this and the surface-wind were intermediate currents from S. points, of considerable velocity, and (as shown by the "silver thaw") of high temperature.

In frosts like that of Jan. and Feb. 1855, when the high pressures are in the north, cirrus travels almost invariably from W. or S. points over the area of frost.

It is remarkable that in no instance are cirrus-currents from easterly points accompanied by severe frost.

On the subject of the general laws of the upper-current circulation I cannot here enter; but I will mention, at the risk of a slight egotism, one out of many proofs of the utility of their study. Through the stormy summer of 1872, being constantly questioned by neighbours as to the probable coming weather, I posted a daily weather forecast on my door. In *no instance* did this prove incorrect, even as to the *hour* of a coming thunderstorm. And in all instances these forecasts were *principally* based on calculations derived from the observation of those upper currents which "weather prophets," *et hoc genus omne*, almost universally neglect.

W. CLEMENT LEY

Ashby Parva, Lutterworth, Jan. 20

Decomposition of Iron Pyrites

THE "curious phenomenon" described by Mr. Frederic Case (NATURE, vol. xi. p. 249) is by no means an uncommon one. It is due to oxidation, and the conversion of a portion of the pyrites into soluble sulphate of iron. This decomposition is much aided by the presence of moisture; it is very doubtful whether it would occur at all in a dry atmosphere, and I suspect that the particular case in the Maidstone Museum, where the pyrites has thus crumbled, is near an outside wall, or otherwise exposed to humid influences. I have seen large heaps of pyrites thus decomposing at the foot of the troughs where coal-slack is washed before converting it into coke. The sulphate of iron used in the manufacture of Nordhausen sulphuric acid is commonly obtained by similar oxidation of pyrites, which is aided and economised in this case by previously roasting away a portion of the sulphur.

Mr. Case may easily test the above explanation by placing some of the crumbled pyrites in a small quantity of water, leaving it there for an hour or two, then filtering through blotting paper and evaporating the clear filtrate slowly to dryness. If I am right, he will find a residue of small crystals of sulphate of iron. A few drops on a strip of glass will be sufficient to show these crystals, if magnifying power is used; or the presence of a soluble salt of iron may be shown by adding a little ferro-cyanide of potassium to this filtered liquid.

W. MATTIEU WILLIAMS

WITH reference to a statement and inquiry put forth last week in your columns by Mr. Frederic Case, of Maidstone, respecting the decomposition of some iron pyrites, I beg to state that precisely the same effect took place with similar specimens exhibited in our museum many years ago. The cause is due, I understand, to the influence of air and moisture forming ferrous sulphate (green vitriol or copperas). In our case this salt appeared in abundant crystals, and was sufficiently strong to partially obliterate and destroy a contiguous manuscript.

Alnwick Mechanics' Institute GEO. LINGWOOD

ON p. 249, vol. xi. is a query by Mr. F. Case as to the spontaneous decomposition of iron pyrites. I would suggest that the sulphur and iron of the mineral have been oxidised at the expense of the oxygen of the atmosphere in the presence of moisture. Some years ago I collected specimens of fossil wood, &c., from the London clay found in a deep well at the corner of Colchester Garrison. After a time my specimens were crumbling to powder, and were covered with light, silky crystals, which upon analysis proved to be *sulphate of iron*. Upon examining the clay minutely it was found to contain numerous golden spangles, exceedingly small, of native sulphuret of iron or iron pyrites, and the conclusion arrived at was that these spangles had absorbed oxygen and produced the crystals, and also rendered the specimens friable.

A. P. WIRE

Dunstable

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—(1). On the 19th of June, 1822, during the visibility of Encke's comet in the southern hemisphere, Rümker, who was then at Paramatta, N.S.W., compared the comet with a star which he judged to be between the fourth and fifth magnitude, but could not find in any of the catalogues. The sun set at Paramatta on this evening at 4h. 58m., and the comet was observed from 6h. 3m. to 6h. 46m. mean times, or from an altitude of 20° to 11°. An experienced observer as Rümker then was would not be likely to make any great error under these circumstances in estimating the magnitude of his comparison-star. Olbers in July 1824 first directed attention to it, as probably a remarkable variable star. He noted its occurrence in Harding's Chart as a seventh magnitude, and supposed it was inserted from an observation by that astronomer, who, as is well known, compared his maps with the sky; and further, he pointed out that it had been observed by Bessel in his sixty-third Zone, 1822, March 14, and then estimated also of the seventh magnitude. Rümker determined the position of his uncatalogued star, by reference to three neighbouring ones found in the "Histoire Céleste," and it agrees almost precisely with that given by Bessel's Zone. This object is No. 134 in Santini's Catalogue (Decl. $-2°$), where it is again estimated a seventh magnitude. It does not occur in Argelander's

"Uranometria," but we find it in the catalogue to Heis's Atlas as a 6·7. In the excellent chart of the seventh hour of R.A., by Fellöcker of Kremsmünster, forming one of the series prepared under the auspices of the Berlin Academy of Sciences, we find it marked only of 8·9 magnitude. There is consequently sufficient evidence upon record to justify the appearance of this star in our catalogues of suspected variables, even if it be not considered decisive as to variability. Yet the object seems to have been generally overlooked of late years. We are nevertheless able to state that in 1873 and 1874 small fluctuations of brightness could be detected, and may recommend it to the attention of observers who are more especially interested in the variable stars. The position for the commencement of the present year is in right ascension, 7h. 23m. 0s., and polar distance, 91° 39′. A star of 9·10 magnitude precedes it about 4 seconds in R.A., and about 1′ north. The colour is a full yellow or light orange.

(2). *Mira Ceti*, according to the formula of sines in the last catalogue of variable stars, issued by Prof. Schönfeld, will attain its maximum in the present year on February 24. The minimum determined in the manner adopted by this eminent authority will fall on September 30. The first maximum of 1876 is on January 17.

(3). β Cygni was indicated as variable by J. Klein, of Cologne, from a series of careful observations by himself, between July 1862 and November 1863, and Schönfeld includes the star in a provisional list prefixed to his catalogue of 1875, ascribing a variation between 3·3 and 3·9 mag. to the brighter component of this beautiful object. It is not the first time that variability has been suspected in one component only of a double star. We are able to state that last August, β Cygni, as a naked-eye object, certainly looked dimmer than we had often remarked it.

THE ZODIACAL LIGHT has presented itself on each clear evening since our last, but most conspicuously on the 31st ult. It was then distinctly traceable to π Arietis, and at best views a fainter offset appeared to extend very nearly to the Pleiades. The axis passed a few degrees south of λ Piscium. The intensity of light was certainly more than twice that of the Galaxy in its brightest part between the constellations Cassiopea and Cygnus.

ENCKE'S COMET.—The re-discovery of this body is not yet announced, but it will be strange if it is not detected with the larger telescopes before moonlight interferes in the evening. In 1842, when the perihelion passage occurred at the same time as in the present year, it was observed with the Berlin 9-inch refractor on Feb. 8th; much more effective instruments, however, are now common, and if the comet's constitution has remained unchanged, we might have expected observations in January.

HALLEY'S COMET.—In our "Astronomical Column," next week, we shall give the principal results of the late M. de Pontécoulant's calculation of the perturbations of this comet (so interesting, especially to English astronomers) during the actual revolution, and describe the path in the heavens which his work indicates for the year 1910.

ANNUAL REPORT OF THE WARDEN OF THE STANDARDS

THERE has been just issued by the Queen's printers the Eighth Annual Report of the Warden of the Standards, Mr. H. W. Chisholm, on the proceedings and business of the Standards Department of the Board of Trade.

When we remind our readers that the Standards deposited in that department have been the result of the labours of many men of science, including Davies Gilbert, Wollaston, T. Young, Kater, Baily, Sir J. Herschel, Earl of Rosse, Lord Wrottesley, Sir E. Sabine, and lastly, but most of all, W. H. Miller and the present Astronomer Royal, we need scarcely say there should be much in this Annual Report worthy of our notice. We confine our notice here to that part of the business of this department which is most likely to interest our readers, without referring to its various official or State duties.

One part of the business of this department appears to be the conducting of comparisons and other operations with standards of length, weight, or capacity, in aid of scientific researches or otherwise. Amongst such comparisons we note the determination of the lengths of two Russian pendulums for use in the Great Trigonometrical Survey of India, in ascertaining by combined astronomical and telegraphic observations the exact position of a number of fixed points on the earth's surface. Standards were also verified for the Governments of Canada and India, for special use.

Chemists and physicists are glad to rely on the accuracy of their measures or weights, as compared with our own or foreign standards, and to be assured of the constancy of the units employed in their researches. This part of the business of the Standards Department would appear therefore to be of practical use to those whose researches require such accuracy. To maintain uniform the weights and measures of our laboratories is not only aiding individual research, but facilitating the exchange of scientific experience.

Many additional instruments are stated to have been added to the valuable collection of comparing apparatus deposited in this department: one of these is the new powerful air-pump, by Deleuil, to be attached to a vacuum balance. During the preparation of new gold and silver standard trial-plates, elaborate experiments were made by the chemist of the Royal Mint, on gold and silver alloys, reference to which is made in the special Report of the Warden of the Standards appended to the Report. These experiments are referred to more particularly in the paper by J. Norman Lockyer, F.R.S., and W. Chandler Roberts, read before the Royal Society on Nov. 20, 1873, on the quantitative analysis of certain alloys by means of the spectroscope.

Attention is called in this Report to the teaching of weights and measures in schools. There is no doubt that a large number of obsolete and unnecessary weights and measures are used in school text-books. The teaching of the metric system of weights and measures is now abandoned in schools under the authority of the Education Department.

The use of the mirror and electric lamp has been so eloquently demonstrated by Professor Tyndall, that our readers will be glad to see appended to the Report a paper on the employment of a mirror and a ray of light for indicating differences in standard weights, or in measures of length. This paper is a translation of a paper by C. A. Steinheil, read in 1867 at the Imperial Academy of Sciences at Vienna, and is a valuable record of the work of one who spent his life in scientific research.

