Nature, October 25th 1877.

Sir Joseph Dalton Hooker

Engraved by C.H. Jeens from a Photograph

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NATURE

A WEEKLY

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

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THURSDAY, MAY 3, 1877

THE UNIVERSITIES BILL

VERY little light has been thrown on the future of Oxford and Cambridge by the discussions in the House of Commons last week and this week. Harassed as they are by the difficulties of the Eastern question, our legislators could not, perhaps, be expected to devote serious thought to the fortunes of higher education in England, but as Mr. Knatchbull-Hugessen said, the debate was "certainly more suited to the debating societies of Oxford and Cambridge than to the arena of the House of Commons." Lord F. Hervey, who opened it, had little weightier to remark than that Mr. Grant Duff was "no doubt a very learned and superior person," and Mr. Grant Duff's chief contribution was the venerable witticism that Lord F. Hervey ought to be carried round the country by himself and other advanced reformers, as "the shocking example" of the results of the present system. Mr. Trevelyan delighted the House and the country by the amusing patriotic statement that "It would not be possible to find in any European University forty mathematicians equal to the Wranglers in the Cambridge Mathematical Tripos, or twenty classical scholars to compare with those who stood first in the Classical Tripos at Cambridge or in the School of *Literæ Humaniores* at Oxford;" and with an equally cheerful indifference to the facts Mr. Lowe replied that the teaching of the Universities was "simply disgraceful." When we add that there was much dispute whether the glories of Lord Macaulay, who was not "a resident fellow of Trinity College, Cambridge," should be credited to that University, and that Sir William Harcourt was delighted to hear that an overworked judge like Sir Alexander Cockburn could find time, in spite of his work, to undertake the arduous office of chairman, which would require the "constant and daily attention of one having entire and absolute leisure," we sum up most of what was interesting and novel in the discussion before going into Committee.

On two questions, however, which are of speculative importance, much incidental light was thrown. The Bill gives large enabling powers to the Commissioners, and although, as "An Oxford Man" pointed out in NATURE (vol. xv., p. 391), it is very doubtful whether large reforms can be effected even on the initiative of a strong-willed and clear-headed Commission; it is perfectly certain that little or nothing can be done if the Commissioners are feeble and without origination. In their preparation of schemes for each of the forty colleges they are to be associated with three residents from the college itself, and it is only from the colleges that they can get money to effect any reforms. It is important therefore to understand what are the views of the Government with regard to the reforms which are practical or possible, because it is to advance these views that the Commissions have been selected. Afterwards, everything depends on the Commissioners themselves, on the spirit in which they have undertaken their task, and on the diligence, ability, and discretion with which they are likely to execute it.

The Opposition offered no formal objection to any of the names proposed by the Government, but they suggested the addition of three names to the Oxford and of two names to the Cambridge list. For Oxford they proposed Prof. Bartholomew Price, Prof. Huxley, and Prof. Max Müller, and for Cambridge Dr. Bateson, the master of St. John's College, and Dr. Hooker, the president of the Royal Society. The addition of these names would have greatly strengthened the Commissions, and those who are anxious to see the Universities question treated in a generous spirit and with a wide knowledge of the subject might have been reasonably hopeful of good results. To our mind it is a fatal objection to the Commissioners as they stand that they include no members who are not alumni of the Universities on which they are to sit. Prof. Huxley and Dr. Hooker would have been of the utmost service, because they would have approached University questions from the point of view of men whose lives have been spent outside the Universities. It is certainly important for the Commissioners to have a practical acquaintance with working details, but that would surely have been sufficiently guaranteed by the presence of nine University men on each Commission even though one outsider had been added to each. Prof. Huxley has sat on the Scotch Universities Commission, and has had the largest experience of teaching at unrestricted institutions like the School of Mines and South Kensington. Dr.

Hooker and he would have strengthened the hands of those who wish to see science represented in our higher education, and the addition of their names would certainly not have upset the balance of the Commission, as Prof. Price, Dr. Bateson, and Prof. Max Müller, would have adequately maintained the interests of the older studies. Surely, when we are setting about the reform of our universities, we want all available information about the systems of foreign countries, and Prof. Max Müller could have told the Commissioners many things they have not learnt from their own experience of Oxford and Cambridge. The refusal of the Government to add any names to the original list was an unfortunate sign of the spirit in which they have framed it, and of the attitude in which the Commissioners will face the problems before them. Ministers were successful, but their majorities were so small as to show that the sense of the few members who will not consent as partisans to vote on such questions was decidedly against them. They carried their point by 11, 34, 24, 26, 32 votes on the successive divisions. After their success nobody will care much what becomes of a bill which is meant to change as little as possible, when every crevice that could let in light from the outside world is carefully stopped against it.

The speech of the Secretary of War, who is Member for the University of Oxford, and the general tone of the debate, clearly confirm these anticipations. There will be a slight restriction of the "prize fellowships," the new Government name for the "idle fellowships" of Lord Salisbury. There will not be a great extension of the professoriate, provision even having been made for the amalgamation of several professorships into one. Some money—5 per cent. from some colleges, 10 per cent. from others, nothing perhaps from a third class—will be taken from the colleges for university purposes. There is a provision "for the extension, not for the suppression," of scholarships. Only the superfluities of the colleges are to go to the University, and Mr. Hardy has never had but one opinion on "what some people called the endowment of research." He did not state that opinion so frankly as Mr. Trevelyan, but there was little doubt from the tone of his remarks that it was substantially the same :—

"It was a mistake, therefore, to assume that we could create in men such qualities by merely endowing old men, and in his opinion it would be better to throw the funds of the Universities into the sea rather than to bestow them in the manner which had been proposed. The people whose prayers the House should listen to were the practical teachers of the University, who were bound to celibacy, and who asked them to make their career a better one, to give them a reasonable income, and to allow them to marry without being compelled to resign their positions. These gentlemen would have six months in the year, which they would be able to devote to the pursuit of science and literature. What they had to do was to find men for the places, and not places for the men. He begged them to consider well before they created a sort of hierarchy of sinecures and semi-sinecures which unless human nature was radically altered by this Bill would only lead to academical jobbery and intellectual stagnation."

No doubt the wholesale conversion of the fellowships of residents and, for that matter, of non-residents into professorships, created in a doctrinaire spirit, and apart from the gradual development of literature and science, would be recklessness and folly. Nobody in his senses wants such a thing. The real note of despair in the whole debate is that Oxford and Cambridge wish to be let alone, and Oxford and Cambridge men in the House are determined that they shall be let alone to consider every question as it comes up from the mere local point of view of Oxford and Cambridge. The jealous exclusion of outsiders is the surest proof of the intention of the framers of the bill and the clearest prophecy of its issues.

The Committee made no real alterations in the bill. There was a desperate attempt to maim it by striking out even the possibility of endowments for research. It was resisted and defeated by an overwhelming majority. Mr. Hardy said "the noble lord and the hon. gentleman seemed to be under the apprehension that if research were brought into the University education would be driven out. On the contrary, he held that no teaching could be successful that was not founded on the most minute research. There were, no doubt, many subjects of research which by their nature were not lucrative to those who prosecuted them but the prosecution of which was of great importance to education throughout the country, and especially to the University in which they were carried on. There was, however, no intention to carry research to the extravagant lengths which some speakers and writers feared would be the case, and which would utterly pervert the purposes of the University. So far from diminishing the educational power of the University, that which was proposed would give to education a more solid basis than it now possessed." Mr. Trevelyan accepted Mr. Hardy's statement as "in all respects satisfactory," and added a remark none the less valuable that it is almost a truism, "They could not have a University where education was proceeding without research proceeding at the same time." The Commissions will thus be left at liberty to use the funds they can detach from the Colleges for the endowment of research. But "Researchers," as Prof. Sylvester calls them, will not for many years to come, grow very fat on the good things of Oxford and Cambridge.

DEEP WELL-BORINGS IN LONDON

THE constantly increasing wants of our English metropolis were very amply provided for during all the earlier stages of its history by the stores of water contained in the extensive beds of gravel lying within the Thames Valley. These stores of water could be reached by means of shallow wells, and all the ancient and famous pumps of our city drew their supplies from this source.

But, as the population of the district increased, the value of this source of water-supply became greatly impaired from two causes; firstly, the excessive drain upon it, caused by the rapid multiplication of wells; and secondly, the pollution of its waters by the refuse-matter of a great city.

Hence it became necessary to seek for new sources of water-supply, and the success which had already attended the construction of Artesian wells in the Tertiary districts of Northern France, led to attempts being made to obtain supplies in a similar manner by putting down borings through the impervious London Clay into the water-bearing beds of the Lower London Tertiaries.

For a time the quantity of water thus obtained, as at Merton, Garrett, and many other points, seem to have induced the belief that an inexhaustible source of the all-essential element had been discovered; but the rapid multiplication of these Artesian wells soon revealed the fact that the new and valuable stores had their limit, and that this limit was being very rapidly approached in consequence of the excessive demands which were now being made upon the new source of supply. The deepening of the wells, by which means water was drawn from the Chalk, as well as from the Tertiary strata, promised, however, to do something towards staving off the evil day when London would no longer be able to depend on drafts being honoured by her great subterranean bank.

Such was the state of the question when Mr. Prestwich, now the Professor of Geology in the University of Oxford, undertook its complete investigation as an important geological problem. No one more competent for the task could possibly have been found, for during many years Mr. Prestwich's studies had been devoted to the Tertiary deposits of the London and Hampshire basins; and his great work—"A Geological Inquiry respecting the Water-bearing Strata of the country around London, with Reference especially to the Water-supply of the Metropolis," which was published in 1851—is a masterpiece of minute observation and close and accurate reasoning.

More than this, the geologist points to the work with pardonable pride, as affording convincing proof that his science has now acquired a character for exactness, analogous to that which is justly regarded as the crowning attribute of astronomy. After a most elaborate study of the nature and relations of the various strata which crop out all round the London Basin and of the disturbances to which they have been subjected since their deposition, Mr. Prestwich ventured on a bold *prediction*, namely, that the Chalk beneath London would be found to have a thickness of 650 feet, the Upper Greensand of 40 feet, and the Gault of 150 feet. (*Op. cit.* p. 142.)

At the time when this announcement was made no well in London had been sunk to a greater depth than 300 feet in the Chalk, but now we can appeal to no less than four deep borings in the metropolis, which afford the most convincing proof of the reliability of the data, and the accuracy of the reasoning by which Mr. Prestwich arrived at his interesting results. For the sake of distinctness, we place the estimated and determined results side by side in a tabular form:—

Mr. Prestwich's Estimate.		Boring at Kentish Town.	Boring at Crossness.	Boring at Loughton.	Boring at Meux's Brewery.
Chalk	650	645	646	650	653
Upper Greensand	40	13½	12	40	28
Gault	150	130½	148	(?)	159

When it is remembered that the Chalk graduates downwards insensibly into the Upper Greensand, and that it is almost impossible to decide on their line of separation in the cores brought up by boring operations, it will be admitted on all hands that the agreement between the estimated and proved results is marvellously close.

One of the most important conclusions of Mr. Prestwich's work was that the strata below the Gault, the so-called "Lower Greensand," would in the future afford a most valuable underground source of water-supply to our overgrown city.

But in 1855 Mr. Godwin-Austen brought before the Geological Society of London his masterly essay "On the Possible Extension of the Coal-Measures beneath the South-Eastern Part of England," in which he announced the conclusion—based on a most elaborate study of the geological structure of the South of England and the adjoining portions of the Continent of Europe—that an old ridge of Palæozoic rocks underlies the line of the Thames Valley, and is only concealed from us by the Upper Cretaceous strata.

Mr. Godwin-Austen's announcement was as strikingly verified as was that of Mr. Prestwich; for, in the same year that it was made, a boring at Kentish Town which passed through the Gault, reached a curious series of red rocks which are now believed by geologists to be either a portion of the old Palæozoic ridge itself, or a set of littoral deposits formed upon its flanks. And in 1857 the deep boring at Harwich afforded still more unmistakable evidence of the existence of this old Palæozoic ridge in the fact that black slaty rocks were found immediately below the Gault clay.

Although the old ridge of Palæozoic rocks must thus limit the area of the available water-bearing "Lower Greensand" beneath the metropolitan district, yet Prof. Prestwich has constantly argued that very large and valuable supplies of water will yet in all probability be obtained from the latter source.

Hence it is that the endeavour to tap this great subterranean reservoir, which is now being carried out in such an enterprising spirit by the Messrs. Meux and Co., in the Tottenham Court Road, is attracting so much attention from geologists and engineers. The nodular beds at the base of the Gault were reached at a depth of 999 feet from the surface, and some sixty feet of rock below has since been penetrated. The splendid cores brought up by the diamond-borer are at once submitted to Mr. Robert Etheridge, the palæontologist of the Geological Survey, who is carefully studying every trace of fossils which they exhibit. At present there are very strong grounds for believing that the "Lower Greensand" has been reached, and we soon hope to be able to announce that the new source of water supply, so long ago pointed out by Prof. Prestwich, has at last been made available for the ever-increasing necessities of this great city.

J. W. JUDD

LATHAM'S ENGLISH DICTIONARY

A Dictionary of the English Language. Abridged by the Editor from that of Dr. Samuel Johnson, as Edited by Robert Gordon Latham, M.A., M.D., &c. (London: Longmans and Co., 1876.)

WE consider ourselves justified in reviewing an English dictionary in these pages for two reasons; first, because the method of its construction ought to be rigidly scientific, and second, because a large proportion of the words in any modern English dictionary must necessarily be scientific terms.

It is admitted by all competent to pronounce an opinion that there is ample room for a new dictionary of the

English language; that when Dr. Latham undertook the task for which his attainments so well fit him, he had an excellent opportunity for doing a splendid service to our tongue and making for himself a lasting name. The only dictionaries that make any pretence to exhaustivenesss, Webster's, Worcester's, and the Imperial, with all their merits, come far short of what an ideal national dictionary should be, and they cannot for one moment be compared with Littré's *magnum opus*. Webster's etymology is extremely unsatisfactory and misleading in its method, the vocabulary is a conglomeration on no principle, and the definitions are too frequently unmethodical. We consider Worcester in some respects more satisfactory, more scientific in its method than Webster. The Imperial is rather a small encyclopædia than a dictionary, minute description frequently giving place to definition, and the vocabulary being much fuller than that of any existing dictionary. This feature, however, seems rather to be the result of a desire to crowd in as many words as possible than of any well-considered scientific plan. The etymology of the Imperial might almost have been written a century ago. Thus Dr. Latham had a splendid field before him, and Littré has shown what one man is capable of doing in the way of dictionary-making. We need not for the hundredth time contrast his work with the endless pottering of the French Academy. Perhaps it scarcely needs to be proved that in the construction of a dictionary, as in most other great undertakings, failure will surely be the result unless one competent man has the supreme command.

The work before us is an abridgment of Dr. Latham's larger work in four quarto volumes. The abridgment has been made mainly by the omission of the illustrative quotations which form so large a feature in the larger work, and of certain disquisitions on extremely minute points which occur during the progress of the work. Many will be of opinion that the omission of the latter is distinctly beneficial; they are too frequently little else than laborious trifling. The omission of the quotations is, no doubt, a disadvantage; they bear the same relation to and throw the same light on the definition that specimens do in the case of geology and experiments in other sciences. A very few have been retained, and it would have been an advantage had there been many more, as there might easily have been had the various meanings under each word been run on instead of being paragraphed.