Also appended to this Report is a short table for the reduction to 0° C. of readings of barometers with metric graduations on their glass tubes, based on those coefficients of the expansion of mercury and glass adopted in standard measurements, viz. :—

Cubic expansion of mercury .	0·00017971	for 1° C.
Linear expansion of glass . .	0·00000886	„

As an instance of the precision with which measurements are now made, we may refer to p. 40 of this Report, from which it appears that the value of a micrometer was determined at two different periods to be 0·00003181 and 0·00003183 inch respectively; showing a difference of only 0·00000002 inch. Such precision may appear to be scarcely necessary except in particular researches. As, however, any error in the production of a direct copy of a standard is many times repeated and multiplied in the production of a weight or measure even for laboratory use, such precision is absolutely necessary in the original standards. For this reason all who value precision in their researches should take care that at least their units of measurement have been directly compared with the standards.

SCHREIBER'S EUROPEAN HERPETOLOGY*

THIS volume, issued by the publishers of Blasius's well-known work on European Mammals, and illustrated in nearly the same fashion, with numerous excellent woodcuts, will be very welcome to naturalists, as supplying in a compendious form an account of an important section of the Vertebrates of our Continent, on which there has hitherto been no generally recognised authority. In England, it is true, we have Bell's "British Reptiles," if it is not out of print. But as regards the lower forms of terrestrial vertebrates, Dame Nature has, we know, treated the British Islands rather scurvily. The fact is, these cold-blooded animals cannot stand a continuously low temperature, and the ice-sheet which so recently enveloped us must have destroyed all traces of reptilian and amphibian life, so that we have only what has been received from the Continent subsequently to the "Great Ice Age." And this is the reason of our scanty allowance. Europe generally, as we shall see from Dr. Schreiber's pages, is much more liberally furnished with representatives of these two orders of vertebrates.

Dr. Schreiber commences his work with an account of the European Amphibians, which naturally fall under the two sections *Urodela* and *Anura.* Of the Urodeles, or Tailed Amphibians, two families are recognised, one containing only the abnormal form *Proteus,* the other the Salamanders, which are divided into seven genera, containing altogether fifteen European species. The tailless division of the order, which comprehends the frogs and their allies, is not quite so numerous, only twelve species being recognised as European, which are assigned to eight genera. The account of these animals is followed by a very interesting chapter on their distribution, accompanied by many illustrations of it in a tabular form. Genera and species of Amphibians are alike most abundant in the south. While England only has eight species belonging to three genera, Germany has fifteen belonging to eight, and France twenty-one distributed amongst nine genera.

The second and larger division of Dr. Schreiber's work treats of European reptiles, beginning with the Snakes and proceeding through the series of Saurians to the few European representatives of the order of Chelonians. As in the former section, each species is well described, and particulars are given as to its distribution and habits. The variations in form and colour, which in some of the lizards and snakes are very numerous, are likewise given, and the mean seems to have been preserved between recognising too many species on the one hand, and allowing too few on the other. Altogether, twenty-four snakes, thirty-five lizards, and five tortoises (sixty-four reptiles in all) are treated of as occurring within the limits of the Continent of Europe. A full treatise on the range and distribution of these sixty-four animals is appended to this portion of the volume, which is concluded with remarks upon the collection, preparation, and transmission of specimens of these animals. On the whole, we can cordially recommend Dr. Schreiber's work as an excellent handbook and work of reference for those who are interested in this branch of natural history.

* Herpetologia Europæa, eine Systematische Bearbeitung der Amphibien und Reptilien welche bisher in Europa aufgefunden sind. Von Dr. Egid Schreiber, Director an der Oberrealschule zu Görz. Braunschweig, F. Vieweg und Sohn, 1875. 1 vol. 8vo., 640 pp., and numerous woodcuts.

BOTANY IN QUEENSLAND

IN his last report on the Brisbane Botanic Gardens, Mr. Walter Hill, the director, gives some interesting details on the progress of the garden, and more especially with regard to his trip to the Bellenden Kerr range, on the north-east coast of Queensland, in November last. Looking at the garden in a utilitarian point of view, rather than as a place of recreation and enjoyment—for which purposes, however, it is largely patronised—we find that the experimental department still continues to prove its utility in the introduction and distribution of plants yielding products of commercial value; frequent application is made for plants yielding fibres, medicinal products, dyes, &c.; more especially among this group of plants are applications made for indigo for the planters upon the northern rivers. Mr. Hill thinks that the growth and manufacture of indigo will probably assume the proportions of valuable and important interest in the tropical regions of the colony, whenever labour can be obtained at a sufficiently cheap rate. The experimental coffee plantation has proved very satisfactory during the past year, and the demand for sugar-cane continues, trials in its cultivation having succeeded in several previously untried localities. Amongst other economic plants distributed for experimental cultivation in Queensland may be mentioned the olive, tea, palm oil, lavender, senna, medicinal rhubarb, cocoa, clove, cinnamon, nutmeg, vanilla, ginger, &c. That trials in the acclimatisation of many of these valuable economic plants are intended in earnest will be understood from the following extract from the report. Mr. Hill says: "I would beg to call attention to the expediency of setting apart 400 acres upon both the Johnstone and the Daintree rivers, these districts offering better advantages as regards aspect and soil than the reserve at Cardwell possesses for the cultivation of the Clove (*Caryophyllus aromaticus*), the Nutmeg (*Myristica moschata*), the Vanilla (*Vanilla aromatica*), the Cocoa (*Theobroma cacao*), the Coca (*Erythroxylon coca*), the Mangosteen (*Garcinia mangostana*), the Durion (*Durio zibethinus*), the Bread Fruit (*Artocarpus incisa*), &c., which require some more degrees of heat and moisture to bring them to perfection than can be had at Cardwell. In fact, with the vast variety of climate and soil of Queensland, it must of necessity be the case that each locality has a distinct description of vegetation most suited to it."

With regard to the ascent of Bellenden Kerr, we are told that the first two miles of the course led through low ground, which, after much wet weather, must become a swamp. The vegetation consisted of *Barringtonia carya*, F. Muell., *Ptychosperma alexandriæ*, F. Muell., *Calamus australis*, Mart. (Lawyer Cane), *Bambusa arundinaceæ*, Retz., *Pandanus aquaticus*, F. Muell.; whilst on the higher portion of the ground were *Wormia alata*, R.Br., *Dysoxylon oppositifolium*, F. Muell., *Aglaia elæagnoidea*, Benth., lawyer cane, bamboo, screw pines, &c. A fine watercourse was here crossed, which was referred to as the Bellenden River. Along the banks of this river the trees consisted of the genera *Castanospermum*, *Eugenia*, *Brucea*, *Ximenia*, *Elæocarpus*, *Owenia*, &c. The soil on both sides was of a sandy nature, with a good admixture of vegetable matter. It took about three hours to reach this place, the distance of which was calculated at about three miles from the point of departure, and having risen, according to the aneroid, to an elevation of 160 ft. Having found a spur, four hours and a half were consumed in covering a distance of one mile and a half, through a complete mass of bamboos, lawyers, and screw pines, where the exploring party camped for the night on a small incline between two ridges, at an elevation of only 1,250 ft. The trees in this neighbourhood consisted of *Erioglossum edule*, Bl., *Cupania Robertsonii*, F. Muell., *Atalaya salicifolia*, Bl., *Harpullia Leichardtii*, F. Muell., *Castanospermum australe*, A. Cunn., *Mimusops parvifolia*, R.Br., *Achras pohlmanniana*, F. Muell. The thic growth of the Pandanus was not one of the least obstacles encountered in the ascent. One tree fern (*Alsophila Rebeccæ*, F. Muell.) and a climbing fern (*Gleichenia Hermanni*, R. Br.), which runs up to a height of 50 or 60 ft., were so abundant that in some places a way had to be cut through them. *Alsophila Rebeccæ* was occasionally so much entangled with other plants, such as *Smilax elliptica*, R. Br., *Flagellara indica*, Willd., &c., that to penetrate them was a work of extreme difficulty.

The top of the range is 5,300 ft. above the sea-level, and in clear weather, considering its situation, the surrounding scenery must be very fine; at the time Mr. Hill and his party visited it, however, everything below was hidden by mist. Though the main purpose of the expedition was the exploring of a certain portion of the north-east coast of Queensland with the view of ascertaining the adaptability of the soil for cultivation, the result was not without interest in a botanical point of view, namely, the discovery of new plants. Mr. Hill records two new palms, discovered at an altitude of 2,000 ft., one of which was a beautiful plant about 20 ft. high, with leaves or fronds about 20 ft. long, and a stem about 9 in. in diameter; the other grew about 12 ft. high, and its stem was about 3 in. in diameter; this appeared to be a species of *Kentia*. A fine proteaceous tree about 60 ft. high, with splendid crimson flowers, was seen at 2,500 ft., and at 500 ft. lower down a beautiful new orchid, a species of *Anæctochilus*, was discovered. Besides these, other new plants of more or less interest were seen, which in course of time will no doubt find their way to this country.

It is not so very long since Baron Mueller recorded the discovery of some colossal trees of the Eucalyptus group in the back gullies of Victoria, trees that rivalled, and even exceeded, in height the largest known Wellingtonia. Now Mr. Hill tells us of a splendid Dammara tree passed by him in his descent from the top of the range, the height of which he roughly estimated at not less than 120 ft., with a trunk 4 ft. through. *Dammara robusta*, C. Moore, is the only species at present recorded in Australia, and this is found rather abundantly in the Queensland forests, and is stated to grow to a height of 150 ft., so that in the matter of height the tree seen by Mr. Hill does not exceed any previously known, but a trunk 12 ft. in circumference is not a small tree.

We hope that Mr. Hill will be enabled to make a further exploration of this part of Queensland, and publish the account of his journey in a more detailed form.

JOHN R. JACKSON

THE TOCK-TAY, OR LARGE HOUSE LIZARD OF EASTERN BENGAL

THIS noisy but harmless animal generally finds a lodgement in the bamboo and mat houses of the district that are anywhere near the jungle. It is also fond of living in hollow trees, which give great resonance to its loud and strongly staccatoed cry of *tock-tay*. It is of a green tint, mottled over with red spots, and suckered feet like its smaller congener, the Tick-tickee, enable it to run under beams and bamboos. Its cry is, however, very different from the gentle *tick-tick* of the small lizard, being sufficient at night to awake the soundest sleeper. He begins with a loud rattle as if to call attention; this is followed by another and more imperative rattle, and when everybody may be supposed to be listening, he strikes in deliberately with *tock-tay*—a moan—*tock-tay*—another moan—*tock-tay*—a last and final moan, with which he winds up, not to be heard again for an interval.