Dr. Latham calls his dictionary a new edition of Johnson; if it were only this it would be at once a confession that the work was an anachronism. To bring the heroic old compiler's work up to date would require quite as much labour as Johnson bestowed on the original; and as Dr. Latham's work has so much that is new in all departments, we must regard its title as mainly an act of courtesy to the memory of "the great exicographer." As the abridgment contains all the vocabulary of the larger work, the two in this respect may be regarded as identical, and from its size and price, the larger work is evidently meant to be a practically complete English dictionary.

Dr. Latham's vocabulary is of course much more extensive than that of Johnson. He has read largely in modern works in all departments of literature and science, and thus been able to register many words that did not exist in Johnson's time, as well as many new meanings that have been given to old words. The consideration of vocabulary is probably the most serious that comes before any one who sets himself to the laborious task of compiling a dictionary. His duty is certainly to set down all words used by reputable writers. But is this all? How far back is an English dictionary-maker to go? to Spencer or to Chaucer? Mr. Freeman might possibly say to "Beowulf." Who are to be considered "reputable" writers? Should only "reputable" writers be taken into account? And should no word that has not been printed in a regular way be admitted? How far should slang terms and provincialisms, including Scotticisms (*pace* Prof. Blackie) be admitted? Again, what is to be considered literature? Must all science be excluded, and the vocabulary be confined to such words as occur in poetry, *belles lettres*, history, philosophy? These and many other questions must be settled at the very outset by the compiler of a dictionary making any pretence to completeness, and we are glad to see that, to a considerable extent, Dr. Latham has settled them on the liberal side. His aim has apparently been to make a work that would be useful to people of wide culture and general reading, and he has interpreted the English language to be the language used by the people of England in expressing their thoughts on the varied subjects that engage their attention.

We are at a loss to discover the principle, however, on which Dr. Latham has compiled his vocabulary. He has certainly inserted a large selection of scientific terms, but the selection appears to us to have been made in a capricious and arbitrary manner. He has, for example, given many of the technical names of the divisions and subdivisions of the animal and vegetable kingdoms, but it is not easy to see by what clue he has been guided. Why should Raptores and Natatores find a place while Scansores, Insessores, and all the other avian orders are omitted? Is it that the two former have been detected by Dr. Latham in some "literary" writer, while he has failed to come across the latter? Even Amphibia and Amphibian find no place, nor the adjective Avian. We find Infusoria and Cetacea, and Monotremata, but no Rodentia nor Carnivora, nor a host of other names even more likely than those capriciously registered to be inquired for by readers of works of popular zoology. It is a very nice question whether this class of words should be admitted at all into an English dictionary, but if it be decided affirmatively the only satisfactory scientific method is to admit all. A generic name (*e.g.*, Dionæa) in this respect is quite as important as that of the largest subdivision in zoology or botany.

The defects of the dictionary are equally apparent in other scientific departments. We find Oolitic and Triassic and Drift, the last in some detail, but not Laurentian nor Cambrian, nor such a common word as Pothole. Biogenesis, Abiogenesis, Heterogenesis, and Bacteria are conspicuous by their absence; as are also Eozoon, Atoll, Globigerina, Hipparion, and Amphioxus: Lepidosiren is given in some detail. To Basin no geological meaning is assigned. Palæozoic (with a bare reference of Cænozoic and Mezoic) is found, but not Azoic; Permian, but not Devonian, Silurian, or Purbeck; Labyrinthodont but not Pycnodont. We have Protoplasma but neither Protoplasm nor Protoplasmic. Photosphere we find, but not Chromosphere, nor Corona in its solar application, and neither Heliostat nor Siderostat. The dictionary contains various terms in electricity and magnetism, but not Magneto-Electric, Electro-Biology, Quantivalence, Anode, nor Cathode. Darwinian and Darwinism, long since used as current common terms, find no place here; and no one would guess from the definitions of Evolution and Development the immense significance which these terms have assumed in recent times.

We could give many instances of similar caprice in the admission of scientific terms, but our space does not admit of it. But it is not alone in this class of terms that the vocabulary appears to us to be defective; many words are wanting which, we venture to think, any man of common sense would look for in a modern English dictionary of the pretensions of that edited by Dr. Latham. Under Mule a reference is made to the spinning-jenny, but under neither Spinning nor Jenny is the use of the term explained. Readers of Arctic narratives will look in vain for an explanation of Ice-foot and Ice-master, and the reader will not be surprised at the omission of Snider, Whitworth, and Mitrailleuse. Can any sound reason be given for omitting such a word as Croquet? And where are we to look for an explanation of such national terms as Over and Bye, if not in the most recent of English dictionaries, which registers the "cricketal" signification of Stump? The work is evidently not meant for circulation in America, if we may judge from the absence of all Americanisms, even those which have become current coin in the English tongue, such as Bunkum, Caucus, Mocassin. Might not such words as Ecchymosis and Deoppilation have been spared (who is likely to look for them?) in favour of some or all of the terms referred to. Many words found in Tennyson, Morris, and Swinburne are marked as "obsolete," showing the danger of using the epithet at all.

The etymology seems to us unsatisfactory. To words whose origin is simple and obvious two or three lines are sometimes devoted; while of others whose etymology is certain enough, but which it would have taken some time and trouble to trace, no satisfactory information is given. What satisfaction is it to be told simply that Abandon comes from French *abandonner*, especially when the history of the word can be so beautifully traced? There is a like want of proportion in the definitions, which are in most cases extremely meagre, but in some cases capriciously and unnecessarily diffuse. In the arrangement of the various definitions under each word, moreover, we fail to discover, as a rule, any logical or historical method. In this as in some other respects Dr. Latham has stuck too closely to the old lines of dictionary construction, and missed the opportunity of compiling a work which might have cast all other similar works into the shade. We cannot say that it has dethroned either Webster or Worcester, unsatisfactory in many respects as these are; and there are two or three smaller and cheaper dictionaries, which we venture to think would be more useful to the general reader. The field is still unoccupied, for Dr. Latham's work can never, in our opinion, serve as the standard dictionary of our language. The work is handsome and well printed, and the "Historical Sketch of the English Language" is thoroughly satisfactory.

GUILLEMIN'S "WORLD OF COMETS"

The World of Comets. By Amédée Guillemin. Translated and Edited by James Glaisher, F.R.S. (London: Sampson Low and Co., 1877.)

MR. GLAISHER mentions that he was anxious that M. Guillemin's interesting work upon comets should appear in our language, from the fact of there not being so far any volume that occupied the ground covered by it, while, it may be added, that the recent important advances in this branch of the science renders a pretty complete summary of progress in late years a most desirable help and guide to the student, scattered as the reports of such progress almost necessarily are in the publications of scientific societies and in periodical scientific works at home and abroad.

The greater portion of the volume before us relates to those particular departments of the subject which may be expected to interest the general reader. The historical portion, especially in the earlier ages, when comets were regarded as omens, good or bad, to the time when Newton developed the laws by which their motions are governed, naturally commences the work; then follow chapters upon their orbits, the periodical comets from the short revolution of Encke's comet, to the revolutions of several thousands of years which have been assigned with a greater or less degree of probability to other of these bodies; more particular descriptions of several great comets in recent times, as the comets of 1744, 1811, 1843, 1858, 1861, and the great comet of Coggia in 1874, which made its appearance just prior to the publication of M. Guillemin's treatise. It is, however, in what we must term cometary physics that the volume is most complete, and in which its interest and probable usefulness will mainly consist. The theories of Olbers, Bessel, Faye, Roche, Tyndall, Tait, and others are noticed in a popular and readable style, and are fairly considered collectively, though differences of opinion must still prevail with regard to any inferences to be drawn from them. The researches of Dr. Huggins, Prof. Secchi, MM. Wolf and Rayet, in the spectral analysis of the light of comets, and particularly of Coggia's Comet of 1874, are described, and to these results, as collected by M. Guillemin, Mr. Glaisher has added an important article by Mr. Lockyer, which appeared while the great comet of 1874 was still visible, and in which are detailed the results of spectroscopic examination of the light of the comet with the aid of Mr. Newall's great refractor. The editor has also made some very desirable additions to M. Guillemin's chapter on "The Common Origin of Shooting Stars and Comets."

The work concludes with a list of elliptic comets and their elements and with a general catalogue of cometary orbits to 1876.

We have said that probably the chief interest and value of M. Guillemin's "World of Comets" will be found to consist in the extensive portion of his volume devoted to cometary physics, to the theories which have been advanced to explain their varied aspect, and the formation of the enormous trains by which some comets are accompanied. The comets of short period—a most interesting class—might well have been treated in somewhat greater detail, and in this division of the work we note several oversights. Thus it is stated that the researches of Dr. Axel Möller upon the motion of Faye's Comet, show that that body supports the theory of a resisting medium, first supposed to be indicated by Encke's investigations relating to the comet which bears his name; but as long since as the year 1865 Dr. Axel Möller had relinquished this idea, and from a rigorous discussion of the observations at the first three appearances, alluded to by M. Guillemin, had succeeded in representing the observations by the simple application of the planetary perturbations, without any hypothesis whatever, and his later researches have also negatived the existence of any trace of the effect of a resisting medium upon the motion of this comet. There is some ambiguity in the definition of the element π, or the longitude of the perihelion in the orbit of a comet; from the explanation given by M. Guillemin it might rather be inferred that the longitude is reduced to the ecliptic, which is not the case. The comet discovered by De Vico at Rome, February 20, 1846, is duplicated, appearing first on p. 140 with a revolution of fifty-five years, and again on p. 143 with a period of seventy-three years; the former period resulted from one of the earlier calculations. Pigott's comet of 1783 is named amongst the contents of a chapter p. 133, but there is no further reference to it. In the catalogue of orbits, there are several cases since the year 1866 where the inclination has been reckoned over 90°, as is frequently the case amongst the German computers, and with the unnecessary addition of the letter R in the column headed "direction of motion." To render these orbits consistent with the method hitherto in general use, and indeed adopted exclusively in the preceding part of the catalogue, the inclination given requires to be subtracted from 180°, and for the longitude of perihelion given in the fourth column, $2\,\Omega - \pi$, should be substituted.

These, however, are small defects which may easily be avoided in a future edition. As a whole, M. Guillemin's "World of Comets" must prove a welcome aid to the student on entering upon this branch of astronomy.

J. R. HIND

OUR BOOK SHELF

Fownes's Inorganic Chemistry. Edited by Henry Watts, B.A., F.R.S. Twelfth Edition. (London: Churchills.)

IN the present edition of this well-known manual the publishers have, wisely as we think, determined to divide it into two parts. In its old form the work had grown to be as unhandsome and cumbersome a volume as could be well imagined; like an overgrown yeast-cell it was obviously getting too big to hold together much longer, and many a student on his way to and from the lecture-room must have wondered, as he struggled to get the thick squat book into a comfortable carrying position, why the process of gemmation was so long delayed.

The present volume, which treats of physical and inorganic chemistry, contains a considerable amount of new matter, and may be regarded as an accurate representation of the present state of knowledge on these subjects. Among the more important additions we may mention an account of Mendeleeff's Laws of Periodicity, and a very good digest of what is known concerning the new metal gallium and its compounds; this element is associated with indium, with the probable atomic weight 68, as already indicated by M. Mendeleeff. The position of the cerite metals is also determined in accordance with the specific-heat estimations recently made by Hillebrand. On the other hand, it may be doubted if iodine tetrachloride has any real existence, and Michaelis has proved that the reaction $3PbSO_4 + 2POCl_3 = 3SO_2Cl_2 + Pb_3P_2O_8$ is not realised in practice. On the whole, however, the work fully maintains its reputation as a faithful exponent of the state of contemporary chemical knowledge. T.

The Microscopist: a Manual of Microscopy and Compendium of the Microscopic Sciences. Third edition. By J. H. Wythe, A.M., M.D. (London: Churchill, 1877.)

IT is now some twenty-five years since the first edition of this work appeared, and as the author himself remarks in his Preface, it is no small compliment to a work of this kind that for so many years it should hold a place among works of reference, although surrounded by larger and more pretentious volumes. For this third edition the book has been entirely rewritten, the advancement of microscopical science having naturally rendered considerable enlargements necessary. Still the work retains its principal qualities as before, viz., the precise and clear language, the absence of all unnecessary verbiage, and last but not least, the excellent arrangement of the contents. Thus after a brief reference to the history and importance of microscopy, we have able descriptions of the microscope itself and its accessories, followed by general remarks on its use and the more modern methods of microscopic investigation. Then, after a short chapter on the mounting and preserving of objects, we come to well-written and richly illustrated treatises on the application of the instrument in the different sciences, each science being spoken of in turn and in a separate chapter. For the beginner this arrangement is of special value, as it enables him quickly to form a general idea of the whole domain of microscopy. Mineralogy and Geology are followed by a chapter on Microscopic Chemistry; then the author treats of Microscopic Biology, devoting a chapter to Vegetable Histology and Botany, one to Zoology, the next to Animal Histology, and the last to Practical Medicine and Pathology.

The illustrations are original to a great extent; many also are taken from the works of Carpenter, Frey, Stricker, Billroth, and Rindfleisch. The larger plates, of which there are twenty-seven, are particularly well drawn, and add greatly to the general excellence of the work.

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.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Hog-Wallows and Prairie Mounds

JUDGING from the descriptions of these deposits, they must be nearly, if not quite, identical with those which I described in a paper on "The Ancient Glaciers North and East of Llangollen," read at the British Association, 1865. These are a series of heaps of glacial drift covering more or less completely the habitat of Cheshire Cheese, *i.e*, the Vale Royal itself, and the slopes which extend from it to those Welsh Mountains that are so prominently seen from Chester. These mounds vary in size and shape according to their position. They are very well defined and numerous in the valley of the Alyn, between Wrexham and Mold, where they have the form of oblong hog-back mounds usually lying parallel to each other with their longer axes (if I may use the term) nearly at right angles to the general slope of the surface. They may be counted by hundreds, and in some parts are so near together as to form a series of connected undulations. They are largest and most abundant opposite the mouths of the lateral valleys opening into the main valley of the

Alyn. Their origin is well indicated in these positions, by the manner in which they lie opposite the mouths of the valleys at right angles to the course of the present streams.

The most remarkable of all these is a long ridge running parallel to the Great Western Railway near Gresford. It is marked and shaded on the ordnance geological map. Bailey Hill, Mold, is another. This is attributed to the Danes—described in the guide books as a Danish fortification. I have proved the glacial origin of these mounds by finding in them striated subangular boulders, that have travelled considerable distances; such, for example, as large blocks of the Llanarmon limestone, and rounded lumps of curly cannel, that must have crossed the ridge of the Hope Mountain, the height of which varies from 300 to 800 feet above the Leeswood and Tryddn valleys from which the coal must have been carried. On one occasion, during the construction of the Wrexham Mold and Connah's Quay Railway, I saw a large fire blazing in a navvy's shed, and upon examination found that the fuel was curly cannel they had found in making a cutting. They described this find as two pieces, each one "bigger than a man's head." I brought away an unburnt fragment of about 2 lbs. weight. It was a subangular corner, smoothed and faintly striated. The nearest cannel seam to this place—which is over the millstone grit—is about four miles, with the Hope Mountain intervening.