In the way of edibles he is fond of a good crust, and the common dung-beetle frequently furnishes him with a *pièce de résistance*. That insensate insect becomes an easy prey, owing to his heedless rattle-dum-clash ways; he is the great extinguisher of lights at night in native houses, and Europeans are also familiar with his strong sustained drone, varied by intervals of silence when he has dashed against some rafter or projection, or given himself a heavy fall; but he is not to be discouraged, and is soon up and droning about as dismally as ever.

The drone, however, is sometimes suddenly quenched without the consequent thump on the floor, and when this is followed by a crunching sound overhead one may safely infer that it is Tock-tay who has been lying in wait for him and has snapped up his prey.

These lizards may easily be caught during the day by slipping a noose over their necks while they are asleep in an exposed position; and when so caught they snarl, growl, and snap at their captor in a very ferocious way. I have not heard, however, that they are venomous.

C. B.

NOTES

THE cause of Technical Education is already much indebted to Sir Joseph Whitworth, who has just added to his former judicious benefactions by proposing to found, in connection with Owens College, Manchester, King's College, London, and University College, London, a certain number of Whitworth Exhibitions, in order to fit young men having a mechanical instinct and some little experience better to become candidates for the Whitworth Scholarships. Competitors for these exhibitions must comply with certain reasonably easy conditions, and the successful competitors will be entitled to receive during the two years next following the examination, instruction in all such subjects (being part of the course of each College) as shall better prepare them for the Whitworth Scholarship Examination—viz., practical plane and solid geometry, machine drawing, mathematics, theoretical mechanics, applied mechanics, and freehand drawing. Sir Joseph Whitworth will pay each College annually for four years, as a trial of the success of his proposal, the sum of 100*l*. for or towards, at the option of each College, the academical expenses of the exhibitioners.

THE Cambridge Mathematical Tripos has been published; it contains this year eighty-six names, of whom twenty-eight are Wranglers, thirty-four are Senior Optimes, and twenty-four Junior Optimes. The Senior Wrangler is Mr. John William Lord, of Trinity College, a son of the Rev. Isaac Lord, of Walton, near Ipswich, lately a Baptist minister in Birmingham. He was educated at Cambridge House, Birmingham, then at Amersham Hall School, near Reading. In 1868 he obtained honours at the matriculation examination of the University of London. At the examination for M.A., in June 1874, he was awarded the gold medal for mathematics. In 1870 he entered Trinity College, Cambridge, when he was awarded an open scholarship for mathematics, and subsequently was elected a foundation scholar. He was declared equal in merit for the Sheepshanks Astronomical Exhibition with Mr. Lewis, of Trinity College. The Rev. E. W. Blore was his college tutor, while he received private tuition from Mr. E. J. Routh, of St. Peter's College. Mr. Lord was distinguished as an athlete, and regularly rowed in his College boat.

THE Minister of Finances of France has at last consented to pay into the hands of M. Eichens the money which he required to begin the construction of the meridian telescope presented by the banker Bishofsheim to the Paris Observatory. M. Leverrier's letter noticing the fact was gazetted. The financial rules of the French Administration are so stringent that they could not be altered for the defence of the country during the Franco-German war; consequently it is an indication of the growing spirit of the times to see they are no longer available for obstructing the path of science. The opposition of the Minister to the payment of the 1,300*l.* which had been placed in his hands by M. Bishofsheim for certain purposes had attracted much notice, and the end of the difficulty has created quite a sensation.

THE Observatory of Paris is to give a series of *soirées* on the first Monday of each month. Instruments will be placed at the disposal of visitors for observing celestial phenomena, and the most important inventions will be exhibited and explained.

THE method of electing the President of the French Academy of Sciences is very peculiar. In the beginning of January each year a member is nominated Vice-president for the year, and becomes President the following year without being re-elected. The appointment is made alternately in the classes of Physical Science and Mathematics. It being the turn this year of the latter section, Admiral Paris has been elected Vice-president and will be President for 1876. The President actually in office is M. Frémy, the celebrated chemist. M. Paris was born at Brest in 1806, and his first voyage was on board the *Astrolabe*, in which he circumnavigated the globe, under Dumont d'Urville, in 1826. He lost his left hand at Pondicherry in 1837, when visiting a factory. He has written many books on steam navigation, and is a member of the Navigation Section of the Academy. He was created an admiral in 1858.

THERE exist in the largest French provincial towns local Academies, the proceedings of which seldom attract attention beyond their immediate vicinity; but they never lose an opportunity of following the lead of the Academy of Sciences of Paris. The Paris Academy having appointed M. Bertrand successor to M. Elie de Beaumont, as perpetual secretary, the Academy of Toulouse shortly afterwards sent to M. Bertrand a brevet of membership to fill the place vacated by the demise of his predecessor. As M. Elie de Beaumont was a member of the Academies of Lyons, Bordeaux, Marseilles, &c., M. Bertrand has a very good chance to acquire without moving all the academical honours which belonged to his predecessor, except in the cities where he was himself previously a local academician.

THE annual conference for regulating the operations of the Mint in connection with international coinage was held recent y at the French Foreign Office, Paris. Except Greece, representatives of all the other nations who are parties to the international convention for the inter-circulation of decimal coins, were present. The system extends now to France, Italy, Belgium, Switzerland, and Greece. No measures of importance were passed, but it is supposed that some useless restrictions on coinage will be abolished in 1876.

THE *Kölnische Zeitung* of Jan. 19 contains a letter from the celebrated African traveller, Dr. G. Schweinfurth, from which we learn that, by order of the Khedive of Egypt, Herr Rohlfs has distributed among a number of eminent personages, scientific societies, and men of science, one hundred albums, magnificently got up, and containing a collection of fifty large photographs of the Libyan Desert, by Remelé, of Gastendonk, near Aldekerk. Remelé accompanied Herr Rohlfs' expedition of last winter into the deserts of Africa, and has, for the first time, photographed landscapes of the district mentioned in a highly artistic manner. Whoever knows the different characteristics of the African climate compared to the European one, will understand that considerable skill was required to produce real works of art under such altered conditions. It is to be regretted that the handsome collection cannot be obtained by purchase: only a few favoured ones can derive from it that enjoyment that every lover of nature would naturally experience from photographs so highly interesting.

WE learn from the *Kölnische Zeitung* that on January 20 the first meeting of the Italian division of the International Commission for the Measuring of the Meridian took place at the Military Topographical Office at Naples. The members are General de Vecchi (president), General Ricci, Major Ferrero (secretary), the astronomers De Gasparis (Naples), Respigi (Rome), Santini (Padua), Schiapparelli (Milan), and Professors Betocchi, Schiavoni, and Oberholtzer. The meeting, in making out the programme for 1875, continued the work begun at the autumn meeting at Dresden.

IN reference to the proposed Channel Tunnel between France and England, we may refer our readers to NATURE, vol. i., pp. 160, 303, 631, and vol. x., p. 181, where the scientific bearings of the subject are pretty fully discussed. While on this matter we may state, on the authority of *La Nature*, that there has been in existence for some time in Spain an Inter-continental Railway Company, whose object is to connect Europe and Africa by a tunnel underneath the Straits of Gibraltar, the maximum depth of which is 819 metres.

DR. COUES has published, in the Proceedings of the Philadelphia Academy, a synopsis of an elaborate work by him upon the mice of North America, based upon the many thousands of specimens in the Smithsonian Institution. In this he considerably reduces the alleged number of species, although describing some that he considers new.

DR. REGEL, in an appendix to the second fascicule of his "Descriptiones plantarum novarum et minus cognitarum in regionibus Turkistanicis, etc., collectis," defends his theory of the descent of the grape-vine of the Old World, in its numerous varieties, from *Vitis labrusca* and *V. vulpina*, two New World species, the former extending to Japan. *V. parvifolia* and *lanata* of Roxburgh, Indian species, he identifies with the foregoing, and thus traces out the relationship of the grapes of the Old and New Worlds. Although Dr. Regel can see his way to this extreme of variation, he still holds fast to the opinion that "the specific limits of any species whatsoever were called into existence (or defined) with the appearance of the first individual of that species, and that there is no gradual evolution from the lower to the higher organisms.

A SECOND EDITION of Hooker's "Synopsis Filicum" has just appeared. It will be remembered that the late Sir William Hooker left the original work unfinished, and that it was taken up and completed by Mr. J. G. Baker. The second edition has also been prepared by the same gentleman. A period of about six years has elapsed since the first publication, and the edition before us contains four hundred additional species. The idea of a species as developed in this work is very broad and comprehensive; hence this number represents nearly as many distinct new forms, very few coming under the denomination of "critical species." The total number of species admitted now exceeds 2,600. The additional species are given in an appendix occupying seventy-seven pages. In the body of the work a number of bad species have been reduced to their respective types, and their places taken by new species. A relatively large proportion of the new species are tree-ferns—Cyathea, 25; Hemitelia, 11; Alsophila, 25; and Dicksonia, 13; and there are no fewer than sixty new species each of the new genera Polypodium and Nephrodium, in the extended sense given to them in this work. Asplenium is represented by about fifty new species. Only one new genus is given, Diplora, an asplenioid form from Solomon Islands, bringing the total up to seventy-six. Whether the generic and specific limits adopted in this work be accepted or rejected, the book is indispensable to all pteridologists. We may mention that the complete index has been issued in a separate form, which will be very useful to all lovers of ferns and horticulturists generally.

AN account has reached us of the Memorial Meeting of the Boston Society of Natural History, on the 7th of October, 1874, held to mark the death of Dr. Jeffries Wyman in September last, of whose life we gave some account shortly after. The principal address at the meeting was by Prof. Asa Gray, who sketched Dr. Wyman's life and his work as a biologist. Prof. Gray speaks in very high terms of Dr. Wyman's work. In the memoir on *Troglodytes Gorilla*, read before the Boston Society in 1847, and of which the osteology and introductory history is by Dr. Wyman, and in the subsidiary papers, Prof. Gray says, "may be found the substance of all that has since been brought forward, bearing upon the osteological resemblances and differences between man and apes."

WE note the receipt of the Annual Report for 1873 of the Birmingham Natural History and Microscopical Society, one of the most energetic of this class of societies in the kingdom. There is a very interesting address by the retiring president, Mr. W. R. Hughes, F.L.S., in which he reviews briefly the recent progress of the study of Marine Zoology. We are glad to see that the Society contemplates going so far afield on an exploring excursion as the Mediterranean; our readers may remember that in the autumn of 1872 they made a very successful dredging excursion to Teignmouth. Mr. Hughes suggests that the Birmingham and similar societies should combine in a petition to the proper quarter to obtain any surplus specimens from the *Challenger* collection which may remain after the British Museum and other headquarters for specimens have been supplied. The suggestion seems to us a very reasonable one, though it may be found that after all the *Challenger* specimens will not go very far in this respect. We are glad to see that the Society continues to be increasingly prosperous.

WE are gratified to learn that a Natural History Society and Field Club was successfully inaugurated at Watford on the 23rd ultimo. It has commenced with about fifty members, ladies and gentlemen, and Mr. J. Hopkinson was appointed secretary. We wish the Society every success; it is the only one of the kind in Hertfordshire, and we hope it will set itself in earnest o extend and complete our knowledge of the natural history of that county.

PROF. HAYDEN has lately printed a catalogue of the publications of the United States Geological Survey under his charge, filling a pamphlet of twenty pages.

IN the number of the *Pharmaceutical Journal* for Jan. 23, Mr. E. M. Holmes throws considerable light on the botanical source of the new drug Jaborandi. Prof. Baillon was the first to refer it to a species of *Pilocarpus*, but upon very insufficient materials. Mr. Holmes, however, has succeeded in obtaining better specimens, including some ripe fruits, and from these he arrives at the conclusion that there are two or more distinct varieties of the drug, one of which is very near if not identical with *Pilocarpus pennatifolius*, Lem., another from a species of the same genus not yet known, and another still from a species of *Piper*. These are now in use both in France and England, but several other plants possessing similar properties and known under the same name of Jaborandi are in use in South America. With regard to its physiological action, Mr. Martindale contributes some interesting notes in the *Pharmaceutical Journal* for Jan. 16.

THE *Journal of the Society of Arts* quotes an article from the *Journal de la Société d'Horticulture* on indiarubber-producing plants. This paper is a *résumé* of well-known facts relating to these valuable plants, the only point of interest being in connection with the Central American Caoutchouc Tree, *Castilloa elastica*, Cerv., which, we are told, in the district of St. John, in Nicaragua, furnishes employment to from 600 to 800 persons, in drawing off the juice. In the neighbourhood of Panama about 2,000 persons are so employed.

SOME official correspondence relating to the conservation of the Government forests in Ceylon has been published in Colombo, from which we learn that a good deal of Satin Wood (*Chloroxylon swietenia*), Calamander (*Diospyros quæsita*), and Ebony (*Diospyros ebenum*), exists in the forests, and that the system of felling trees by the natives for firewood and other uses, though illegal, is still carried on to some extent, many of the natives being quite ignorant of forest reservation, while others are such adepts at stealing that the forest officers are not sufficiently numerous to prevent it.

COL. PLAYFAIR, the Consul-General of Algeria, reports that the cultivation of the vine in that country is becoming yearly of greater importance, the advance in the prices of wine in France having given a greater impetus to its cultivation in Algeria. The Sahel, which comprises an area of 125,000 acres, is specially suited to the vine culture, and it is anticipated that this space will some day be nearly covered with the plant. At the time of writing the report, Consul Playfair says, the Phylloxera had not reached Algeria, and the importation of vine-cuttings from any part of Europe was rigorously prohibited.

MR. J. M. WILSON, of Rugby, writes (Jan. 29), with reference to Antares :—

"The subjoined measures may interest the readers of the astronomical column in NATURE, vol. xi. p. 249. I will measure it again soon :—

Position.	Distance.	Date.
268·7	3·46	73·42

THE additions to the Zoological Society's Gardens during the past week include a Clouded Tiger (*Felis macrocelis*) from Burmah, purchased; an Azara's Fox (*Canis azaræ*) from South America, presented by Mr. J. Williamson; a Common Paradoxure (*Paradoxurus typus*), a Bonnet Monkey (*Macacus radiatus*), and a Macaque Monkey (*M. cynomolgus*), all from India, presented by Mr. D. D. Abbott, Miss S. Melley, and Mr. F. G. Lane respectively.

DETERMINATION OF THE VELOCITY OF LIGHT AND OF THE SUN'S PARALLAX*

I HAD the honour to submit to the Academy various improvements relating to the method devised in 1849 by M. Fizeau for the direct determination of the velocity of light. These improvements, tried upon a moderate distance (10,310 metres between the Ecole Polytechnique and Mont Valérien, $V =$ 298,500 kilometres, probable error below 0·01), entirely succeeded, and permitted me to affirm that the improved method was capable of giving results of great precision under the conditions of operating at a greater and better determined distance and employing more powerful apparatus.

The preparations of the expedition for observing the Transit of Venus drew the attention of astronomers to the utility of a precise determination of the velocity of light, for this velocity combined with certain astronomical constants allows the calculation of the sun's parallax, of which the direct observation demands such laborious voyages and the devotion of many astronomers. Thus, at the suggestion of M. Le Verrier, director of the Paris Observatory, and of M. Fizeau, member of the Council, the Council of the Observatory decided at the commencement of 1874 that a determination of the velocity of light should be undertaken without neglecting anything that could give to the operation all the desirable precision.

The Council did me the honour of confiding to me this important operation. Much honoured by and very happy at this decision, I should nevertheless have hesitated to accept so grave a responsibility had I not been strongly encouraged by M. Fizeau, who has not ceased during the whole duration of the labour to offer me the most liberal and precious advice.

After a searching examination of various stations I adopted the Observatory and the tower of Montlhéry, distant about 23 kilometres. I was guided in this choice by the consideration

* Translated from a paper read by M. A. Cornu before the Paris Academy of Sciences.

that the value of the distance of these two points is beyond the pale of all discussion. In fact, their position has been determined or verified by the most eminent observers, especially on the occasion of great geodesic works and of the measure of the velocity of sound undertaken by the Academy in the last century, at the time of the meridian operations, of the determination of the metre, of the map of France, and of the new measure of the velocity of sound made by the Bureau des Longitudes. These two stations are thus in a manner classic, and are bound up with the most glorious memories in the history of French science.

The experiment was installed in conditions worthy of the importance of the problem to be solved. The emission telescope has not less than 8·85 metres focal distance, and 0·37 m. aperture. The mechanism of the toothed wheel permits a velocity of the latter exceeding 1,600 revolutions per second; the chronograph and electric recorder ensure the measurement of time to the thousandth of a second. M. Breguet, to whom the construction of these pieces of mechanism had been confided, has brought to bear upon their execution that devoted co-operation which he has always given to all the operations with which his name is associated.

All the apparatus is firmly fixed on the superior terrace of the Observatory; an electric communication, establishing the correspondence of the chronograph with the beatings of the pendulum of the meridian chamber, fixes the unit of time with the greatest precision. At the opposite station, on the summit of the Montlhéry tower, there is but a reflecting collimator, of which the objective is 0·15 m. in aperture and 2 m. focal distance; it is surrounded by a large cast-iron pipe, fixed into the wall, in order to secure it from the curiosity of visitors.

The description of the apparatus and of the method of observation will form the subjects of a detailed memoir. I will only recall now the principle of the method. A beam of light is sent across the teeth of the moving wheel, which beam is reflected from the opposite station. The luminous point which results from the return of the rays appears fixed, notwithstanding the interruptions of the beam, owing to the persistence of the impressions upon the retina. The experiment consists in ascertaining the velocity of the toothed wheel, which extinguishes this *luminous echo*. Extinction occurs when, in the time necessary for the light to traverse double the distance of the stations, the wheel has substituted a tooth for the *interval* between two teeth which permitted the passage of the light at starting, so that the extinction of the order n corresponds to the passage of $2n-1$ semi-teeth during this short space of time. The law of the motion of the mechanism which moves the toothed wheel inscribes itself on a smoked cylinder, and the observer, by an electric signal, records the precise moment when the necessary velocity is attained.

The observations are thus preserved as tracings, which I have the honour to submit to the inspection of the Academy.

The following is a summary of the results obtained from 504 experiments, which I have sought to vary by diversity of wheels, by the number and form of the teeth, as well as by the magnitude and direction of the rotation. These results represent the velocity of light in air expressed in kilometres per second of mean time; they are arranged according to the order n of the extinction which determined them; the number accompanying them represents their *relative weights*, that is, the product of the number of observations into the factor $2n-1$.

	$n=4$	$n=5$	$n=6$	$n=7$	$n=8$
V	300,130	300,530	300,750	300,820	299,940
$k \times (2n-1)$ ...	15 × 7	33 × 9	20 × 11	10 × 13	7 × 15
	$n=9$	$n=10$	$n=11$	$n=12$	$n=13$
V	300,550	300,640	300,350	300,500	300,340
$k \times (2n-1)$ ...	94 × 17	69 × 19	72 × 21	3 × 23	4 × 25
	$n=14$	$n=15$	$n=16$	$n=17$	$n=18$
V	300,350	300,290	300,620	300,000	300,150
$k \times (2n-1)$ ...	9 × 27	65 × 29	4 × 31	22 × 33	35 × 35
	$n=19$	$n=20$	$n=21$		
V	299,550	,,	300,060		
$k \times (2n-1)$ ...	6 × 37	,,	36 × 41		

The agreement of these numbers is as close as can be desired in experiments of such difficulty, and which the least undulation of the atmosphere can hinder; it is true that I always awaited a purity and exceptional calmness of the atmosphere to make these measurements, my patience being thereat much tried, but owing to this precaution the series have always been very regular. It is necessary to add, that in no case can atmospheric disturbances be the cause of systematic errors, for their occurrence is always fortuitous, and on the mean of a large number of observations their influence is *nil*.

The experiments were made at night by means of the Drummond light, with the exception of the series of the fifteenth order, which, by an exceptionally favourable meteorological circumstance, were able to be performed by day with sunlight. Notwithstanding the difference in the nature of the luminous source, the result does not deviate from the mean.

The mean of all these values, having regard to the importance of each group, is equal to 300,330, which, multiplied by the mean refractive index of air (1·0003), gives as definite result the velocity of light *in vacuo*, V = 300,400 kilometres per second of mean time,* with a probable error below one-thousandth in relative value.

From this the solar parallax is deduced in two different manners.