A curious example of the unexpected bearings of scientific investigations upon commercial interest was presented by these cannel boulders. Two or three years before I commenced the study of the ancient glaciation of this district, Mr. W. C. Hussey Jones had proved the value of this curly cannel as a source of paraffin, and what are called paraffin oils, &c. Great excitement resulted, and a great rush was made to "*the Flintshire oildorado.*" This curly cannel was sold at prices varying from twenty-five shillings to thirty shillings per ton at the pit's mouth, while the price of ordinary main coal was only six shillings. The owners of this cannel, or holders of leases or "tak notes," giving a licence to work it, made large sums of money (as much as 80,000*l*. was paid for the transfer of one lease), and consequently great search was made for new seams. Among the searchers were the farmers, landowners, and outside speculators, who commenced boring and sinking and forming companies for cannel mining in the region covered by these "hog wallows;" the evidence upon which their expectations were based being the discovery of pieces of cannel on or near the surface, turned up by the plough or otherwise. Many thousands of pounds were thus wasted. One very worthy man, that I knew very well—a hard-working Welsh farmer—spent the savings of a whole life-time in searching for cannel on his farm, where he had frequently turned up fragments in ploughing. His death speedily followed his ruin. There were many other similar cases. Had I commenced my investigations three years sooner I might have explained the strange and apparently incomprehensible anomaly of Leeswood cannel being found on the south side of the Chester and Mold Railway, and in the neighbourhood of Caergwrle, in spite of an intervening ridge of mountain.

One very curious and instructive feature of these mounds is their change of shape as we proceed from the hill slopes towards the great plain known as the Vale Royal, which was formerly a great estuary or fjord of the Dee. Instead of the long and rather steep hogback ridges we now find a general outspreading deposit dotted here and there rather sparsely with obtuse conical mounds, so obtuse and so much disturbed by agricultural operations that they can only be detected by careful observation.

My explanation of these differences is that the glacier which planed the millstone grit of the Hope Mountain by sweeping over and around it, originally spread out upon the waters of the estuary now forming the Vale Royal, and thus formed the outspread deposit; that it afterwards receded, and the icebergs that broke off and floated away from it were stranded here and there, thawed, deposited their contents, and thereby formed the mounds; while the oblong ridges mark the final step-by-step recession and oscillations of the dying glacier, which formed them partly as terminal moraines, and partly by ploughing up and thrusting before it, in the course of its advancing oscillations, the previously deposited glacial drift. I throw out these speculations suggestively, to be taken for what they are worth; they fit the facts well enough so far as I have been able to study them, but the main object of this letter is to direct attention to this and other corresponding deposits near at home that appear to me to be worthy of further investigation, especially by residents in the neighbourhood and the members of local field-clubs, &c. The Liverpool Naturalists' Field Club paid a visit to the district while I lived there, and I showed the geological members some of these deposits. W. MATTIEU WILLIAMS

Belmont, Twickenham, April 24

IT is apparent from Prof. Le Conte's description of the prairie mounds (NATURE, vol. xv. p. 530) that the drift mounds figured and mentioned by me (vol. xv. p. 379) have quite different origins. The prairie mound would seem to be somewhat similar and have the same origin as a tussocky bog or mountain. The formation of a tussocky bog has been described in "Valleys and their Relation to Fissures, &c.," p. 14. A tussocky mountain is similarly formed [illegible] very hot weather cracks the peaty up[illegible] soil forming deep fissures; while subsequent weathering chan[illegible] portions between the fissure into small hills. I lately saw on the coast of Wicklow a considerable area of Æolian drift of this hummocky nature; the hillocks being about four feet high. They were so regular as to have the appearance of being moulded from one model. These could not possibly have their origin in fissures; but they seemed to have a connection with bunches of bent, round which the wind collected heaps of sand. But again why should the bunches of this grass grow at regular intervals? In the same neighbourhood some of this Æolian drift is piled in long parallel ridges, about five or six feet high, and having quite an artificial look. These evidently are wind formed; but how it is hard to conjecture, as they run oblique to the prevailing and most effective winds. G. H. KINAHAN

Ovoca, April 24

Greenwich as a Meteorological Observatory

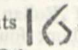
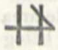
IN Mr. Buchan's objections to the hypothesis that the temperature of Greenwich is raised by the proximity of London one most important consideration has been omitted. Granted that the mean temperature of the summer months, June to September, is 0°·9 higher at Greenwich than at the eight other stations referred to, it does not follow that this alone is the cause of the higher average temperature at the former place. Greenwich occupies a position farther from the Atlantic and nearer the Continent than the majority of the selected stations, and we might therefore expect to find it subject not only to a higher temperature in summer, but also to a lower temperature in winter. If this be so, the excess which Mr. Buchan admits may be accounted for by the raising of the mean winter temperature from artificial causes; and this view of the case seem to be confirmed by observation. The station at Leyton, Essex, supplies the requisite data; for, although near London and rapidly increasing in population, it is, or rather was, in a country district when the observations were made. It is situated on the verge of Epping Forest, is separated from London by the Hackney Marshes, is rather more than 6¼ miles in a direct line from St. Paul's Cathedral, from which Greenwich is 4¾ miles distant, and is 7 miles nearly north of the last-mentioned place. The meteorological observations were undertaken with the express intention of comparing them with those at the Royal Observatory, with which object the instruments were mounted on a stand precisely similar to the Greenwich stand, and the exposure was unexceptionable. The comparison relates to the daily maximum and minimum temperatures for the three years ending November, 1863. The average was at Greenwich 50°·4, Leyton 49°·9. Allowing for elevation, the results are:—

	Annual.	Maxima.	Minima.	June to September.	December to March.	Maxima June to September.	Minima June to September.	Maxima December to March.	Minima December to March.
Greenwich...	51°·0	58°·9	43°·0	61°·0	41°·9	71°·0	51°·1	47°·7	36°·1
Leyton ...	50·2	58·3	42·1	61·3	40·8	72·0	50·7	46·9	34·8
Greenwich warmer than Leyton.	+0·8	+0·6	+0·9	−0·3	+1·1	−1·0	+0·4	+0 8	+1·3

These results prove that Greenwich is warmer than Leyton, which is farther removed from the influence of London, and that during the winter months the temperature is higher both by day and night, but chiefly by night, when the excess is 1°·3; also that in summer, while the nights at Greenwich are warmer than at Leyton, the days are cooler. The inference is that the artificial heat of London sensibly affects Greenwich, mostly by raising the temperature of the air in winter and at night, when it might be expected to do so with the greatest effect; and that the temperature at Greenwich by day in summer is depressed by the smoky atmosphere hindering the transmission of the sun's rays when they are most potent. H. S. EATON

Croydon, April 24

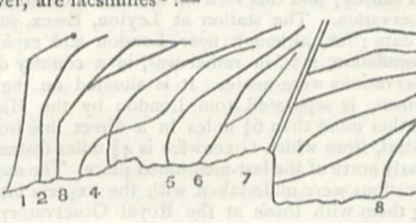
Ancient Characters at Cissbury

Two years ago some marks were discovered at the entrances of galleries in one of the pits at Cissbury, which appeared to have been scratched on the chalk with a flint instrument. They were suspiciously like figures or masons' marks, but yet had all the signs of age, and resembled more or less early letters.[1] The little woodcuts ,  represent the forms with sufficient exactness. Other marks found shortly afterwards in a second pit were thought to be merely a trellis pattern. In attempting to cut them out of the rock, the chalk was broken into fragments, but fortunately rubbings had been previously taken.

The doubt as to the genuineness of the above marks was removed by the further discovery, in September, 1875, of a third set (again at the entrance of a gallery) in another pit at Cissbury Camp. They were arranged in two lines, the lower one presenting all the appearance of an inscription. A number of detached blocks, with distinctive marks upon them, were found in this pit amongst the rubble with which it was filled. One of these blocks, which was discovered about five feet below the surface, had four definite marks scratched upon it at even distances.

Up to the time that this third pit was opened no distinctive marks had been met with, except those above-mentioned, though there were many thousand accidental pick-marks on the walls and loose chalk.

I have now the satisfaction of mentioning that upon examining with more care the marks found in the second pit, the diagonal scratches of the trellis prove to be eight branching characters of a peculiar form. The vertical scores which cross them turn out to be later additions, cut with a finer tool than the serrated flint that has left its mark on the more superficial and broader lines of the characters beneath. In the following woodcut the vertical lines are not shown, and the rune-like forms are placed slightly further apart than is actually the case; the characters themselves, however, are facsimiles[2]:—



Tracings and photographs have been submitted to Professors Sayce and Rhys, and also to Dr. Haigh and other palæographists, who all consider the marks to be characters, though unable at present to give an opinion as to their date. But several on the detached blocks found near the surface, it is thought, may possibly be Anglo-Saxon.

Some of your correspondents may perhaps be able to say whether similar forms have been met with elsewhere. Can it be that the branching characters are examples of the symbols alluded to in the traditions of the Bards?

I may mention that Dr. Haigh thinks that the Celts had writing distinct from and earlier than the Oghams; and he has noticed on the stones of a sepulchral chamber at Keryaval, in Brittany, signs very like letters. J. PARK HARRISON

The Rocks of Charnwood Forest

IT has been a matter of regret to geologists that Mr. Plant has not published in some accessible form his stores of knowledge on Charnwood. We cannot tell how far our facts may be new to him, but we believe that we have been able to make considerable corrections in and additions to all contained in Jukes, Ansted, Coleman, or the Survey Memoir.

[1] *Journ. Anthropol. Inst.*, No. 18, p. 265.

[2] The last character, on the right of the inscription, has been corrected by lengthening the upper stroke. In the rubbing it was accidentally detached from the cross-lines.

We are glad to find Mr. Plant supporting us on the intrusive character of the syenites. But the question can hardly be regarded as previously settled. Mr. Coleman leaned to the idea of their priority to the stratified rocks, Prof. Jukes to their being contemporaneous, and Prof. Ansted to their being metamorphic. When in NATURE (vol. xv. p. 97) Prof. Green suggested the first of these views no one adduced any proof to the contrary. Of all that Mr. Plant says we were well aware, but could not regard the evidence as conclusive. Our opinion is founded on the examination of actual contacts between syenite and sedimentary rock, a thing which so far as we know has not previously been described.

We are well acquainted with the very curious "altar stones" which are doubtless of volcanic origin, but these and the rocks of Bardon no more prove the Markfield syenite to be intrusive, than the ashes and breccias of the Borrowdale series prove the intrusive character of the Wastwater granite. Further, we cannot admit any connection between the Bardon "greenstones" and the Markfield syenite. T. G. BONNEY

St. John's College, Cambridge, April 28 E. HILL

Yellow Crocuses

SEVERAL years ago I observed that snowdrops which I had introduced into my garden were destroyed by poultry getting in among them at the hungry season when these are in blossom. I recollect placing a bantam cock in the garden, and observed that he pecked hastily at a few of the blossoms, and then left off. I then tore up pieces of writing-paper and spread them over the newly turned-up soil. These were hastily visited and as hastily dropped by a few of the poultry. Next I procured some Indian corn, and scattered it among the poultry for the first time. A few hens tried to swallow a grain here and there, but left the most of them. It required two or three days' experience to get them to feed on the Indian corn, and a very short time taught them to exclude snowdrop blossoms from their bill of fare. May not the case of the crocuses mentioned by Mr. Renshaw be explained as similar to that of schoolboys, who eagerly try a bright unknown berry and soon leave off when it is unpalatable? At least so I explained the fact of my snowdrops being more fiercely attacked on their first appearance in the garden than ever they have been since.

Our glen in a few weeks will be made beautiful by the blossoms of the bird-cherry, which grows plentifully on the margin of the streams and the waysides, attaining much larger dimensions than those given by Mr. Bentham in his "Handbook of British Flora," many of the trees being twenty feet high. The caterpillar of the pale spotted ermine moth feeds so eagerly on its leaves that I have, in some summers, seen the trees reduced to ugly skeletons by the middle or end of July. In autumn the beautiful red berries of the Guelder-rose adorn our thickets, but if "fruit has become beautiful so as to point it out to birds for the dissemination of the seed," we do not seem to have the birds which care for these berries, as only three weeks ago I pulled some fine clusters from a bush growing in a sheltered nook.

Tynron, Dumfriesshire, April 21 JAMES SHAW

INCLOSED is a letter that I had from my friend, Dr. Grierson, Dumfriesshire, a month ago, complaining of a pair of ducks that had gobbled up almost every one of his yellow crocuses, and only the yellow ones. I am further informed by Mr. John Young, Hunterian Museum, Glasgow, that the habit of the sparrows taking the yellow crocuses without touching the blue or striped has been long known to him. DAVID ROBERTSON

The Ship-Worm

Teredo navalis certainly is able to endure a long continuance of fresh water. At the town of Brisbane (Queensland), piles, &c., are sheathed with "Muntz metal" to prevent its attacks. The river is subject to long-continued freshes. I remember one which lasted at least ten days, and during that time ocean-going steamers could not ascend to the town, the flood was so powerful. Brisbane is situated far below the *extreme* salt-water flood, but whenever there is a fresh in the river, of even small amount, the water at that town is (according to my recollection) rather more fresh than salt at the end of each ebb tide.

I never saw *Teredo* there, but I took its existence for granted, from the fact that piles, &c., were protected with metal, and the caution given me by the builder of my boat against keeping her in the water when not in use. Brisbane is about twenty-five miles from the full influence of the Pacific, and, to the best of my recollection, the salt water is carried (on the flood) at least thirty miles up the river above the town, when there is no fresh coming down. So far does the salt water indeed extend, that at a time of severe drought (1865–66, I think) it was proposed to bring fresh water for the supply of the town from the principal affluent, the Bremmer, which joins the Brisbane about forty-two miles above the town, as it could not be obtained nearer on account of the high range of the salt flood. It was to have been brought in huge floating tanks towed by a steamer.