1. *From the equation of light.*—It is thus that was designated in the last century the time θ which the sun's light takes to traverse the mean radius R of the terrestrial orbit. The reduction of more than a thousand eclipses of Jupiter's satellites gave Delambre $\theta = 473{\cdot}2$ mean seconds. Calling ϵ the parallax of the sun and ρ the equatorial radius of the earth ($\rho = 6378{\cdot}233$ km.), we have obviously $R = V\theta$, $\rho = R \tan r$, whence $\tan \epsilon = \frac{\rho}{V\theta}$ and $\epsilon = 8''{\cdot}878$.

2. *From the aberration of light.*—Bradley, who discovered this phenomenon, found for the annual semi-elongation α of an ideal star situated at the pole of the ecliptic (elongation due to the composition of the mean velocity u of the earth in its orbit with the velocity of light V), the value $\alpha = 20''{\cdot}25$. According to W. Struve this number ought to be increased to $20''{\cdot}445$. The equation of condition, designating by T the duration in mean seconds of the sidereal year ($T = 365{\cdot}26 \times 86400$), will be:—

$$\tan \alpha = \frac{u}{V} = \frac{2\pi R}{VT} = \frac{2\pi\rho}{VT \tan \epsilon}$$

whence

$$\tan \epsilon = \frac{2\pi\rho}{VT \tan \alpha}.$$

By substituting $\alpha = 20''{\cdot}25$ we deduce $\epsilon = 8''{\cdot}881$; with $20''{\cdot}445$ we get $8''{\cdot}797$. The agreement of the two methods is complete if we adopt Bradley's number.

I will recall the fact that Foucault had, by the method of a revolving mirror, found for the velocity of light the number 298,000 km., but with an indeterminate approximation, and by combining this value with Struve's constant he concluded $8''{\cdot}86$ to be the value of the solar parallax.

The study of the planetary perturbations leads to a value for the solar parallax which still further increases the interest of this agreement. I will specially cite the profound study of the perturbations of the motions of Venus and Mars made by M. Le Verrier, and which has led to the following numbers: $\epsilon = 8''{\cdot}853$ by the consideration of the latitudes of Venus at the moments of the transits of 1761 and 1769; $\epsilon = 8''{\cdot}859$ by the discussion of the meridian observations of Venus in an interval of 106 years; finally, $\epsilon = 8''{\cdot}866$ deduced from the occultation of ψ Aquarii, observed by Richer, Picard, and Rœmer on the 1st of October, 1672; the mean of these values gives $8''{\cdot}86$.

To summarise, the methods which serve in astronomy to determine the parallax of the sun can be classed into three groups:—

1. *Physical methods*, founded on the observation of an optical phenomenon; they comprise the observation of the eclipses of Jupiter's satellites, or the aberration of the fixed stars, combined with the value for the velocity of light deduced without the intervention of other astronomical phenomena; the present work permits us to profit by the observations which are the basis of the method: the results are, $\epsilon = 8''{\cdot}88$, $8''{\cdot}88$, $8''{\cdot}80$. Mean, $8''{\cdot}85$.

2. *Analytical methods*, which depend on the comparison of astronomical observations with theoretical laws founded on the principle of universal gravitation: they give, as we have just seen, values near $8''{\cdot}86$.

3. *Purely geometrical methods*, depending on the parallactic displacements of the planets near the earth: the oppositions of Mars furnished, in 1862, $\epsilon = 8''{\cdot}84$. But the transit of Venus across the sun is the phenomenon in which the geometrical method can attain the greatest precision.

* The velocity in English miles per mean second will be 186,700.

Thus we see what interest there is for astronomy to determine the parallax of the sun by three independent methods; I trust that the experiments that I have the honour to submit to the Academy will justify, by their precision, the theoretical importance of the physical method. R. M.

*ON THE MUSCULAR MECHANICAL WORK DONE BEFORE EXHAUSTION**

II.

ONE of the principal sources of error in the series of experiments before discussed, was the fatigue caused by the downward-plunging weight. To eliminate this, the apparatus shown in vertical section in Figs. 1 and 2 was constructed. The shelf *o*, armed with a plate of car-spring caoutchouc, serves as a support for the weight. This shelf is fastened by the iron bands, *I*, and a vertical backpiece, *B*, to the slide, *u*, being further supported by a crosspiece. By suitable blocks, *a*, the slide may be raised to any desired height, which height is read off on a scale marked on the upright pieces, *A*. *s* is a support for the arm during the interval of rest, and it can be adjusted to any desired height; *W* is a wire, from which a small cord, *b*, passes horizontally to the wall of the room. By some modifications this cord can also be made movable, which will become necessary when I come to investigate the influence of elevation of the arm, upon the work done. The weight is a bucket of shot, provided with a stiff bail and a wooden handle, so that for any position of the arm while lifting the weight, the line passing through the centre of the hand and the centre of gravity of the weight is a vertical. Placing the bucket upon the shelf *o*, the experimenter stands to

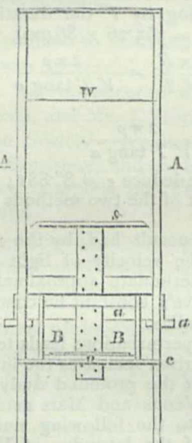


FIG. 1.

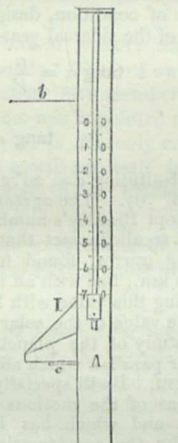


FIG. 2.

the right of the apparatus (as in Fig. 2), and lifts the weight until his knuckles touch the cord *b*. The instant of beginning and close of this interval of work is marked by the sharp click of a metronome, the time of whose beat is *t*. At the instant when the knuckles touch the string, the weight is grasped by an assistant, † and by him lowered to the shelf *o*, the arm of the experimenter being entirely relaxed, and resting upon the stift bail of the bucket and the support *s*. ‡ This is continued until the arm becomes unable to lift the weight to the required height. The determination of the number of lifts should *never* be made by the experimenter, who should furthermore try to lose all estimate of time during the process. In the earlier experiments it became evident that the arm not only grew gradually stronger, but also that it varied greatly from day to day. In order to get some measure of the strength, the arm was exhausted on each day of experiment, by a constant weight (5·0 kilos.) lifted through a height h = 0·70 metres in a time τ = 1·25 sec. The values of n were all reduced to the mean strength, as shown by the constant experiment.

In the series here given, w was variable, h = 0·70 metres, and τ = 1·25 sec., the interval of rest being equal to the interval of work. The mean value of n for the constant experiment for the weights w = 3·0, 3·5, 4·0, &c.—7·5, in all 100 experiments, is 35·79. Taking these values, c, as the measure of the strength, and assuming that the work done with any weight at different times is proportional to the strength,* and we have—calling n' the number of lifts before exhaustion, and n the number reduced to the basis of the mean constant (35·79)—

$$n = \frac{35 \cdot 79}{c}\, n'$$

from which we have the following values of n, which hereafter we shall call n (obs.) Each of these values is a mean of ten independent determinations.

TABLE II.

w	n (obs.)	n (calc.)	$d\,n$	e
2·50	283	242	−14·4	7·5
3·00	152·5	150·3	− 1·4	3·7
3·50	95·8	99·4	+ 3·6	3·6
4·00	67·2	69·2	+ 2·9	2·9
4·50	51·2	50·1	− 2·1	3·3
5·00	36·9	37·4	+ 1·3	2·4
5·50	28·6	28·7	+ 0·3	2·0
6·00	22·7	22·5	− 0·9	1·3
6·50	18·1	18·0	− 0·5	1·1
7·00	14·5	14·6	+ 0·7	0·7
7·50	10·4	11·9	+14·4	0·9
8·00	7·7	9·9	+28·5	5·2

The determination of n for w = 7·5 and 8·0 was consciously bad, as the arm was unable to manage such weights at such a

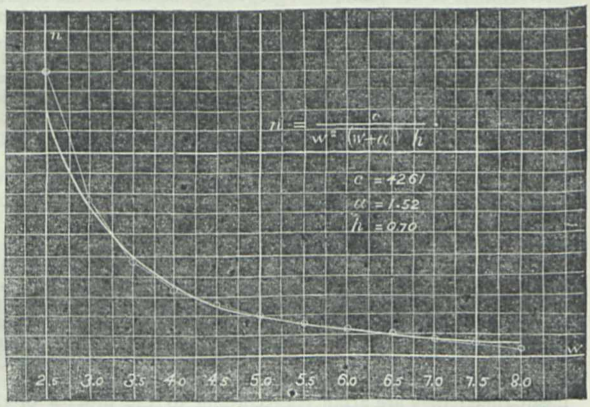


FIG. 3.

velocity, so that I was obliged to stop *before the arm was exhausted*.† The values of n for w less than 3·0 were also dropped in the final calculation, as with such light weights the work is found to vary greatly with a slight variation of strength.

Assuming the arm to be a uniform cylinder, and denoting by α one half the weight of the arm, and we have as the dynamical work done before exhaustion—

$$W = (w + \alpha)\, h\, n \qquad (6).$$

The value of α can be determined directly by means of a spring-balance. Exhaust the arm thoroughly, then grasp the hook of the spring-balance, the dial of which should be turned from the face of the experimenter, the reading being done by an assistant. After several minutes the muscles tire, and the practised experimenter can then gradually relax them fully. Untrained muscles, when thus tried, act involuntarily, and precise

* Continued from p. 257.

† I am under many obligations to friends, among whom I may mention Mr. W. C. Preston and Mr. D. A. Myers, for aid in this very laborious work.

‡ The arm is raised in the plane which make an angle of 45° with the vertical plane passing through the centres of the shoulder-joints.

* This is only approximately true, but is accurate enough for our purpose. We shall develop this point further on.