ARTHUR NICOLS

PROF. TYNDALL ON THE SPREAD OF DISEASE

PROF. TYNDALL occupied the chair on Saturday night at the concluding lecture of Dr. Corfield's course on the laws of health. The subject of the lecture was "Infectious Diseases." In proposing a vote of thanks, Prof. Tyndall paid a high compliment to the lecturer for the thoroughly sound instruction which he had so clearly conveyed. He had made it plain that contagion consisted, not of gas or vapour, but of definite particles sometimes floating in gas, in the air we breathed, or in the water we drank; and that, like organic seeds in the soil, they multiplied themselves indefinitely in suitable media, the great probability being that these disease-producing particles were living things. A close study of the subject, extending now over several years, enabled him to agree entirely with the lecturer in the parallelism which he had declared to exist between the phenomena of contagious disease and the phenomena of ordinary putrefaction. The case of flies, for example, to which the lecturer ascribed the power of communicating disease from one person to another, was exactly paralleled by phenomena in putrefaction. Chop up a beefsteak, steep it in water, raise the temperature a little above the temperature of the blood, pour off the water, and filter it; you get a perfectly clear liquid; but that liquid placed in a bottle and exposed to the air soon begins to get turbid, and that turbid liquid, under the microscope, is found to be swarming with living organisms. By suitably heating this perfectly clear beef tea, it can be sterilised, everything being killed which is capable of generating those little organisms which produce the turbidity; and by keeping it from coming in contact with the floating particles of the air, it might be preserved transparent for years. He had now some sterilised beef-tea of this sort, which had been preserved for eighteen months in a state of perfect transparency. But if a fly dipped its foot into an adjacent vessel containing some of the turbid fluid, and then into the transparent fluid, that contact would be sufficient to infect the sterilised infusion. In forty-eight hours the clear liquid would be swarming with these living organisms. The quantity of the turbid liquid which attaches itself to the finest needle-point suffices to infect any amount of the infusion just as the vaccine lymph taken up on the point of a surgeon's lancet spreads disease through the whole body. Here, also, as in the case of contagious disease, there was a period of incubation. In proof of what the lecturer had stated that the contagion of these communicable diseases was not gaseous or liquid, but solid particles, he would describe an experiment he had made only a few weeks since. Eighteen months ago he had a chamber prepared from which all floating particles of dust were removed, and in it he placed a number of vessels containing animal and vegetable refuse which soon fell into putrefaction, and also two or three vessels containing perfectly clear beef-tea and mutton broth, as transparent as water, in which the infective particles had been killed by heat. Although all these vessels had stood for eighteen months side by side there had been no communication of contagion from one to the other. The beef tea and mutton-broth remained as transparent as when put in, though the other vessels emitted a most noisome stench. But if a bubble were produced in one of the putrefying masses by blowing into it, and if on rising to the surface and bursting the spray of the bubble was allowed to fall into the transparent beef-tea or mutton-broth, in forty-eight hours it became as bad as its neighbours. It was not therefore sewer gas which did the mischief, but the particles which were carried and scattered by the sewer gas. Referring to another point on which the lecturer had insisted—viz., that there was no power of spontaneous generation of the germs or contagion of diseases, Prof. Tyndall said that, though at present great names were opposed to that view, he would venture to predict that ten years hence there would be very few great names opposed to the lecturer on that matter. With regard to the power of specific contagia to be generated in decomposing animal matter, he would say that for the last twenty-one years he had been in the habit of visiting the upper Alpine valleys, where, amongst the Swiss châlets, there was the most abominable decomposition going on from day to day, and exceedingly bad smells, but there these contagious diseases were entirely unknown. If, however, a person suffering from typhoid fever were transported there, the disease would spread like wildfire from this infected focus, and probably take possession of the entire population. It might be taken, therefore, that any of these special diseases required its special germ or seed for its production, just as you required a grape seed to produce a vine. He entirely agreed with all that the lecturer had stated as to these diseases "breeding true." He never found the virus of small-pox producing typhoid, or *vice versâ*. The subject was one of the most important which could engage the attention of the scientific physician—indeed, Prof. Tyndall doubted whether, in the whole range of medical art and science there was a subject of equal importance. But in dealing practically with this question of infectious disease, the scientific physician must not stand alone—he ought to be aided by the sympathy of an enlightened public. Here, in England, we did not like to be pressed into good behaviour by external influence; and if anything was to come in the way of really great sanitary improvement, it would be from the people themselves. Hence, in a people who were jealous of government interference, it was of primary importance that they should be properly instructed; and he did not exaggerate in the slightest degree in declaring that sound and healthy instruction had been imparted to them in the lecture which they had just heard.

SUSPECTED RELATIONS BETWEEN THE SUN AND THE EARTH

I.

WHEN the telescope first enabled us to scrutinise the solar surface, the spots thereby revealed formed a stumbling-block to some of the early observers, who were unwilling to attribute the smallest taint of imperfection to our luminary. And although the spots came speedily to be recognised as true solar appendages, yet until comparatively recent times they were looked upon as mere scientific curiosities, having no perceptible reference to ourselves, or indeed to anything else.

In the eyes of the last century astronomers the sun shone upon the earth and kept us in leading-strings, and this was an end of the whole matter. But we have now advanced one step beyond the position of those men, inasmuch as we have accumulated evidence tending to show that the physical state of the solar surface affects us in a variety of ways. With regard to some of these we are nearly certain, while with regard to others we are less so; in all we are profoundly interested, but we are not yet fully awake to a true measure of our responsibility or to the necessity of keeping a continuous watch upon the sun. It may perhaps be desirable here to review the somewhat heterogeneous mass of evidence from various quarters which leads us to believe in the existence of these peculiar relations.

SOLAR SPOTS, MAGNETIC DECLINATION, AND AURORAL DISPLAYS.

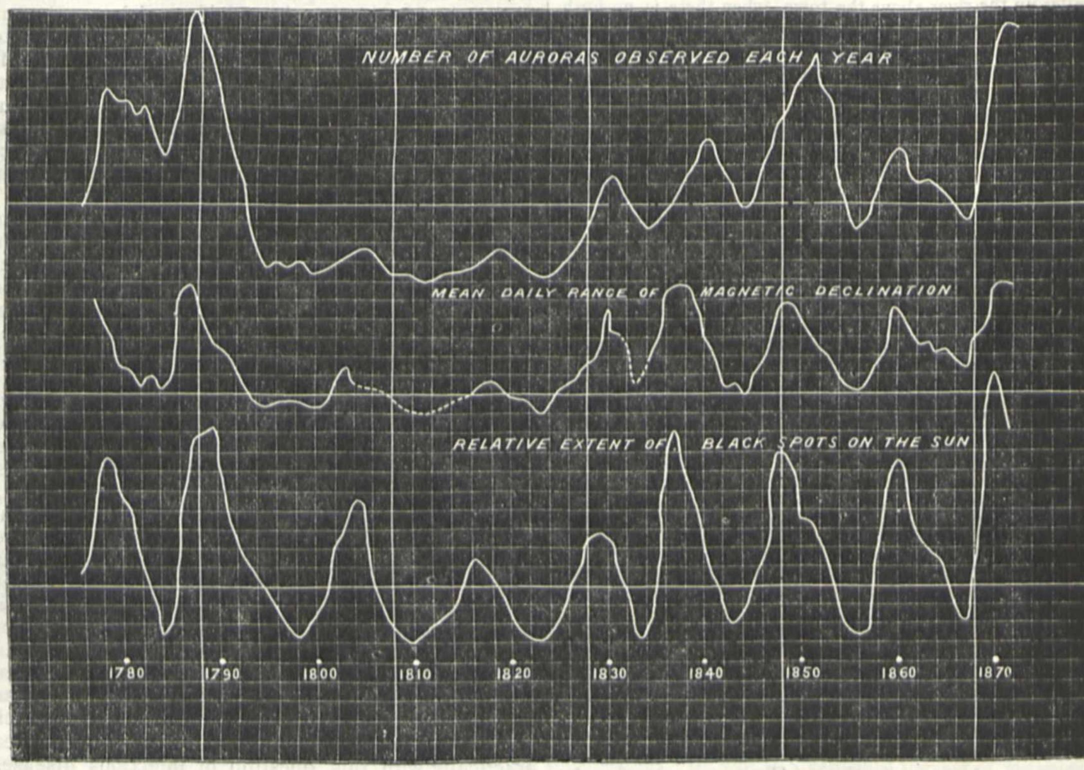


DIAGRAM A

About fifty years ago a careful observer, Hofrath Schwabe, of Dessau, with true Teutonic persistence set himself to observe the sun's surface day after day, and as the result of forty years' observations, he was rewarded by the discovery of a cycle in the frequency of spots. This will be seen from the following table :—

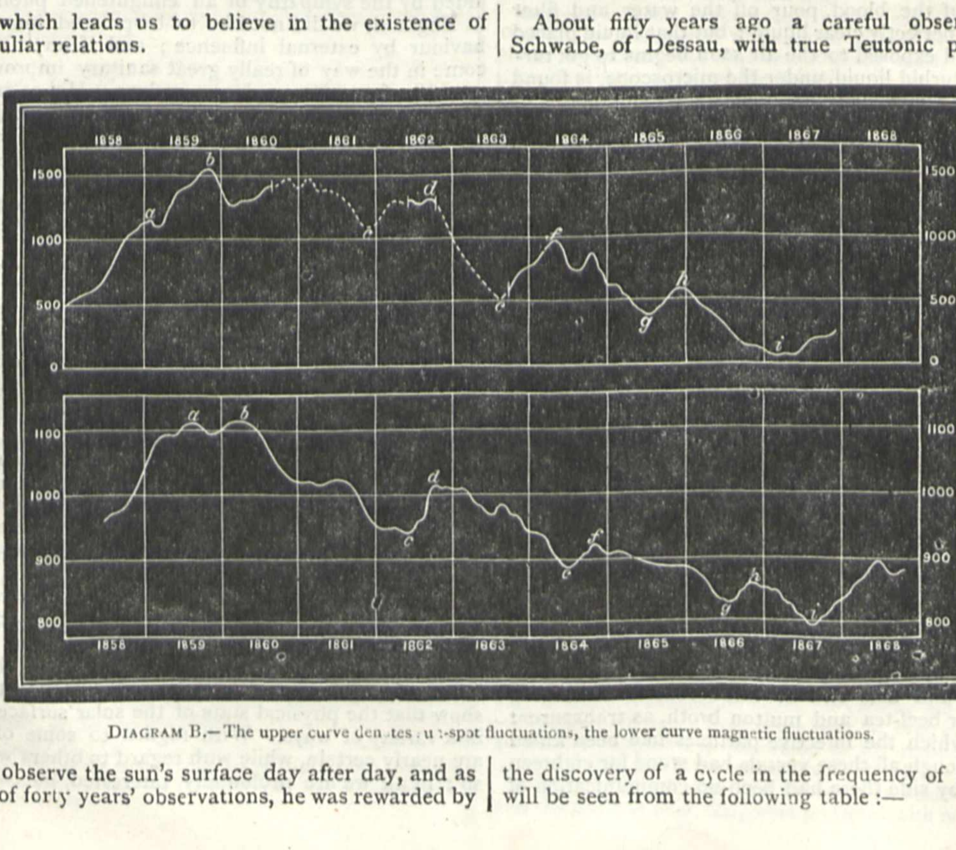


DIAGRAM B.—The upper curve denotes sun-spot fluctuations, the lower curve magnetic fluctuations.

TABLE I.

Number of New Groups of Sun-spots observed each Year. The Observations from 1826 *to* 1863 *were made by Hofrath Schwabe, the others were made at the Kew Observatory.*

Year.	No. of new groups.	Year.	No. of new groups.	Year.	No. of new groups.
1826	118	1842	68	1858	188
1827	161	1843	34	1859	205
1828	225	1844	52	1860	210
1829	199	1845	114	1861	204
1830	190	1846	157	1862	160
1831	149	1847	257	1863	124
1832	84	1848	330	1864	113
1833	33	1849	238	1865	93
1834	51	1850	186	1866	45
1835	173	1851	151	1867	17
1836	272	1852	125	1868	115
1837	333	1153	91	1869	224
1838	282	1854	67	1870	403
1839	162	1855	38	1871	271
1840	152	1856	34	1872	186
1841	102	1857	98		

From which it appears that 1828, 1837, 1848, 1860, and 1870 were years of maximum, while 1833, 1843, 1856, and 1867 were years of minimum sun-spot frequency.

While Schwabe was observing the sun with praiseworthy regularity, Sir E. Sabine was likewise observing the magnetism of the earth. A freely suspended magnetic needle is usually thought to be very constant as to the direction in which it points, and this is no doubt quite true as far as large fluctuations are concerned. Nevertheless, between certain small limits it is always in motion—it has, for instance, a well understood oscillation depending upon the hour of the day, besides which it is also liable to irregular fluctuations that occur abruptly. Now Sabine perceived that these abrupt and spasmodical affections of the needle were most frequent in years when sun-spots were most frequent; and, furthermore, inasmuch as these fluctuations of the magnet are almost invariably accompanied with displays of the aurora borealis, he came to the conclusion that auroral displays occur most frequently in years of maximum sun spots. Our readers will no doubt remember the brilliant auroræ of 1870, which was likewise (see Table 1) a year of maximum sun-spot frequency.

What we have said refers to the spasmodical affections of the needle, but its diurnal oscillations are not less dependent on the state of the sun's surface.

Here also we have a maximum amount of fluctuation in years of maximum sun-spot frequency.

This near relation between sun-spots on the one hand, and magnetic oscillations and auroral displays on the other, is exhibited in Diagram A, which has been compiled by Prof. Loomis, the well-known American meteorologist.

Close and striking as is the relation between these three associated phenomena exhibited in the above diagram, the intimacy of this connection may be rendered even more obvious if we confine ourselves to such observations of the solar surface and of magnetic fluctuations as have been made with the greatest possible accuracy.

For this purpose Schwabe's eye-observations are not precise enough, and we must, as far as sun-spots are concerned, make use of some very accurate measurements of the solar spotted area made at Redhill by the late R. C. Carrington, along with the results deduced from the solar photographs taken at the Kew Observatory, under the superintendence of Mr. Warren De La Rue.

Again, as far as magnetic observations are concerned, let us employ the results derived from the self-recording magnetographs at the Kew Observatory.

Furthermore, in order to equalise oscillations of short period, let us plot a solar curve, each point of which represents the mean of nine months' sun-spot observations, and alongside of it a magnetic curve, each point of which similarly represents the mean of nine months' magnetic observations.

A comparison of this kind has been made by the writer of these remarks, the results of which were recently communicated by him to the Royal Society. These results are embodied in Diagram B, in which accurate sun-spot observations are compared with Kew declination ranges, that is to say, with the diurnal oscillations of a magnetic needle, freely suspended at the Kew Observatory.

A comparison of the two curves given above will show us that almost every prominent fluctuation of the sun-spot curve is represented in the magnetic curve, similar letters being employed to denote what appears to be corresponding fluctuations.

There is, however, a greater want of similarity for that part of the solar curve which is dotted, but this represents the results of eye-observations taken by Hofrath Schwabe, while the more accurate Kew photoheliograph was unfortunately out of action.

It will be perceived that the magnetic fluctuations invariably follow after or lag behind the corresponding solar fluctuations in point of time, the mean amount of this lagging being probably six months. We may therefore conclude from these comparisons that there is a very close and intimate relation between the physical condition of the sun's surface and the diurnal oscillations of the magnetic needle freely suspended at the Kew Observatory, and also that the former is probably the cause of which the latter is the effect, or at least that the magnetic change lags behind the corresponding solar phenomenon in point of time. BALFOUR STEWART

(*To be continued.*)

THE FRENCH TRANSIT MEDAL

WE recently announced that the Paris Academy of Sciences had presented an appropriate medal to those Frenchmen who were engaged in observing the recent transit of Venus, as well as to all the members of the Academy. By the kindness of the editor of *La*

Nature we are able to give an illustration of the principal face of this medal, the design being that of the artist M. Alphée Dubois. It will be seen that the artist has had recourse to mythology to represent under a graceful form the important astronomical phenomenon. Venus, in the simple costume of the goddesses, passes before the car of Apollo, the god of the sun, while Science observes the phenomenon on the earth and records the results. The legend is the composition of a member of the Academy of Inscriptions. On the obverse of the medal is the following inscription :—

INSTITUT DE FRANCE
ACADÉMIE DES SCIENCES
PASSAGE DE VÉNUS SUR LE SOLEIL
8-9 DECEMBER, 1874.

THE EFFECT OF INAUDIBLE VIBRATIONS UPON SENSITIVE FLAMES

DURING a recent visit to Birmingham my friend and host, Mr. Lawson Tait, showed me some interesting experiments with one of Mr. Galton's whistles, capable of yielding vibrations beyond the limit of hearing. This led to the suggestion of trying a sensitive flame with these whistles, and in fulfilment of my promise to select and send to Mr. Tait a burner sensitive to very high notes, I was yesterday led to make the following experiment, the result of which is, I believe, new, and I think sufficiently interesting to put on record. A sensitive flame was obtained just two feet high when undisturbed, but shrinking down to seven inches under the influence of the feeblest hiss or the clink of two coins. Adjusting the Galton whistle, which Mr. Tait lent me, so as to yield its lowest note, little effect was produced on the flame ; a shrill dog-whistle produced a slight forking of the flame, but that was all. Raising the pitch of the Galton whistle, the flame became more and more agitated, until, when I had nearly reached the upper limit of audibility of my left ear, and had gone quite beyond the limit of my right ear, the flame was still more violently affected. Raising the pitch still higher, until I quite ceased to hear any sound, and until several friends could likewise detect no sound, even when close to the whistle, I was astonished to observe the profound effect produced upon the flame. At every inaudible puff of the whistle the flame fell fully sixteen inches, and burst forth into its characteristic roar, at the same time losing its luminosity, and when viewed in a moving mirror, presenting a multitude of ragged images, with torn sides and flickering tongues—indicating a state of rapid, complex, and vigorous vibration.

Nor was this effect sensibly diminished by a distance of some twenty feet from the flame. Placing the flame at one end of the large lecture theatre of this college, and blowing the whistle at the furthest point away, a distance at least of fifty feet and more than thirty feet above the flame, still the effect produced was very pronounced. There can hardly be a more striking experiment. A single silent and gentle puff of air sent from the lips through the whistle, nothing whatever to be heard, and yet fifty feet away an effect produced that might readily be seen by thousands of people.

The extreme smallness of the amount of motion actually concerned in producing this great change in the aspect of the flame is evident. For the inaudible vibrations, having at their origin but a small amplitude, gave rise to a spherical air-wave,[1] which at a radius of fifty feet—and with the vast enfeeblement due to this distance—knocked down a two-foot flame, though the surface acted upon had an area of less than a square inch—for it is only the root of the flame that picks up the wave motion. Of course everything depends upon the delicately-poised state into which the flame has previously to be brought. It then, like a resonant jar, enters into a state of vibration which appears to be synchronous with the note producing the effect. By this means it may be possible, with the aid of a mirror moving at a known speed, to determine the vibration number of these high notes, and thus with greater exactitude fix the upper limit of hearing.

The flame giving the effect here described was produced by coal gas contained in a holder under a pressure of ten inches of water, and issuing from a steatite jet having a circular orifice 0·04 inch in diameter.[1]

W. F. BARRETT

[1] I have no doubt a similar result would attend an experiment made in the open air, if the air were still enough to allow it to be made.

[1] The conditions necessary for obtaining the utmost sensitiveness of the flame are described in an article I published on the subject in the *Popular Science Review* for April, 1867.

SOUND-VIBRATIONS OF SOAP-FILM MEMBRANES

THE vibration-forms of membranes agitated by their fundamental and upper tones, have usually been studied by means of thin bladder or india-rubber stretched on a ring or frame (see Helmholtz "Sensations of Tone," chaps. iii. and v. ; Pisko, "Die Neueren Apparate der Akustik," p. 75). While I was lately trying with Mr. R. Knight the capabilities of various membranes of taking impressions from vocal sounds for phonautographic purposes, the idea occurred of using soap-film. This was at once carried into effect by dipping the end of a lamp-chimney into some soap-solution, strengthened in the usual way with glycerine and a little gelatine. On singing near the open end of the chimney, the series of forms belonging to the various notes became plainly visible, those produced by the upper tones being as it were engine-turned in their complex symmetry, in a way to which the sand-lines on so coarse a material as caoutchouc can bear no comparison. To exhibit these forms at a popular lecture here last night, the light of an oxyhydrogen magic lantern was simply reflected off the vibrating film upon the screen in a disc of some three feet in diameter, so as to show its patterns on a large scale when set in movement by talking, singing, and playing a cornet in its neighbourhood. The effects were of singular clearness and beauty. To lecturers who may use this new and easy means of making the more complex sound-vibrations appreciable by the eye, I would mention that by slightly thinning the soap-solution, and adding a few drops of ammonia, they may obtain a film more free from interference-colours, so as to display the vibration-figures on an almost clear ground. But if this is done, the thicker mixture should be used afterwards, for the gorgeous scenic effect of the masses of prismatic colour whirled hither and thither by the musical vibrations.

EDWARD B. TYLOR

Wellington, Somerset, April 20

THE OTHEOSCOPE[2]

I COMMUNICATED to the Royal Society in November last, an account of some radiometers which I had made with the object of putting to experimental proof the "molecular pressure" theory of the repulsion resulting from radiation. Continuing these researches I have constructed other instruments, in which a movable fly is caused to rotate by the molecular pressure generated on fixed parts of the apparatus.

In the radiometer, the surface which produces the molecular disturbance is mounted on a fly, and is driven backwards by the excess of pressure between it and the sides of the containing vessel. Regarding the radiometer as a heat-engine, it is seen to be imperfect in many respects. The black or driving surface, corresponding to the heater of the engine, being also part of the moving fly, is restricted as to weight, material, and area of surface. It must be of the lightest possible construction, or

[2] On Repulsion Resulting from Radiation. Preliminary note on the Otheoscope, by William Crookes, F.R.S., &c. Read before the Royal Society, April 26, 1877.

friction will greatly interfere with its movement; it must not expose much surface, or it will be too heavy; and it must be a very bad conductor of heat, so as to retain the excess of pressure on one side. Again, the part corresponding to the cooler of the engine (the side of the glass bulb) admits of but little modification. It must almost necessarily be of glass, by no means the best material for the purpose; it is obliged to be of one particular shape; and it cannot be brought very near the driving surface.

A perfect instrument would be one in which the *heater* was stationary; it might then be of the most suitable material, of sufficient area of surface, and of the most efficient shape, irrespective of weight. The *cooler* should be the part which moves; it should be as close as possible to the heater, and of the best size, shape, and weight, for utilising the force impinging on it. By having the driving surface of large size and making it of a good conductor of heat, such as silver, gold, or copper, a very faint amount of incident radiation suffices to produce motion. The black surface acts as if a molecular[1] wind were blowing from it, principally in a direction normal to the surface. This wind blows away whatever easily movable body happens to be in front of it, irrespective of colour, shape, or material; and in its capability of deflection from one surface to another, its arrest by solid bodies, and its tangential action, it behaves in most respects like an actual wind.

Whilst the radiometer admits of but few modifications, such an instrument as the one here sketched out is capable of an almost endless variety of forms; and as it is essentially different in its construction and mode of action to the radiometer, I propose to identify it by a distinctive name, and call it the Otheoscope (ωθέω, I propel).

The glass bulb is an essential portion of the machinery of the radiometer, without which the fly would not move; but in the otheoscope the glass vessel simply acts as a preserver of the requisite amount of rarefaction. Carry a radiometer to a point in space where the atmospheric pressure is equal to, say, one millimetre of mercury, and remove the glass bulb; the fly will not move, however strong the incident radiation. But place the otheoscope in the same conditions, and it will move as well without the case as with it. In the preliminary note already referred to,[2] I described a piece of apparatus by which I was able to measure the thickness of the layer of molecular pressure generated when radiation impinged on a blackened surface at any degree of exhaustion. At the ordinary density of the atmosphere the existence of this molecular disturbance was detected several millimetres off, and its intensity increased largely as the generating surface and movable plate were brought closer together. It would be possible, therefore, to construct an otheoscope in which no rarefaction or containing vessel was necessary, but in which motion would take place in air at the normal density.[3] Such a heat-engine would probably work very well in sunlight.

Aided by the mechanical dexterity of my assistant, Mr. C. H. Gimingham, I have constructed several varieties of otheoscope. These I propose to exhibit at the *soirée* of the Royal Society on Wednesday next, as illustrations of the very beautiful manner in which, at this stage of my investigations, theory and experiment proceed hand in hand, alternately assisting each other, and enlarging our knowledge of those laws of molecular movement which constitute a key to the relations of force and matter.

The following is a list of the otheoscopes I have already made, together with some new experimental radiometers, which will be exhibited for the first time on Wednesday:—

1. *Otheoscope.*—A four-armed fly carrying four vanes of thin clear mica is mounted like a radiometer in an exhausted glass bulb. At one side of the bulb a plate of mica blacked on one side is fastened in a vertical plane in such a position that each clear vane in rotating shall pass the plate leaving a space between of about a millimetre. If a candle is brought near, and by means of a shade the light is allowed to fall only on the clear vanes, no motion is produced; but if the light shines on the black plate the fly instantly rotates as if a wind were issuing from this surface, and keeps on moving as long as the light is near.

2. *Otheoscope.*—A four-armed fly carries roasted mica vanes and is mounted in an exhausted glass bulb like a radiometer. Fixed to the side of the bulb are three plates of clear mica equidistant from each other in a vertical plane, but oblique to the axis. A candle brought near the fixed plates generates molecular pressure, which, falling obliquely on the fly, causes it to rotate.

3. *Otheoscope.*—A large horizontal disc, revolving by the molecular disturbance on the surface of inclined metallic vanes, which are blacked on both sides in order to absorb the maximum amount of radiation.

4. *Otheoscope.*—Inclined aluminium vanes driven by the molecular disturbance from the fixed black mica disc below, blowing (so to speak) through them.

5. *Otheoscope.*—A large horizontal coloured disc of roasted mica, driven by inclined aluminium vanes placed underneath it.

6. *Otheoscope.*—A bright aluminium disc cut in segments, and each segment turned at an angle, driven by a similar one below of lampblacked silver.

7. *Radiometer.*—A vertical radiometer, made with eight discs of mica blacked on one side, and the whole suspended on a horizontal axis which works in two glass cups. The motion of the radiometer is assisted on each side by driving vanes of aluminium blacked on one side.

8. *Radiometer.*—A vertical turbine radiometer, the oval vanes of roasted mica blacked on one side.

9. *Radiometer.*—A spiral radiometer of roasted mica blacked on the upper side.

10. *Radiometer* of large size, showing great sensitiveness.

11. *Radiometer.*—A two-disc radiometer, the fly carrying roasted mica discs blacked on one side; in front of each blacked surface is fixed a large disc of thin clear mica. The molecular disturbance set up on the black surface, and streaming from it, is reflected in the opposite direction by the clear plate of mica, causing the fly to move abnormally, *i.e.*, the black surface towards the light.

12. *Radiometer.*—A two-disc radiometer, the fly carrying roasted mica discs blacked on one side, similar to No. 11, but with a large clear disc on each side. The molecular disturbance, prevented from being reflected backwards by the second clear disc, is thus caused to expend itself in a vertical plane, the result being a total loss of sensitiveness.

13. *Radiometer.*—A two-disc, cup-shaped, aluminium radiometer, facing opposite ways; both sides bright. Exposed to a standard candle 3·5 inches off, the fly rotates continuously at the rate of one revolution in 3·37 seconds. A screen placed in front of the concave side so as to let the light shine only on the convex surface repels the latter, causing continuous rotation at the rate of one revolution in 7·5 seconds. When the convex side is screened off, so as to let the light shine only on the concave, continuous rotation is produced at the rate of one revolution in 6·95 seconds, the concave side being apparently attracted. These experiments show that the repulsive action of radiation on the convex side is about equal to the attractive

[1] *Molecular*, not *molar*. There is no wind in the sense of an actual transference of air from one place to another. This molecular movement may be compared to the movement of the gases when water is decomposed by an electric current. In the water connecting the two poles there is no apparent movement, although eight times as much matter is passing one way as the other.

[2] *Proc.* Royal Soc., November 16, 1876, p. 310.

[3] Since writing this I have constructed such an instrument. The movement takes place in the way I had anticipated.—W. C., April 26, 1877.

action of radiation on the concave side, and that the double speed with which the fly moves when no screen is interposed is the sum of the attractive and repulsive actions.

14. *Radiometer.*—A two-disc, cup-shaped, aluminium radiometer, lamp-blacked on the concave surfaces. In this instrument the usual action of light is reversed, rotation taking place, the bright convex side being repelled, and the black concave attracted. When the light shines only on the bright convex side, no movement is produced, but when it shines on the black concave side, this is attracted, producing rotation.

15.—*Radiometer.*—A cup-shaped radiometer similar to the above, but having the convex surfaces black and the concave bright. Light shining on this instrument causes it to rotate rapidly, the convex black being repelled. No movement is produced on letting the light shine on the bright concave surface, but good rotation is produced when only the black convex surface is illuminated.

16. *Radiometer.*—A multiple-disc, cup-shaped, turbine radiometer, bright on both sides, working by the action of warm water below and the cooling effect of the air above.

17. *Radiometer.*—A four-armed metallic radiometer with deep cups, bright on both sides.

18. *Radiometer.*—A four-armed radiometer, the vanes consisting of mica cups, bright on both sides.

19. *Radiometer.*—A four-armed radiometer having clear mica vanes. The direction of motion being determined by the angle formed by the mica vanes with the inner surface of the glass bulb.

DROUGHTS AND FAMINES IN SOUTHERN INDIA[1]

THE paper on this subject, noted below, a copy of which we have just received, will no doubt awaken much interest, not only on account of its scientific bearings but also from its bearings on so very practical a subject as the famines of India. It is most gratifying to see that the subject has been taken up by one who gives evidence on every page of rare capacity as a scientific statistician. There is throughout an absence of straining the facts before him beyond what they may legitimately bear, and a skill in combining them so as to eliminate, as far as possible, what is merely accidental from the results ultimately arrived at in their relation to the sun-spot period.

The data discussed in Dr. Hunter's paper are the amounts of the annual rainfall at Madras from 1813 to 1876, and the relative number of sun-spots from 1810 to 1876. The results of the inquiry are given in the following six propositions:—

1. That no uniform numerical relation can be detected between the relative number of the sun-spots and the actual amount of rainfall.

2. That although no uniform numerical relation can be detected between the relative number of sun-spots and the actual amount of rainfall, yet that the minimum period in the cycle of sun-spots is a period of regularly recurring and strongly marked drought in Southern India.

3. That, apart from any solar theory, an examination of the rain registers shows that a period of deficient rainfall recurs in cycles of eleven years at Madras; that this period consists of the eleventh and second series of years in the cycle; which two series also contain six out of the seven years of minimum sun-spots falling in this century up to 1878.