† This is a highly important point. Try to lift 20 kilos. in a second of time through 0·7 metres. You will fail to lift it once, and *yet not be exhausted*. The problem of maximum velocity attainable with different weights, is wholly different from the one under consideration. I think Mr. Haughton has overlooked this influence on his own experiments.

results cannot be obtained. The mean of ten determinations gave, for my right arm, $a = 1{\cdot}50$ kgr. The mean of twenty determinations likewise gave $a = 1{\cdot}50$ kgr., with a probable error of 0·01 kgr. Calculating from (6) the values of W for the different values of w, and co-ordinating these two quantities, and it is plain that the function is hyperbolic. It was found that W did not vary inversely as $(w + a)$, or as any power of this quantity.* The equation

$$(w + a)\,h\,n = \frac{c}{w^v} \qquad (7).$$

was then assumed, where c and v are constants to be determined. From this we readily have

$$\log.\,(w + 1{\cdot}5) + \log.\,n = k - v \log.\,w,$$

which is of the form

$$y = k - v.x,$$

where y and x can be calculated from the observations. Co-ordinating these values of y and x, and the curve is found to be linear, and we find v, as the change in y for each unit of change in x, to be 2·007. Hence Eq. (7) becomes

$$(w + a)\,h\,n = \frac{c}{w^2} \qquad (8).$$

Calculating now the values of a and c by the method of least squares, we find $c = 4261$ and $a = 1{\cdot}52$. The difference between a (calc.) and a (obs.) is only 1·3 per cent. of a(obs.) Solving (8) for n, and substituting the proper values, and we have n (calc.), as given in Table II. $d\,n$ is the difference in per cent. of n (obs.) Column e is the probable error of n (obs.), also in per cent. The comparison between n (calc.) and n (obs.) is shown graphically in Fig. 3, the observations being represented by the small circles.

Soon after arriving at Eq. (8), Prof. Haughton's book came to hand, containing his reduction resulting in Eq. (5). As already shown, this equation does not represent my later and more accurate observations. In order to test the matter still further, experimentally, the following experiments were made :—

1. I lifted my right arm from a vertical to a horizontal (h = 0·71 cm.), the experiments being conducted exactly as in the case of those given in Table II. The arm was lifted 2,000 times without feeling any appreciable exhaustion. According to (5), when $w = 0$, complete exhaustion should occur when $n = 1{,}000$. According to (8) it should occur when $n = \infty$.

2. A weight, $w = 0{\cdot}5$ kgr., was lifted in the same manner, and the arm allowed to drop with the weight during the interval of rest, as in case of my earlier experiments. It was thus lifted 1,500 times with very little exhaustion. According to (5) complete exhaustion should occur when $n = 400$. According to (8) n should be 12,000. This would make the total time of exhaustion 8 hours and 20 minutes. The total mechanical work would be 16,800 kgr. metres. The daily labour of a working man is about 100,000 kgr. metres. From estimates based upon this fact, and from the slight fatigue felt in the second experiment, I am convinced that my arm, at its mean strength, could work for $8\frac{1}{3}$ hours at the above rate, if the experiment were conducted as described above, care being taken to eliminate the fatigue caused by standing on the feet, &c. It would, however, be a highly dangerous experiment.

It will be remembered that each value of n (obs.) in Table II. is a mean of ten independent determinations. It occurred to me to co-ordinate the originally observed values of n with the daily determination of strength c. The result was most instructive. Each value of w gave a curve which is really parabolic, but which—since one of these curves ($w = 5{\cdot}0$) was taken as a unit in which to represent the others—appeared here as a straight line, or very nearly so, with exception of those which had been before rejected in calculating the constants. The reason for the great value of n for $w = 2{\cdot}5$ (Table II.) is thus apparent.

This at once opened up a new field—the relation of strength to work. In the investigations here the strength is determined by a spring balance, so arranged that the arm is held horizontally and the strain exerted upwards. Calling s the reading of the dynanometer, and the strength is $(w + a)$.† Co-ordinating, for the different weights used in Table II., the strength with the work done before exhaustion, and we have for each value of w a curve which is apparently parabolic, intersecting the axis of abscissæ (strength) at a point just inside the point where $s + a = w + a$.* As w diminishes, the curves increase in steepness with great rapidity. Eq. (8) shows the relation between the points on each of these curves, which correspond to my mean strength.

This opens up a way of estimating the statical work of a muscle, a problem which has been in view from the outset. We will take as the unit of statical work, the *kilogram-second*, or the work done by a muscle in sustaining for one second a strain of one kilo. exerted at right angles to its line of contraction. If now the same weights be used in exhausting the horizontally outstretched arm, we shall have by co-ordinating the work (in kgr.-sec.) with the strength, a system of curves as in the case of dynamical work. Accurate values of the constants for these curves have not yet been obtained, and we therefore will not discuss them further here. For each weight, co-ordinate the dynamical with the statical work, and it is readily seen that the relation between them can be made out, so that—given the total energy of a muscle in kgr.-sec. with any weight, and we can calculate the dynamical work in kgr-metres which this same muscle could do with this same weight. I intend to determine as accurately as possible the values of the constants in the cases heretofore discussed in these papers. I shall also thus investigate the effect of variation of the angle of elevation of the arm on the dynamical and statical work, including the case of statical work where the angle of elevation is zero : also the dynamical work, where the strain on the muscles is *continuous*, and (1) where the strain on the muscles (a weight) is constant, and the velocity of motion uniformly varied ; (2) where the velocity is constant, and the weight uniformly varied ; and (3) where both weight and velocity are constant. Making in this latter case, $v = o$, and we have the case of statical work. The apparatus necessary for this investigation has been already devised. FRANK E. NIPHER

* The equation $(w + a)\,h\,n = \frac{c}{(w + a)\,2{\cdot}63}$ will represent the observations, but it is a highly improbable relation

† $(s + a)$ is really the highest tension attainable by the muscle in exerting a uniformly accelerated force, with a uniform velocity through the space moved over by the hook of the dynanometer.

* My left arm is about five-sixths the strength of the right. Each varies greatly from day to day. Several other persons, the length of whose bones approximated my own, have been experimented upon. The co-ordinated values of work and strength are continuous with my own.

SCIENTIFIC SERIALS

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, Dec. 15.—To this number Dr. Prestel contributes an article on lines of cirrus as a means of foretelling storms. Storm signals he presumes to be inadequate for warning sailors of an approaching gale. He has compared during last year the indications of cirrous streaks with the weather shown by the charts to be prevalent on each day when his observations were made. From all the instances in which the streaks were well developed, he comes to the conclusion that the currents of the upper air do not follow the law of Buys Ballot ; that is, that in the region of cirrus the air has neither a cyclonic nor anticyclonic movement, but streams from the point of highest pressure in the area of high pressure to the point of lowest pressure in the area of low pressure.—Herr Köppen, having remarked the tendency of cyclones to follow closely upon one another, gives a table for Northern Russia of the intervals which most commonly separate them. Of 107 cyclones, occupying 393 days in the territory, 33 per cent. came in less than twenty-four hours after their predecessors ; 32 per cent. after an interval of one day ; 19 per cent. after two or three days ; 19 per cent. after four, five, or six days ; and 18 per cent. after seven, eight, nine, or ten days.—The observations of MM. Fautrat and Sartiaux, by which it appeared that more rain fell within than without the forest of Halatte, are objected to on account of the disturbing influence of wind, which blows less stongly at the one position, six metres above tree-tops, than at the other, fifteen metres above the plain.

Reale Istituto Lombardo. Rendiconti : vol. vii. fasc. ix., xi.—The first paper is On variations in the temperature of Milan, by Giovanni Celoria. Meteorological observations were commenced at the Observatory of Brera in 1763, and have been carried on without intermission, and show regular and irregular variations. The maximum temperature follows the culmination of the sun, and shows an oscillation in time of seventy minutes, being at 2h. 4m. in January and at 3h. 14m. in July. The minimum temperature in summer is eight minutes before the rising of the sun, and in winter forty-nine minutes before sunrise. This variation is less at Milan than elsewhere. The author follows Dove in dividing the year into seventy-three periods of five days each. There are two periods of medium temperature in the year, April 15 and 16, and October 18 ; 179 days are colder and 186 hotter than these. May shows no regular retrogression of temperature, as in northern countries, though it is more variable than other months, and there is no Martinmas summer in autumn; thus confirming the doctrine that the Alps divide Europe into two meteorological regions. There are also variations coincident with the periods of sun-spots. Thus, from 1763 to 1768, from 1812 to 1817, from 1829 to 1838, from 1855 to 1858, the annual temperature was lower than the average; while from 1769 to 1772, from 1778 to 1781, from 1790 to 1794, from 1796 to 1798, from 1824 to 1828, from 1861 to 1872, excluding the years 1864 and 1871, the temperature was constantly higher.—The next paper is by Prof. Gaetano Cantoni, On the direct assimilation of nitrogen from the atmosphere. Having compared the production of corn and clovers, the author concludes that the Leguminosæ can absorb nitrogen from the air, but that Graminæ have not this power.—Prof. Tullio Brugnatelli and Dr. Pelloggio publish the results of their examination of the mineral water of Monte Alleo. It is sulphurous, and will keep for months in sealed bottles, but ultimately develops Cryptococcus brumes. Its temperature is 13° C.; it smells like a saturated solution of sulphuric acid, but is not unpalatable. A litre gives a solid residue of 3·96 grains, chiefly formed of chloride of sodium and sulphates of magnesia and lime.—Prof. Leopoldo Maggi contributes a note On the distinctions introduced in spontaneous generation, and defines clearly and adopts the terms agenia, necrogenia, and xenogenia, introduced by Milne-Edwards, and suggests that agenia may be divided into inorganic and organic agenia. At the reading of this paper, Prof. Sangalli remarked that he found long Bacteria and Micrococcus in an ulceration in the throat, and the same organisms in a diseased stomach.—The next paper is by Prof. Achille de Giovanni: Clinical and anatomical observations concerning the pathology of the sympathetic system; in which his researches respecting the infiltration of the intercostal ganglia are continued. In a former paper he attributed the infiltration to the growth of numerous adventitious vessels, but in a section of a ganglion hardened in a solution of bichromate of potash the presence of a very fine connective tissue is easily seen to accompany the nerve-tubes and involve the ganglia, and in this he believes some deposits to take place. —The last paper in Part xi. is by Prof. Sayno, On a machine for drawing spirals, which he figures.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Jan. 21.—On the anatomy of the connective tissues, by G. Thin, M.D.

Transparent animal tissues, when sealed up fresh in aqueous humour or blood-serum, by running Brunswick black round the edge of the cover-glass, undergoes a series of slow changes, by which, mostly within a period of two to five days, anatomical elements otherwise invisible become distinct. The paper is chiefly a record of observations made by this method. The author describes the results of its employment in the case of sections of the cornea, in which the stellate-branched cells are seen, after about twenty-four hours, to consist of masses of protoplasm, sharply defined. He has also similarly examined tendon neurilemma, fibrillary tissue, nerve-bundles, and muscular fibre; and compared the results with those arrived at by other methods of treatment.