4. That after the period of minimum rainfall in the eleventh and second series of years in the cycle, the rainfall rises to a maximum in the fifth year; after which it again declines to its minimum period in the eleventh and second years.

5. That, apart from any solar theory, the statistical evidence shows that the cycle of rainfall at Madras has a marked coincidence with a corresponding cycle of sun-spots; that in this cycle of eleven years both the sun-spots and the rainfall reach their minimum in the group consisting of the eleventh, first, and second years; that both the rainfall and the sun-spots then increase till they both reach their maximum in the fifth year, after which they decline together till both again enter their minimum period in the eleventh, first, and second series of years.

6. That while the statistical evidence discloses a cycle of drought in Southern India, coincident in a marked manner with a corresponding cycle of sun-spots, it also tends to show that the average rainfall of the years of minimum rainfall in the said cycle approaches perilously near to the point of deficiency which causes famine. That the average is, however, above that point; and that, while we have reason to apprehend recurring droughts and frequent famines in these cyclic years of minimum rainfall, the evidence is insufficient to warrant the prediction of a regularly recurring famine.

It will be observed that these results are strongly confirmatory of the general conclusions arrived at by Meldrum and others, who have examined the question from data collected from a large area, and embracing an extended series of years, the only noteworthy point of difference being the larger rainfall of the first year of the cycle, as compared with the eleventh and second years which immediately precede and follow it. It is perhaps only to be looked for that such an anomaly should be met with in dealing with the rainfall of only one place, embracing a period of sixty-four years, seeing that the accidental occurrence of one or two cyclones, accompanied with unusually heavy local rainfall, would be sufficient to produce the anomaly in question. The anomaly would in all likelihood have disappeared if the area of observation had been wider or the time of observation longer. It is scarcely necessary to do more than point out the absolute necessity of establishing physical observatories in order to obtain the data for the investigation of the connection between the state of the sun's surface and the state of terrestrial convection currents, it being only through their cosmical relations that we may reasonably hope to solve many of the more difficult problems of meteorology, some of which lead to intensely practical issues.

[1] "The Cycle of Drought and Famine in Southern India," by W. W. Hunter, LL.D., Director-General of Statistics to the Government of India.

OUR ASTRONOMICAL COLUMN

MR. GILL'S EXPEDITION TO ASCENSION.—In an address to the Royal Astronomical Society on April 8, 1857, "On the means which will be available for correcting the measure of the sun's distance during the next twenty-five years," the Astronomer-Royal directed attention to a method of making observations for parallax, not applicable to the planet Venus, but applicable to Mars, namely, by "observing the displacement of Mars in right ascension when he is far east of the meridian, and far west of the meridian, as seen at a single observatory," and he particularised the advantage of this method, and expressed his opinion that it is "the best of all." The observations are not attended with the very great expense which is involved in the efficient observation of a transit of Venus, indeed if made at an established observatory need entail little or no cost; they may be conducted by a single observer or series of observers, in the latter case with a due regard to personal equation, and each observatory co-operating in the work, will furnish a result quite independent of the rest, so that the observer has the satisfaction of knowing that by the method recommended his own observations alone will give a value for the most important unit of measure in astronomy. The Astronomer-Royal confined his remarks to the observation of differences of right ascension, recommending as of the first consequence a firmly-mounted equatorial, and as advantageous though not absolutely necessary the chronographic method of transits first introduced by the American astronomers. The oppositions of Mars in 1860 and 1862 were referred to with regard to their relative advantages for such observations.

Mr. Gill has taken a further and an important step in the direction of utilising observations of Mars for the determination of the solar parallax. Encouraged by Lord Lindsay's liberal offer of the loan of the heliometer employed in the expedition to the Mauritius for the observation of the transit of Venus, Mr. Gill proposes to leave England this month for the island of Ascension, and to apply the heliometric method of measurement of distances instead of observing differences of right ascension, as suggested in the Astronomer-Royal's address, and as was stated in NATURE last week, the council of the Royal Astronomical Society have guaranteed 500*l.* for the expenses of Mr. Gill's expedition. Ascension has been fixed upon, not without a careful consideration of probable meteorological conditions about the time of the opposition of Mars in September, in which it is understood the records of the Meteorological Office have been of the greatest service, and in fact, have induced Mr. Gill to fix upon Ascension for the site of his temporary observatory in preference to St. Helena, the astronomical condition being about the same for the two islands, *i.e.*, their latitudes not differing much from the declination of the planet when nearest to the earth, so that it is observable at a considerable hour-angle on both sides of the meridian.

The *modus operandi* proposed by Mr. Gill, is as follows:—two stars, *a* and *b*, one preceding and the other following the planet, are selected for each night of observation, and their angle of position and distance relative to the planet are computed roughly for 4h. E. and 4h. W. hour-angle, and the right ascension and declination of the middle point between star and planet; so that the proper stars of comparison are readily found. The heliometer axis is directed to this middle point, the position-circle set to the position-angle, and the segments set to the approximate distance. The observer finds in the field of view a star and the planet; by turning the handle by which the segments are moved in *distance*, the images of star and planet are made to move relatively to each other in the direction of a line joining the objects, while if the position-handle is turned, the images move in the direction of a line perpendicular thereto. Suppose that the star *a* is viewed through segment A, and the planet through segment B. According to Mr. Gill's usual practice the observation would proceed thus:—

I. Measure of position-angle.
II. Measure of distance, both limbs.
III. Reverse segments, and view star by segment B and planet by segment A.
IV. Measure position-angle.

This constitutes one measure.

V. Repeat this process with star *b*.
VI. Reverse position-circle and repeat the comparison with star *b*.
VII. Compare again with star *a*.

This constitutes a complete symmetrical set, which Mr. Gill has found can be secured on an average in 1h. 30m., sometimes in 1h. 10m., or if there be interference from cloud it may occupy 2h.

In the measure of a position-angle, by a movement of the handle for distance, the star may be made to move, relatively to the planet along the line of separation of the lenses, so that the star successively occupies positions 1, 2, 3 . . . 3, 2, 1, &c. This motion may be very slow and the position-circle being set so that the motion of the planet completes the bisection, the observer has only to go on moving the star slowly till the limb is seen to symmetrically bisect the star (the time of which is noted) precisely as Jupiter's limb bisects one of his satellites.

The measure of distance is conducted with equal care, but is not so readily explained without a diagram. Mr. Gill finds his method possesses very great delicacy. It sometimes happens that it is not possible to find a star sufficiently bright to compare with Mars in his full light. In such cases the brilliancy of the planet can be easily kept down by a wire-gauze screen, which, by an arrangement at the eye-end, can be laid over either segment of the object-glass and at any angle thereto.

In a letter to M. Leverrier, published in the *Bulletin International* of April 27, Mr. Gill states that the observations of Juno, which he made with Lord Lindsay at the Mauritius with the same heliometer, showed that the determination of the diurnal parallax by measuring with this instrument the distance of the planet from a star preceding and a star following is susceptible of an extreme precision, and he found the probable error in the determination of the planet's position for each complete observation of the morning or evening did not exceed $\pm 0''\cdot075$. Lord Lindsay has stated that the value of the solar parallax, resulting from these observations of Juno (a single discordant one only being rejected) is $8''\cdot82$, which approaches near to Prof. Newcomb's value, $8''\cdot85$, adopted provisionally by the German astronomers, and to M. Leverrier's theoretical determination, $8''\cdot86$. This sufficiently indicates the utility of the method, and Mr. Gill intends to avail himself of the close oppositions of the minor planets Ariadne and Melpomene during his visit to Ascension to obtain values of the parallax by observation on the same principle.

COMET 1877 II. (WINNECKE, APRIL 5).—This comet may be expected to prove a fine telescopic object during the absence of moonlight in the circumpolar sky, with its stellar-looking nucleus and double or broad fan-shaped tail. The annexed positions for midnight at Berlin are from elements by Herr Plath, of Hamburg, and have been received from Prof. Winnecke:—

	R.A. h. m. s.	Declination. ° ′	Log. Distance from Earth.
May 4	23 26 5	+65 59·2	9·99601
5	23 36 41	68 7·2	9·99640
6	23 49 22	70 11·6	9·99741
7	0 4 45	72 11·3	9·99902
8	0 23 31	74 4·5	0·00123
9	0 46 49	75 48·8	0·00400
10	1 15 34	77 21·5	0·00732
11	1 50 47	78 38·3	0·01116
12	2 32 59	79 35·1	0·01549
13	3 19 55	80 7·8	0·02028
14	4 8 57	+80 13·6	0·02548

The following orbit has been calculated by Mr. Hind from observations at Strasburg, on April 5 and 25, and at Berlin and Leipsic on April 14:—

Perihelion Passage, 1877, April 17·64687, G.M.T.

	° ′ ″	
Longitude of Perihelion	253 30 9	Mean Equinox, 1877·0
,, Ascending Node ...	316 33 53	
Inclination	58 54 22	
Distance in Perihelion	0·950250	

Heliocentric motion—retrograde.

These elements represent the observations during the interval very closely.

NOTES

M. FLAMMARION has been authorised by M. Leverrier to use one of the largest refractors of the Paris Observatory for the investigation of the motion of double-stars round a common centre of attraction. This liberality on the part of the chief of the Paris Observatory is highly creditable. M. Leverrier, indeed, is desirous of placing the immense means of investigation possessed by the observatory at the service of a number of independent workers not belonging to the staff of the establishment, but who have given solid proofs of their zeal and capacity for research in some particular science. His ambition is to create at the observatory a national astronomical institution where qualified scientific men may find ample means for following their own special studies.

SIR DAVID MONRO, late Speaker of the House of Representatives in New Zealand and an active promoter of science in that colony, died at Nelson, New Zealand, on February 15. He graduated in Medicine in the University of Edinburgh in 1834, where his great grandfather, grandfather, and father successively held the Chair of Anatomy. He devoted the leisure of an active political life to the pursuit of botany, and by his discoveries, which were published by Dr. Hooker in his "New Zealand

Flora," he added largely to our knowledge of the vegetation of New Zealand, on which he also wrote an instructive essay that is published in the first volume of the *Transactions* of the New Zealand Institute.

WE learn with the greatest pleasure that the Health Committee of the Police Board of Glasgow has agreed to carry out at eight stations in that city the system of continuous automatic observation of the constituents of the air, special attention being given to its impurities arising from manufactures and other causes which has been devised and worked out since March, 1876, by Mr. E. M. Dixon, in connection with Dr. Russell, Medical Officer of Health. The Committee has already expended fully 200*l.* in fitting up a laboratory and the observing stations with the instruments required, and are prepared to expend a sum of 300*l.* per annum in carrying out this very important practical investigation. The results, including meteorological observations made in connection with the scheme, will be published monthly, the first number appearing in June next.

GAY-LUSSAC, the great French physicist and chemist, was born in 1778, and his centenary will be celebrated by a festival and the erection of a statue either in Limoges or Paris.

A SERIES of lectures upon zoological subjects will be given in the Zoological Gardens, Regent's Park, on Thursdays at 5 P.M., after Whitsuntide. The first lecture will be delivered in the Lion House, and others in the lecture-room near the Reptile House. May 24: "The Lion House and its Inhabitants," P. L. Sclater, F.R.S; May 31: "Sea-urchins and Star-fishes," Prof. Huxley, F.R.S.; June 7: "Sloths and Ant-eaters," Prof. Flower, F.R.S.; June 14: "Whales and Porpoises," Prof. Flower, F.R.S.; June 21: "Man-like Apes," Prof. Garrod, F.R.S.; June 28: "Variation in Domestic Animals," W. B. Tegetmeier, F.Z.S.; July 5: "Hornbills and their Habits," Dr. Murie, F.Z.S.; July 12: "Birds of Prey," R. B. Sharpe, F.Z.S.; July 19: "Frogs and Toads," Prof. Mivart, F.R.S.; July 26: "The Ornithorhynchus," Prof. Garrod, F.R.S. These lectures will be free to Fellows of the Society and their friends, and to other visitors to the Gardens.

THE annual *conversazione* of the Royal Society was held at Burlington House on Wednesday week, and was numerously attended. There was a large collection of instruments brought together, among the principal of which were the following:—An Automatic Spectroscope, which can be used with 2, 4, or 6 prisms, solar eye-piece arrangement, and new split slit, whereby any lines in the spectrum can be measured; a Heliostat, with large crown-glass prisms, to be employed with the spectroscope; Governor for 18-inch reflector, which will keep time with a variation of rate of five seconds per minute, at pleasure; all designed and exhibited by Lieut.-Colonel Campbell, of Blythswood, and constructed by A. Hilger.—Prof. W. G. Adams exhibited an Apparatus for producing interference of light by means of thick plates, and Apparatus for the reflection and refraction of radiant heat and light, fitted to Clifton's optical bench, and constructed by Messrs. Elliott Brothers. The half-prism direct-vision spectroscope made for Greenwich, about which there has recently been a correspondence in NATURE, was also shown. Then there was a Hydroclinometer, an instrument for taking ranges, without any calculation, from coast batteries over 100 feet in height; a small hydroclinometer, a modified form of the above, for giving the inclination of slopes, &c., without any adjustment, and for larger guns; an electric position- and range-finder for coast batteries; a Field-Artillery range-finder; an Infantry range-finder; a patent self-adjusting optical square, which by a simple adjustment can immediately be corrected to the true right angle, without the aid of any other instrument; an electric chronograph, for the measurement of minute portions of time, velocities of shot, &c., by the *free* fall of a weight; these were exhibited by Capt. Watkin, R.A.—Lieut. G. S. Clarke and Prof. Herbert M'Leod showed an instrument called the Cycloscope, an apparatus for determining the speed of machinery by means of a tuning-fork or reed of known period; also for ascertaining the pitch of a tuning-fork by means of a cylinder rotating at a known speed. There were also Telephone and (patent) Thermo-electric Pile (in action), with specimens of Gray's telephone, exhibited by Messrs. C. and L. Wray; improved Holtz electrical machine with four plates and self-charging arrangement, in glass case, ready for use in any condition of the atmosphere, and Manometric apparatus, for showing effects of sound on a sensitive flame, exhibited by Mr. Ladd; teeth, bones, and ancient works of art lately found in caves in Derbyshire, exhibited by Mr. Boyd Dawkins, F.R.S.; specimens of cast and wrought iron treated by Prof. Barff's process for the prevention of corrosion, which consists in acting on iron at suitable temperatures with dry steam, exhibited by Prof. Barff; specimens of the core of well, from Meux's Brewery; the large induction-coil, with secondary wire of 280 miles, constructed for Mr. W. Spottiswoode by Mr. Apps (in operation), was shown in the meeting room, and Mr. Crookes's Otheoscope, of which we give an account this week.

ON Monday Prof. Boyd Dawkins commenced a series of eight Field Lectures on Geology at Owens College. Six of the lectures will be in connection with excursions to various places from Manchester.

MR. WILLIAM GOSSAGE, F.C.S., the inventor of several important processes in practical chemistry, died at Earlsleigh, Bowdon, Cheshire, on April 9, in his seventy-eighth year.

THE Council of the Royal Geographical Society have awarded the Royal medal to Capt. Sir George S. Nares, R.N., for having commanded the Arctic Expedition of 1875-6, and to Pundit Nain Singh, for having added a greater amount to our positive knowledge of the map of Asia than any individual of our time. In his first great journey he for the first time determined the position of Lhassa, the capital of Tibet, besides surveying the course of the great river Tsanpo, or Bramaputra, from near its source to near its entrance into the Himalayan region; in his last he traversed and surveyed the high Plateau of Tibet from its extreme north-west to Lhassa, a line of 1,200 or 1,400 miles of entirely new country. No reward was ever better earned than that bestowed by the Society on Nain Singh, who, indeed, deserves to be ranked among the first of explorers. While pursuing his arduous and dangerous work he was paid at the rate of 7*l.* per month, and now retires, satisfied we believe, on a pension of 50*l.* a year. Through his labours we have now for the first time a scientific basis on which to construct a map of Tibet. A gold watch, with an appropriate inscription, was at the same time awarded to Capt. Albert Markham, R.N., for having commanded the northern division of sledges in the Arctic Expedition of 1875-6, and for having planted the Union Jack in 83 deg. 20 min. 26 sec. N., a higher latitude than had ever been reached by any previous expedition.

IT is but a poor set-off to the horrors of war that it is a means of speading a real knowledge of geography; but that it does do so was shown in this country during the last Oriental war—the Crimean. As might have been expected, numerous war-maps have already appeared. The most satisfactory of these maps is a large one published by Mr. Stanford on the scale of fifty miles to an inch, including Turkey in Europe and her tributary states, together with such parts of neighbouring countries in Europe and Asia as are more immediately connected with the settlement of the Eastern Question. Any one wishing to follow the movements of the two armies could not obtain a better guide. All the physical and political features, including the railways up to date, are shown with great clearness. Mr. Stanford publishes two other war-maps, one on a smaller scale and at a cheaper price than the above, and Jankowsky's Russo-Turkish war-map, a picture or bird's-eye map of Turkey and the Black Sea. A very fine and moderate-priced map comes to us from Perthes, of Gotha. It is prepared by Dr. Petermann, and is evidently a compilation from several of the maps in Stieler's Atlas. It embraces all the country in Europe and Asia likely to be included in the theatre of war, so long at least as it is confined to the two combatants now in the field. This map, sold at a very moderate price, may be had in London from Mr. Stanford.

THE war just begun will in no way interfere, we believe, with the forthcoming Paris Exhibition. The works are progressing with such activity that everything but the Trocadero palace will be ready at an earlier date than was anticipated. The Trocadero building has been delayed by legislative difficulties, which, however, have been overcome, and that building will not be behind its time.

M. HENRY GIFFARD is constructing, near the Champ de Mars at Paris, a workshop for the preparation of sulphate of iron. The apparatus was tried for the first time last Friday, when the balloon *Eole* was inflated in an hour and a half, and was sent up with an aëronaut. The capacity of the balloon being 220 cubic metres, the rate of production is very satisfactory. It is expected that the sale of sulphate will cover almost all the expenses, so that numerous scientific ascents may be made in the ensuing summer. The monster captive balloon of 20,000 cubic meters will be inflated by the same process.

THE annual meeting of the Royal Institution was held on Tuesday. The Annual Report of the Committee of Visitors for the year 1876, testifying to the continued prosperity and efficient management of the Institution was read and adopted. The real and funded property now amounts to above 84,000*l*. entirely derived from the contributions and donations of the members. Seventy-two new members paid their admission fees in 1876.

THE forty-eighth anniversary of the Zoological Society was held on Monday. The number of fellows, fellows-elect, and annual subscribers at the close of the year 1876 amounted to 3,311, showing an addition to the strength of the society of seventy members during the year 1876. The number of honorary members at the same date was fourteen, of foreign members twenty-five, and of corresponding members 199. The total income of the society in 1876 was 34,955*l*., exceeding that of the year 1875 by 6,216*l*. The total expenditure of the society in 1876 was 31,635*l*. The total assets of the society on December 31, 1876, were calculated to be 15,516*l*., while the liabilities were reckoned at 4,430*l*. The total number of visitors to the society's gardens in 1876 had been 915,764, the corresponding number in 1873 (hitherto the most successful year in this respect) having been 713,048. The number of visitors in 1876 had therefore exceeded that of any other previous year since the opening of the gardens, by more than 200,000. The report stated that the total number of animals in the collection on December 31, 1876, had been 2,265.

IN the May part of Petermann's *Mittheilungen* Herr K. Zöppritz has a critical paper on Watson and Chippendall's Survey of the White Nile and Junker's Survey of the Sobat. Herr Zöppritz expresses some dissatisfaction with the observations of the former as being vague and careless and difficult to reconcile with data already obtained. A valuable paper by Dr. Dorst describes and discusses the movements of the ice between Greenland and Spitzbergen as observed by him in the steamer *Bienenkorb* in 1869. It is an important contribution to our knowledge of the currents of this region.

THE examination for the Sheepshanks Astronomical Exhibition, which is of the annual value of 50*l*. and tenable for three years, will be held on May 21 in Trinity College Lecture-room No. 4. All undergraduates of the University are eligible, but in the event of a candidate who is not a member of Trinity College being elected, he must become a member of Trinity. Candidates are required to send their names, and, if not members of Trinity, certificates of moral character and good conduct to one of the tutors of Trinity on or before May 19.

A DETAILED account of Father Cecchi's remarkable seismograph to which we recently referred will be found in the January number (1877) of *Elettricista*. The Cecchi seismograph has been adopted with good success at several of the larger Italian observatories and meteorological stations. In order to enable also smaller establishments to obtain a similar apparatus at much less cost, Prof. Cecchi has lately constructed a simpler one on the same principle, which meets all the requirements for seismical observations and gives nearly as many and as exact data as the larger instrument. A full description of this is now being published in the *Elettricista*, and the adoption of it for meteorological stations may be strongly recommended. The whole cost will not exceed 4*l*. or 5*l*.

M. SICARD, member of the Italian Anthropological Society, on making excavations on his property near Kischeneff, in Bessarabia, at a place called Moguil Liondia, discovered a very large tumulus of earth, with human skeletons, remains of iron objects, and an amulet of carved bone. One of the corpses appeared to have been interred with a horse, much in the same way as the tribes of the Tehuelches and Pehuelches still bury their fellow-men. Unfortunately the skulls were dispersed, but M. Sicard is going to continue his excavations, and will give a detailed account of his highly interesting discovery in the *Rivista di Antropologia e Etnologia*, published by Prof. Mantegazza.

AT the last meeting of the Ethnographical Section of the Russian Geographical Society, M. Poliakof, referring to the results of his last journey on the Obi, pointed out the remarkable similarity between the present state of civilisation of the Ostiaks and that of the prehistoric inhabitants of the reindeer period of France and Middle Europe. After a description of the features which the present flora and fauna of the banks of the Obi have in common with those of Europe at that period, M. Poliakof described the primitive mode of life of the Ostiaks. Their utensils and implements almost exactly resemble those of the stone period and the islands of the Pacific, being made exclusively of stone, of teeth and claws of bears, and of bone, and their clothes being either furs or woven from nettle filaments. M. Poliakof described at length their mode of life, their wretched homes, their customs, their family relations, and their religion, the latter being a mixture of the rudest fetishism with the strangest superstitions. This people are rapidly fading away before the advance of European civilisation.

DURING the diluvial epoch, the Danube entering into the Vienna Basin, formed an inland sea, and covered the Tertiary formations with deep layers of so-called loess, a mixture of loam, lime, sand, and foliaceous mica. The Imperial Academy of Sciences at Vienna has lately set in operation an extensive series of excavations with the view of uncovering the secrets hidden beneath this thick coating of alluvium, and has already been rewarded by interesting discoveries. The excavations in the neighbourhood of Zeiselberg have disclosed a widespread deposit of bones mingled with numerous evidences of the presence of mankind. These consist in quantities of charcoal, bones which have been worked, artificially prepared flints, &c. The bones among which these prehistoric remains were found, are those of the bear, horse, mammoth, ox, reindeer, rhinoceros, and wolf, all belonging to the diluvial fauna, and all apparently inhabiting the Vienna Basin at that distant epoch in the company of man, for a chance gathering of these remains through the agency of water is precluded by the local topography cf the place.

NEWS from M. Prshevalsky, forwarded on March 23 by telegraph from Vernyi, appears in the official paper, the *Russian Invalid.* On February 11 he had reached Lake Lob-Nor, *viâ* the Valley of the Lower Tarim. The population of the Valley is very sparse. Its height above the sea is somewhat more than 2,000 feet. Its flora and fauna very poor. The topography is quite different from that represented on the maps. He was, at the time of telegraphing, in the mountains Altyn-Tagh, some distance south of Lake Lob-Nor. The valleys of the exterior spurs of these mountains reach about 12,000 feet above the sea. Here, as well as in the lower regions there are wild camels. In the neighbourhood of Lob-Nor he found the ruins of two old towns. He was to spend February and March at Lob-Nor, April on the Lower Tarim, and May and June on the Tian-Shan, returning to Kuldja at the beginning of July.

WE have received as a contribution to the Gauss Fund, 1*l.* from Mr. G. Griffith.

THE additions to the Zoological Society's Gardens during the past week include an Egyptian Gazelle (*Gazella dorcas*) from Egypt, presented by Her Majesty the Queen; an Indian Leopard (*Felis pardus*) from India, presented by Dr. Sidney Smith; a Crested Porcupine (*Hystrix cristata*) from Ceylon, presented by Capt. Smerdon, s.s. *Orion*; a White Pelican (*Pelecanus onocrotalus*) from Egypt, presented by Mr. A. C. Henderson; a King Parrakeet (*Aprosmictus scapulatus*) from New South Wales, presented by Miss Jones; a Suricate (*Suricata zenik*) from South Africa, presented by Mr. J. Forbes Dixon; an Indian Cobra (*Naia tripudians*) from Ceylon, presented by the Hon. W. D. Wright; a Beisa Antelope (*Oryx beisa*), two African Sheep (*Ovis aries*), eight Vulturine Guinea Fowls (*Numida vulturina*), from East Africa, a Toque Monkey (*Macacus pileatus*) from Ceylon, deposited; a Pigmy Marmoset (*Hapale pygmæus*), two Bay-headed Parrots (*Caica leucogastra*), a Rough Terrapin (*Clemmys punctularia*) from the Upper Amazons, purchased.

SCIENTIFIC SERIALS

The American Journal of Science and Arts, April, 1877.—On the sensation of colour, by C. S. Peirce.—Note on the binocular phenomenon observed by Prof. Nipher, by J. Le Conte.—Revision of the genus Belemnocrinus, by C. Wachsmuth and F. Springer.—Thorpe's and Bunsen's methods for the estimation of nitrogen in nitrates, by S. W. Johnston.—Westfield during the Champlain period, by J. S. Diller.—New embryonic forms of trilobites, by S. W. Ford.—The winds of the globe, or the laws of atmospheric circulation over the surface of the earth, by J. H. Coffin.—On some nitro-derivatives of diphenylamide, by P. T. Austen.—On mineral analysis; on some fluorides; and on molecular volumes, by F. W. Clarke.—On the identity of the so-called Peganite of Arkansas with the Variscite of Breithaupt and Callamite of Damour, by A. H. Chester.—On a fibrous variety of sepiolite from Utah, by the same.—On Dr. Peale's notes on the age of the Rocky Mountains in Colorado, by J. J. Stevenson.

Poggendorff's Annalen der Physik und Chemie, No. 2, 1877.—The spectra of chemical compounds, by M. Moser.—Researches on the volume-composition of solid bodies, by M. Schröder.—Current regulator for gas, by M. Teclu.—Contribution to Boltzmann's theory of elastic reaction, by M. Kohlrausch.—Further communications on the connection between the viscosity and the galvanic conductivity of various liquids, by M. Grotrian.—On the theory of resonators, by M. Grinwis—On photography of the less refrangible parts of the solar spectrum, by M. Vogel.—Researches on the motions of radiating and irradiated bodies, by M. Zöllner.—New proof of the falsity of the emission theory of light, by E. Feussner.—On double excitation of the ebonite electrophorus, by M. Schlösser.

Beiblätter zu den Annalen.—Quantitative comparison between friction and galvanic electricity in respect of tension, by M. Nystrom.—On the deduction of a new electrodynamic fundamental law, by M. Clausius.—Thermoelectric researches, by M. Tidblom.

THE *Naturforscher* (March).—From this part we note the following papers:—On the functions of the larger brain (cerebrum), by Herr Goltz.—On the expansion of growing vegetable cells through the tension existing between the contents of the cells and the membrane forming them, by Hugo de Vries.—On the spectrum of the new star in Cygnus, by R. Copeland.—On the atomicity of phosphorus, by Ira Remsen.—On the high tides in the River Elbe, by K. R. Bornemann.—On the reproduction of eels, by M. C. Dareste.—On the formation of hail, by H. Fritz.—On the inhalation of air by the roots of plants, by MM. P. P. Déhérain and J. Vesque.—On electrolysis accompanied by the development of hydrogen at both electrodes, by Emil Elsaesser.—On the daily and yearly course of magnetic declination, by J. Hann.—On the behaviour of leaves in an atmosphere free from carbonic acid, by B. Corenwinder.—On the companions of the pole star, by A. de Boe and others.—On the spreading of drops of liquids, by Fillipo Centolesi.—On the preparation of photographic plates in daylight, by Oswald Lohse.—On the origin of the flying power of bees, by Herr Dönhoff.—On the chlorophyll of Coniferæ germinating in the dark, by R. Sachsse.—On the behaviour of chlorophyll in the vine, by G. Briosi.—On the glycogen contained in muscles, by Th. Chandelon.

Journal de Physique, March.—On the dynamical theory of gases, by M. Violle.—On the effects of a jet of air sent into water, by M. de Romilly.—On the suspension and ebullition of water on a large-meshed tissue, by the same.—On the phenomenon of the black drop and its influence on observation of the transit of Venus, by M. André.—The persistence of impressions on the retina, various experiments with the projection-phenakisticope, by M. Gariel.—On Optography, by M. Kühne.

Reale Istituto Lombardo di Scienze e Lettere, Rendiconti, vol. x., fasc. iii.—On two recent works (on flagellation and the anatomical museum at Pavia) presented to the Institution, by M. Verga—On some rare alterations of the first formation of the uterus and its attachments; on a cause not yet confirmed of distonia, by M. Sangalli.—On a new defence of the theory of Melloni on electrostatic induction, by M. Cantoni.—On the divisibility of comets into minute parts, and on a dark spot found in the Milky Way, by P. Secchi.