Jan. 28.—On the atmospheric lines of the solar spectrum, illustrated by a map drawn on the same scale as that adopted by Kirchhoff, by J. H. N. Hennessey, F.R.A.S. Communicated by Prof. Stokes, Sec. R.S.

The spectroscopic observations described in this paper were made with instruments belonging to the Royal Society, and in accordance with certain suggestions which had been made to the author by a committee appointed in consequence of a letter of his to Sir Edward Sabine, president, dated 13th February, 1866. In view of his residence at a considerable height above the sea-level, and of the exceedingly clear atmosphere prevailing at some periods of the year, it was suggested that the locality was peculiarly favourable for a determination of the lines of the solar spectrum due to atmospheric absorption; and that for this purpose the solar spectrum when the sun was high should be compared with the spectrum at sunset, and any additional lines which might appear in the latter case should be noted with reference to Kirchhoff's map.

Accordingly the author set to work with the spectroscope first supplied to him, and in the autumns of 1868 and 1869 mapped the differences in question from the extreme red to D. These results appeared in the "Proceedings of the Royal Society" for June 16, 1870, and the map of the spectra, sun high and sun low, of the region in question forms Plate I. of the nineteenth volume.

The instrument first supplied to the author was found in practice to be of insufficient power to permit of ready identification of the lines seen in the spectrum of the sun when high with those represented in Kirchhoff's map; and a new spectroscope of greater power was supplied to him, which reached him at the end of the year 1871. Observations for a continuation of his map had in the mean time been taken with the old instrument in the autumns of 1870 and 1871, and the spectrum mapped from D to F, in continuation of the former map. But the new instrument proved so superior to the old, that the author determined to map the whole spectrum afresh from observations made with it, using the former maps merely as skeleton forms. The observations with the new instrument were carried on in the autumns of 1872 and 1873, and the map now presented is the result.

Observations were also made to ascertain whether any of the lines which came out when the sun is low, especially those which are also seen, but narrower and less conspicuous, when the sun is high, could be due, not to *specific* atmospheric absorption, but to the general weakening of the light, causing parts of the spectrum already weakened by *solar* absorption to appear dark when a *general* weakening of the light was superinduced, though they had appeared bright when the light was strong. For this purpose the spectrum of the sun when high, as seen in the usual way, was compared with the spectrum when the intensity was artificially reduced in various ways. The best comparison was obtained by taking advantage of a natural phenomenon. At Mussoorie, late in the autumn, a haze, visible at sunset, extends over the low country, and grows day by day in height, till it causes the sun virtually to set in haze while still 3° or more above the horizon, whereas in the clear season it is visible till it attains a depression of 1¼°. The result of the comparison was, that none of the additional lines were discovered to have any other origin than selective atmospheric absorption.

Royal Horticultural Society, Jan. 20.—Scientific Committee.—Dr. J. D. Hooker, C.B., Pres. R.S., in the chair.—The Rev. M. J. Berkeley exhibited specimens of vine stems with large burr-like excrescences, which he suggested might be due to the attacks of a fungus like *Exobasidium*.—Mr. Worthington Smith exhibited a drawing of the microscopical appearance of the swellings on cucumber roots, confirming the accuracy of the observation long since made by the Rev. M. J. Berkeley, which connected these swellings with the presence of nematoid worms —probably an undescribed species of *Tylenchus*.—Prof. Thiselton Dyer called attention to a communication made to the Entomological Society by Prof. Forel, in which there was evidence to show that the Phylloxera had been introduced into vineries belonging to Baron Rothschild in the commune of Pregny, in the canton of Geneva, from England. The Phylloxera was discovered in England in 1863 by Prof. Westwood.—Prof. Thiselton Dyer also called attention to the statement in the *Daily News* (Jan. 19), that the Imperial Chancellor had introduced at the sitting of the Federal Council at Berlin on Jan. 18, an ordinance "prohibiting the importation of potatoes and the refuse and packing materials of potatoes from the United States," the object being to prevent the Colorado beetle from being imported into Germany. It was stated that the English Government had refused to prohibit the entry of American potatoes, on the ground that "it does not appear that the eggs or larvæ of the beetle have been or are deposited in the tuber of the potato." Mr. Andrew Murray described from his own observation the ravages effected by the beetle in Canada. Mr. McLachlan remarked that the beetle seems to have first spread from Mexico.—Prof. Thiselton Dyer stated with reference to the fruiting of *Hibiscus rosa-sinensis*—which had been said on the authority of Dr. Cleghorn not to take place even in India—that ripe capsules had been obtained after artificial fertilisation at Mauldslie Castle, Carluke, N.B., in 1871 and 1872, and plants raised from the seeds.—Dr. Masters exhibited specimens from Mr. Corderoy, of Didcot, of mistletoe parasitic on itself.

General Meeting.—Mr. W. A. Lindsay in the chair.—The Rev. M. J. Berkeley commented on the objects exhibited.—Mr. Bull showed a fine collection of Cycadaceous plants.—Mr.

Parker sent specimens of *Aponogeton distachyon*, flowered in the open air at Tooting, in a pond supplied by a spring, the temperature of which never fell below freezing-point.

Anthropological Institute, Jan. 26.—Prof. Busk, F.R.S., president, in the chair.—Anniversary meeting.—In the Report for 1874, the Council stated that the Institute had been enabled through the liberality of its members to pay off the debt which had so long burdened it, and that one of the immediate advantages arising from its improved position would be the more regular issue of its *Journal*, which in future would contain varied anthropological news and notices in addition to its usual proceedings.—In his address, on his retiring from the presidency, Prof. Busk gave a summary of the chief works and memoirs on the many branches of anthropology that had appeared during the past year, especially referring to the labours of Prof. Owen, M. Mortillet, Dr. P. Broca, Dr. A. B. Meyer, Madame Royer, &c. ; and in conclusion, he drew attention to the comprehensive range of subjects contained in the proceedings of the Institute, and to the professed aim of the Council to exclude no subject that could possibly be embraced under the general term of Anthropology. The officers and Council to serve for 1875 were elected as follows :—President, Col. A. Lane Fox, F.S.A. Vice-Presidents : Prof. George Busk, F.R.S., John Evans, F.R.S., A. W. Franks, F.R.S., Francis Galton, F.R.S., George Harris, F.S.A., Sir John Lubbock, Bart., F.R.S. Directors : E. W. Brabrook, F.S.A., F. W. Rudler, F.G.S. Treasurer, Rev. Dunbar I. Heath, M.A. Council : J. Beddoe, M.D., F.R.S., W. Blackmore, H. G. Bohn, F.R.G.S., Hyde Clarke, J. Barnard Davis, M.D., F.R.S., W. Boyd Dawkins, F.R.S., Robert Dunn, F.R.C.S., David Forbes, F.R.S., Sir Duncan Gibb, Bart., M.D., Chas. Harrison, F.R.S.L., J. Park Harrison, M.A., Prof. T. McK. Hughes, F.G.S., T. J. Hutchinson, F.R.G.S., Prof. Huxley, F.R.S., F. G. H. Price, F.R.G.S., J. E. Price, F.S.A., C. R. Des Ruffières, F.R.S.L., Lord Arthur Russell, M.P., Rt. Hon. D. H. Stone, E. Burnet Tylor, F.R.S.

Medical Microscopical Society, Jan. 15.—Mr. Jabez Hogg, the retiring president, in the chair.—From the report of the committee it appeared that the society was in a flourishing condition, the number of members being 135. The number of papers read during the past year was sixteen, besides several minor communications, all of which were followed by brisk discussion. Above 100 specimens were exhibited during the year, and eighteen presented to the society. A present was also announced of a microscope for use in the *exchange* of specimens, a system which is found to work well and offers great facilities for obtaining a large collection of good preparations. The treasurer's report showed a balance of 15*l*. 10*s*. The following officers were elected : —President, Dr. J. F. Payne. Vice-Presidents : Mr. Jabez Hogg, Mr. W. B. Kesteven, Mr. H. Power, Dr. U. Pritchard. Treasurer, Mr. T. C. White. Hon. Secretaries : Mr. C. H. Golding Bird, Mr. J. W. Groves. Committee :—St. Bartholomew's, Mr. J. A. Omerod ; Charing Cross, Dr. M. Bruce ; St. George's, Mr. E. C. Baber ; Guy's, Mr. F. Durham ; King's, Mr. H. S. Atkinson ; London, Mr. J. Needham ; St. Mary's, Mr. George Giles ; Middlesex, Dr. S. Coupland ; St. Thomas', Dr. W. S. Greenfield ; University College, Mr. E. A. Schäfer ; Westminster, Dr. W. H. Allchin ; General Profession, Dr. Foulerton. The retiring president then read an address.

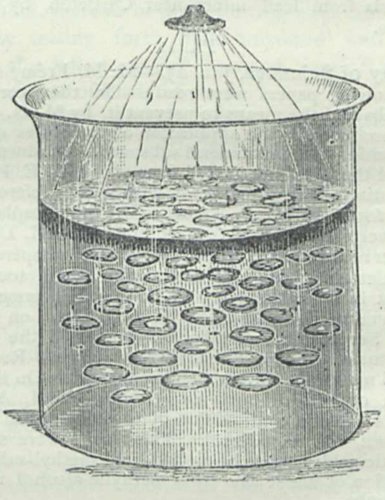
Dublin

Royal Irish Academy, Dec. 14.—William Stokes, F.R.S., president, in the chair.—Dr. S. Ferguson, vice-president, read a paper on further Ogham texts from Monataggart, County Cork. —Mr. W. Archer read a paper descriptive of the apothecia and spores found by him in two species of *Scytonema* and two of *Sirosiphon*, and one of *Stigonema*, all of them specifically different from any of the few similar cases hitherto recorded.—Mr. R. C. Tichborne read a paper entitled "Laboratory Notes :" On the solution of alloys and metals by acids ; on fluorescence as a means of detecting adulteration ; on the printing inks of the 16th and 17th centuries.—Mr. G. R. Leeper read a paper on retro-peritoneal cavities in man.

Manchester

Literary and Philosophical Society, Dec. 29, 1874.—Mr. E. W. Binney, F.R.S., vice-president, in the chair.—On a case of reversed chemical action, by Mr. James Bottomley, B.Sc. Having observed the solubility of iodine in a solution of borax, an experiment was made to see what the result of this solution would be, expecting to obtain a combination of soda with excess of acid. 27·8475 grms. of borax were dissolved in about 250 grms. of water. The iodine was added at hazard, the quantity used being nearly seven grms. When assisted by heat, almost the whole of this quantity dissolved in the solution. The solution, which amounted to about 200 cc., had only a faint yellowish tint. Being set aside for some days, it deposited crystals which proved to be ordinary borax, for 0·5932 grms. of the crystals lost by heating 0·2773 grms. of water of crystallisation, corresponding to 46·75 per cent., the theoretical quantity being 47·13. After removing the crystals the solution was still further evaporated in a retort. As the evaporation proceeded, instead of the faint yellow tinge disappearing as was anticipated, the colour of the solution began to darken, finally becoming opaque owing to the quantity of free iodine in solution ; vapours of iodine were also given off along with the steam. Thus the iodine which had previously dissolved and chemically united with the soda when the solution was dilute, was displaced and eliminated in the free condition when the mixture was past a certain degree of dilution. The explanation of this reversal of chemical action is as follows. When sodic borate is diluted with water, its constituents are so far dissociated that the iodine acts towards the soda in the same way as it would towards caustic soda, sodium iodide and sodium iodate being the result. When, however, the solution is concentrated, the boracic acid, notwithstanding its feebly acid powe, is able to displace continuously and simultaneously small quantities of iodic and hydroidoic acid from combination with sodium, but these two acids cannot coexist in the free state ; by mutual reaction they give iodine and water.

Jan. 12.—Mr. R. Angus Smith, F.R.S., vice-president, in the chair.—On the action of rain to calm the sea, by Prof. Osborne Reynolds, M.A. There appears to be a very general belief amongst sailors that rain tends to calm the sea, or, as I have often heard it expressed, that rain soon knocks down the sea. Without attaching very much weight to this general impression, my object in this paper is to point out an effect of rain on falling into water which I believe has not been hitherto noticed, and which would certainly tend to destroy any wave motion there might be in the water. When a drop of rain falls on to water the splash or rebound is visible enough, as are also the waves which diverge from the point of contact ; but the effect caused



by the drop under the surface is not apparent, because, the water being all of the same colour, there is nothing to show the interchange of place which may be going on. There is, however, a very considerable effect produced. If instead of a drop of rain we let fall a drop of coloured water, or, better still, if we colour the topmost layer of the water, this effect becomes apparent. We then see that each drop sends down one or more masses of coloured water in the form of vortex rings. These rings descend with a gradually diminishing velocity and with increasing size to a distance of several inches, generally as much as eighteen, below the surface. Each drop sends in general more than one ring, but the first ring is much more definite and descends much quicker than those which follow it. If the surface of the water be not coloured this first ring is hardly apparent, for it appears to contain very little of the water of the drop which causes it. The actual size of these rings depends on the size and speed of the drops. They steadily increase as they descend, and before they stop they have generally attained a diameter of from one to two inches, or even more. The cut on p. 279 shows the effect which may be produced in a glass vessel. It is not that the drop merely forces itself down under the surface, but in descending carries down with it a mass of water which when the ring is 1 inch in diameter would be an oblate spheroid having a larger axis of 2 inches and a lesser of about 1½ inches. For it is well known that the vortex ring is merely the core of the mass of fluid which accompanies it, the shape of which is much the same as that which would be formed by winding string through and through a curtain ring until it was full. It is probable that the momentum of these rings corresponds very nearly with that of the drops before impact, so that when rain is falling on to water there is as much motion immediately beneath the surface as above it, only the drops, so to speak, are much larger and their motion is slower. Besides the splash, therefore, and surface effect which the drops produce, they cause the water at the surface rapidly to change places with that at some distance below. Such a transposition of water from one place to another must tend to destroy wave motion. This may be seen as follows. Imagine a layer of water adjacent to the surface and a few inches thick to be flowing in any direction over the lower water, which is to be supposed at rest. The effect of a drop would be to knock some of the moving water into that which is at rest, and a corresponding quantity of water would have to rise up into the moving layer, so that the upper layer would lose its motion by communicating it to the water below. Now, when the surface of water is disturbed by waves, besides the vertical motion the particles move backwards and forwards in a horizontal direction, and this motion diminishes as we proceed downwards from the surface. Therefore in this case the effect of rain-drops will be the same as in the case considered above, namely, to convey the motion which belongs to the water at the surface down into the lower water where it has no effect so far as the waves are concerned, and hence the rain would diminish the motion at the surface, which is essential to the continuance of the waves, and thus destroy the waves.—On the stone mining tools from Alderley Edge, by Prof. W. Boyd Dawkins, F.R.S.—Archaic iron mining tools from lead mines near Castleton, by Mr. Rooke Pennington.

PARIS

Academy of Sciences, Jan. 25.—M. M. Frémy in the chair.—The following papers were read:—On the decrease of the upper Doubs and the means to prevent it, by M. H. Resal.—On the effect produced by the application of armatures on magnets, by M. J. Jamin.—On the mineral substances contained in the juice of beet and the potash extracted from it, by M. E. Peligot.—On the fertilisation of the genus *Viola*, with special reference to *Viola tricolor hortensis*, by M. A. Trécul.—On the phosphorescence of Marine Invertebrata, by M. de Quatrefages.—M. Daubrée then read a letter received from H.M. Don Pedro, Emperor of Brazil, giving a description of an earthquake which took place on Oct. 30 last in the province of St. Paul.—The same gentleman then communicated a memoir by M. J. D. Dana, on the Pseudomorphs of Serpentine and other minerals from the mine Tilly-Foster, Putnam County, State of New York.—Researches on albuminoid matter, by M. P. Schützenberger.—On the action of electrolytic oxygen on methylic alcohol, by M. A. Renard; experiments made in continuation of those described on Jan. 11 (see NATURE, vol. xi. p. 240). The results were similar, producing acetic acid, acetate of methyl, and methyl-sulphuric acid. The formation of acetic acid from methylic alcohol is explained by the formulæ—

$$\left.\begin{matrix}CH_3\\H\end{matrix}\right\}O + 2O = 2H_2O + CO$$

$$CO + \left.\begin{matrix}CH_3\\H\end{matrix}\right\}O = \left.\begin{matrix}CH_3CO\\H\end{matrix}\right\}O$$

—On the flame of sulphur, and the different lights that can be utilised in photography, by MM. A. Riche and C. Bardy. The authors examined eight different flames, viz., the oxy-hydrogen light, Drummond's lime-light, zinc burning in oxygen, the magnesium flame, a current of nitric oxide gas burning in a globe containing bisulphide of carbon, a jet of nitric oxide gas on a test containing bisulphide of carbon, a jet of oxygen on the same, and a jet of oxygen on a test containing sulphur. The eight lights showed their photographic power in the order mentioned, the last being eight times as strong as the first.—After some short mathematical notes, M. D. Lontin read a paper on his improvements of dynamo-electric machines.—A note by M. Lecareux, on the treatment of cholera.—A memoir by M. Anninos, on the direction of aërostats.—MM. Hemmerich, Bourquelot, Chaperon, Heyduck, and Robinson then made some communications on Phylloxera. The Minister for Agriculture and Commerce has placed more funds at the disposal of the Academy for the investigation of this subject.—A letter was then read, dated Noumea, Nov. 4, 1874, from MM. André and Angot, announcing their successful installation for the observation of the Transit of Venus.—The Minister for Foreign Affairs transmitted to the Academy documents received from the French Consul at Manilla, with reference to the same subject, and announcing the forwarding of ten photographic proofs taken during the transit.—A letter on the same subject from M. Héraud, dated Saigon, Dec. 18, giving a complete description of the observations and their results.—A letter from Mr. J. Norman Lockyer, describing the preparations for the expedition sent by the Royal Society of London to observe the total eclipse of the sun. The observations will be mainly confined to the spectra of the chromosphere and the coronal atmosphere, with the principal view to determine the chemical constitution of the latter.—On elimination; calculation of Sturm's functions by determinants, by M. Lemonnier.—A note on the partition of numbers, by Mr. Glaisher.—A note on the theory of surfaces, by M. Halphen.—On a formula of transformation of elliptic functions, by M. J. Brioschi.—A note by M. T. Schloesing, on atmospheric ammonia.—On the presence of copper in the organism, by MM. Bergeron and L'Hôte.—On the general phenomena of the embryogeny of Nemertida, by M. J. Barrois. M. de Quatrefages then made a few remarks on this paper.—On the organs of touch in man, by M. Jobert.—On the invasion of grasshoppers in Algeria (April—August, 1874), by M. Brocard.—On the electro-chemical resistance of aluminium when employed as a positive electrode of a voltameter, by M. Ducretet.—M. Chapelas then gave an account of barometrical observations he made in Paris during the gale on Jan. 21.—M. Mangot read a note on the causes of the rupture of axles, and generally of pieces of iron, that are subjected to repeated vibrations.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—The Native Races of the Pacific States of North America: Hubert Howe Bancroft (Longmans).—Assyrian Discoveries: George Smith (Sampson Low and Marston).—Valleys, and their Relation to Fissures, Fractures, and Faults: C. H. Kinahan, M.R.I.A., F.R.G.S.I., &c. (Trübner).—Newcastle-upon-Tyne Chemical Society; On the Manufacture of Caustic Soda.—Bird Life, by Dr. A. E. Brehm. Translated by H. M. Labouchere, F.Z.S., and W. Jesse, C.M.Z.S. Parts 5 to 10 (John Van Voorst).—Logarithmic and Trigonometrical Tables for Approximate Calculation: J. T. Bottomley, M.A., F.R.S.E. (Wm. Collins).—Fragmentary Papers by the late Sir H. Holland: Rev. J. Holland (Longmans).—Outline of the Evolution-Philosophy, by Dr. M. E. Gazelles. Translated by the Rev. O. B. Frothingham, of New York (Trübner).—The History of India from the Earliest Ages. Vol. iii.: J. Talboys Wheeler (Trübner).—The Countess of Chinchon and the Chinchona Genus: Clements R. Markham, C.B., F.R.S. (Trübner).

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