Revue des Sciences Naturelles, tome v. No. 4.—On the so-called cladodes of Ruscus, by M. Duval-Jouve.—Study of a chromogenic bacterium in the water of steeping of flax (*Bacterium rubescens*, Ray Lankester [?]), by Prof. Giard.—On the development of the Anguillula Aceti, Ehrb., by M. Hallez.—Economical Aquarium, by M. Sabatier.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 22.—"On Stratified Discharges *v.* Stratified and Unstratified Forms of the Jar-Discharge," by William Spottiswoode, M.A., F.R.S. It is well known that if a Leyden jar be discharged through a vacuum tube, the discharge generally takes the form of an unbroken column of light, extending from the point of the positive terminal to the hilt of the negative, *i.e.*, to the extreme negative end of the tube; and that it shows no trace of either negative glow or intervening dark space. On the other hand, I have found, by experiments with a large Leyden battery, that if a tube having one terminal connected with the negatively charged coating of the battery and the other held beyond striking distance from the positively charged coating, the discharge in the tube will show a separation of the positive from the negative part by a dark intervening space. Under suitable circumstances of exhaustion it will also show striæ, in the same manner as when the discharge is effected directly with a Holtz machine, having the conductors either closed or open beyond striking distance (see Roy. Soc. *Proceedings*, vol. xxiii. p. 460). Again, I have found, with the same battery, that if the tube be connected—otherwise as before—and held at a distance less than at first, but a little greater than striking distance, a stratified discharge much more brilliant and more like that produced by a coil will be exhibited. The latter form of discharge appears to the unassisted eye as an unbroken column of light, but with a negative glow and dark space. A revolving mirror, however, resolves the column into a regular array of striæ, having a rapid proper motion towards the positive terminal.

With a view to examining the transition from the stratified to the unstratified form as closely as possible, a Holtz machine was employed, with a battery of one or more jars. The outside of this battery and one terminal of the tube were connected with the earth; and the inside and the other terminal were alternately connected with the positive conductor of the machine, so that the battery was alternately charged and discharged through the tube. The amount of charge was regulated partly by the distance through which the conductors of the machine were separated, and partly by the number of revolutions of the machine during which the charging took place.

The first object proposed was to ascertain whether a jar could be charged with so small a quantity of electricity as of itself to give a stratified discharge in a tube.

A number of tubes tried with various amounts of battery charge, but with the same surface, showed that, as the charge was increased, the head of the positive column advanced towards the negative terminal, the dark space became narrower, and the glow contracted in dimensions; and when the head of the column drew very near to the negative terminal, the glow, instead of covering the whole surface of the terminal, formed a small drop at the point. On still further increasing the charge, the drop withdrew to the hilt of the terminal; and finally, when it had completely retreated into the hilt, the continuous or true jar-discharge took place.

With a view to testing experimentally how far the effects here described were due to quantity, and how far to tension, the size of the jar was altered, all other circumstances remaining the same. It was then found that the maximum charge compatible with stratification was greater with a large than with a small jar.

As a further experiment in this direction, a series of jars were arranged in cascade, and it was found that the greater the number of jars so arranged the smaller the charge necessary to ensure a true jar-discharge. A charge insufficient to destroy stratification with one jar was sufficient to destroy them when more than one was used in cascade. These results point to tension rather than to quantity as the determining cause of the character of the discharge.

The duration of the stratified discharges observed throughout these experiments was exceedingly short, indistinguishable, in fact, from that of the true jar-discharge. When viewed in a revolving mirror they showed no sign whatever of prolonged duration, and we may thence conclude that, so far as our present instrumental arrangements extend, there is no inferior limit to the duration of discharge necessary for the production of striæ.

A comparison of the results here obtained with those detailed in Part ii. of these researches, shows that the phenomena produced by suitable disposition of the Leyden battery coincide with those produced by the induction-coil. With the coil it was found that (1) for a given electromotive force the column of striæ was shorter the larger the battery surface or strength of current used; (2) that the proper motion, when directed as usual towards the positive terminal, was more rapid the greater the electromotive force employed. With the Leyden battery it was found that (1) in order to maintain the same length of column with an increased surface the charge must be increased in a larger proportion than the surface; and (2) it was noticed that the striæ which when the tension was low were distinct and well separated, became more blurred as the tension rose, until they sometimes were blended into an apparently unbroken column of light. The presence, however, of the negative glow still showed that the true jar-discharge had not yet been reached.

Geological Society, April 11.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—John Robert Campbell, James Carter, William Radcliffe Ellis, William Hamilton Merritt, William Morgans, and Edmund Albert Parsick, were elected fellows of the society. The following communications were read:—On sandworn stones from New Zealand, by John D. Enys, F.G.S. The author exhibited specimens of sandworn pebbles from near Wellington, in New Zealand, and described their mode of occurrence.—The Bone-caves of Cresswell Crags, third paper, by the Rev. J. Magens Mello, F.G.S. In this paper the author gave an account of the continued exploration of these caves, and of the completion of the examination of the Robin Hood Cave, noticed in his previous communications. Five deposits could be distinguished in the Robin Hood Cave, namely, when all present:—1. Stalagmite, 2 feet. 2. Breccia, with bones and flint implements, 1 foot 6 inches. 3. Cave-earth, with bones and implements, 1 foot 9 inches. 4. Mottled bed, with bones and implements, 2 feet. 5. Red sand, with bones and quartzite implements, 3 feet. The most important discoveries were made in the cave-earth, and chief among these was a fragment of bone, having on it a well-executed outline of the head and neck of a horse, the first recorded discovery of any such work of art in this country. As the result of the exploration of these caverns, the author said it is evident that during the Pleistocene period, Derbyshire and the adjoining counties were inhabited by a very numerous and diversified fauna, the vast forests and pastures which extended far to the east and south offering a congenial home to the mammoth, the woolly rhinoceros, the hippopotamus, the Irish elk, the reindeer, the bison, and the horse, whilst among them the hyæna, the glutton, the bear, the lion, the wolf, the fox, and the great sabre-toothed *Machairodus*, roamed in search of prey; and that with these and other animals man lived and waged a more or less precarious struggle, amidst the vicissitudes of a varying climate, sheltering himself in the numerous caves of the district, which were already the haunts of the hyæna and its companions.—On the mammal-fauna of the Caves of Creswell Crags, by Prof. W. Boyd Dawkins, F.R.S. In this paper the author gave an account of the remains found in the caves explored by the Rev. J. M. Mello. He stated that the recent explorations had proved that the Robin Hood Cave was inhabited by hyænas, not only during the deposition of the cave-earth and breccia, but also during that of the red-sand clay underlying it, which had also furnished traces of the existence of man. After noticing the conditions of the fossil bones found in the caves, the author proceeded to remark upon the general results of the explorations with regard to their Pleistocene fauna, and concluded that there is no evidence from these or other caves in this country to prove that their faunas are either pre- or inter-glacial, and that we have no proof of the existence of pre- or inter-glacial man in Britain.

Zoological Society, April 17.—Mr. Osbert Salvin, F.R.S., in the chair.—The secretary exhibited and made remarks on some young Anacondas which had been produced dead by the large female Anaconda purchased on February 15.—The secretary exhibited some photographs of the young gorilla, now living in the Berlin Aquarium, and made some remarks on what, it now seemed certain, was an example of this ape, which was formerly living in one of Wombwell's travelling menageries, and was after its death transferred to the late Mr. C. Waterton's collection.—A letter was read from Mr. W. A. Willes, in which he gave an account of the success which had attended the endeavours of the Acclimatisation Society at Christchurch to introduce salmon into New Zealand from the United States.—A communication was read from Mr. W. A. Forbes, F.Z.S., containing a description of the peculiar organ known as the *Bursa Fabricii* in birds, and of its variations and modifications in the different genera of the class which he had had an opportunity of examining.—A communication was read from M. L. Taczanowski, in which he gave a list of the birds collected in North-Western Peru in 1876 by Messrs. Jelski and Holzmann. Amongst several new and interesting forms described was a new genus and species of Fringillidæ proposed to be called *Gnathospiza raimondii*.—A communication was read from the Rev. R. Boog Watson, containing some notes on the Madeiran Mollusc identified by the Rev. R. T. Lowe as *Achatina folliculus*.—A communication was read from Mr. E. P. Ramsay containing the concluding portion of his list of birds met with in North-Eastern Queensland, chiefly at Rockingham Bay.—A communication was read from Dr. Otto Finsch, containing a preliminary account of the birds collected during his recent journey in the North-Eastern part of Turkestan.—A communication was read from Prof. Owen, containing the description of a new species of extinct kangaroo of the genus *Sthenurus*, which he proposed to call *Sth. minor*, together with some remarks on the relation of this genus to *Dorcopsis*.—Mr. Edgar A. Smith read a paper containing descriptions of new species of South-American *Helicidæ* in the British Museum.—The Marquis of Tweeddale, F.R.S., gave descriptions of four new species of birds from the Indian region. These he proposed to name as follows:—*Trichostoma leucoprocta*, *Chrysococcyx limborgi*, and *Pomatorhinus austeni* (from Tenasserim), and *Brachypteryx buxtoni* (from Sumatra).—Mr. Osbert Salvin exhibited and pointed out the character of a new genus and species of bird of the family Ampelidæ, from Costa Rica, and proposed to call it *Phainoptila melanoxantha*.

Meteorological Society, April 18.—Rev. T. A. Preston, M.A., in the chair.—W. Morris Beaufort and Arthur A. Pearson were elected fellows of the Society.—The following papers were read :—On the meteorology of Mozufferpore, Tirhoot, for 1876, by C. N. Pearson, F.M.S. This year partook of the abnormal character of its predecessor, but in a different degree, and with widely different results. The total fall of rain was 57·69 inches, of which no less than 43·34 inches were registered in August, September, and October.—On the Diéthéroscope, by Prof. J. Luvini, of Turin. This is a new instrument contrived by the author for observing the changes of atmospheric refraction optically.—Improved form of thermometer for observing earth temperature, by G. J. Symons, F.M.S. This apparatus consists of an iron pipe driven in the ground to the required depth, and a small but very strong thermometer, the bulb of which is so protected that no change of indication occurs when the thermometer is drawn out of the tube for reading. The pipe is closed at the bottom by welding, and the point hardened so as to penetrate the soil with ease. For depths of 3 feet and under the thermometer is inserted in a light rod, but for all greater depths it is mounted in a short weighted stick attached to a strong chain.—Note on the degree of accordance of Mr. Glaisher's and the Kew thermometer standards, by William Ellis, F.R.A.S. This paper gives an account of the comparison of eight thermometers at the Royal Observatory which had been previously compared with Mr. Glaisher's and the Kew standard thermometers, and the result shows that the two standards are practically identical.

Entomological Society, April 4.—Prof. Westwood, president, in the chair.—Messrs. G. Harding, C. A. Briggs, and J. T. Carrington were elected ordinary members, and Messrs. E. H. Birchall, T. D. Gibson-Carmichael, and V. Cluse were elected subscribers.—The Secretary exhibited a collection of fine species of Lepidoptera from a place about twenty miles from Bangkok in Siam, forwarded to him by Mr. R. Garner, F.L.S., of Stoke-upon-Trent.—Mr. McLachlan exhibited a specimen of *Ophideres materna*, a brightly-coloured exotic species of *Noctuidæ*, given to him by Mr. R. H. Scott, of the Meteorological Office, with a note to the effect that it was taken at sea in lat. 25° 24′ S., long. 62° 10′ E. (the nearest land being the island of Mauritius, about 360 miles distant), by Capt. Raeburn, of the ship *Airlie*. The moth is a common Indian species, but is found also in Africa. A specimen was long ago received from Brazil, and Mr. Grote had recently noticed its occurrence in Florida. He also exhibited a cocoon and pupa of a species of *Cetoniidæ* (probably *Diplognathus silaceus*), from Cameroons, sent to Mr. Rutherford. The cocoon appeared to be formed of dark brown earth, but attached thickly to the exterior were oval, slightly flattened, deep black, hard bodies (each nearly five lines long by two broad), which he thought were probably the excrement of some rodent animal. Mr. Champion exhibited *Stenus kiesenwetteri* (hitherto only found in this country at Wimbledon), *Gymnusa brevicollis*, *Bembidium nigricorne*, and *Plociomerus luridus*, all from Chobham ; also *Philonthus cicatricosus*, from Shoreham.—Mr. Howard Vaughan exhibited (on behalf of Mr. Bidwell) a specimen of *Notodonta trilophus*, taken about the year 1867 by a lamplighter at Ipswich, who had it alive with several specimens of *N. ziczac*. It was only the second (authentic) capture of the insect, the first having been found at Saint Osyth, Essex, by Mr. Douglas.—The President read a letter he had received from Mr. B. G. Cole respecting the subject of Season-Dimorphism in Lepidoptera. He observed that from a number of eggs laid by *Ephyra punctaria*, those that emerged in July were of the spotted variety, while those which remained in the pupa state till the following May, in all respects resembled the mother. Mr. Cole referred to some remarks by Dr. Knaggs, published in the Entomologists' *Monthly Magazine* (vol. iii. p. 238) as bearing on the same subject. He considered it probable that the insects that were produced by a slow process of development would produce the May form (which might be considered the type), whilst those whose development was hastened by the heat and light of summer would produce smaller and less perfect insects. Mr. McLachlan alluded incidentally to the Lepidoptera brought home by the Arctic Expedition from the far north (82° N.), and said that the larvæ of most of those species, must, of necessity, require more than one season to acquire their full growth ; for the short and fitful summer was utterly inadequate for the full development in one season of most of the species, and furthermore, it was probable that the pupa state might habitually last several years.—The President read notes upon a strepsipterous insect, parasitic on an exotic species of Homoptera, (*Epora subtilis*, Wlk.), from Sarawak, accompanied by drawings illustrating the metamorphosis. He also read notes on the genus *Prosopistoma*, especially with regard to the species from Madagascar described by Latreille, of which he exhibited the types.—Mr. Cameron communicated a paper on East Indian *Tenthredinidæ*, and Mr. Butler a paper on the Lepidoptera of the Amazon Valley, collected by Dr. Trail in the years 1873–75.—Mr. Baly communicated descriptions of new species of *Halticidæ* and Mr. C. O. Waterhouse a monograph of the Australian species of the Coleopterous family *Lycidæ*.—Mr. F. Smith read descriptions of new species of the genera *Pseudomyrma* and *Tetraponera*, belonging to the family *Myrmicidæ*.

Institution of Civil Engineers, April 24.—Mr. George Robert Stephenson, president, in the chair.—The first paper read was on a deep boring for coal at Scarle, Lincolnshire, by Prof. Edward Hull, F.R.S. This boring was commenced about four years ago by a local company, to test the presence of coal in the neighbourhood of Lincoln—Mr. J. T. Boot, of Mansfield, being the engineer—and had been carried out by the Diamond Rock Boring Company. The total depth attained was 2,030 feet ; but as this depth was insufficient for the object in view, it was desirable that the bore-hole should be carried further down. The following formations, with their approximate thicknesses, had been passed through :—

	Depths. Feet.	Thickness. Feet.
Alluvial Strata	1 to 10 ...	10
Lower Lias Clay and Limestone	10 ,, 75 ...	65
Rhœtic Beds	75 ,, 141 ...	66
New Red Marl and Sandstone	141 ,, 1,500 ..	1,359
Permian Beds	1,500 ,, 1,900 ...	400
Carboniferous Strata	1,900 ,, 2,030 ...	130

Although the carboniferous strata had been reached, the cores brought up were of so peculiar a character as to leave it uncertain to what portion of the carboniferous formation they belonged ; and, as the question of the eastward extension of the Yorkshire coal-field was one on which a boring at this spot was calculated to throw much light, it was important, both in an economic and in a scientific point of view, that it should be continued until something definite had been determined.—The second paper read was on street tramways, by Mr. Robinson Souttar.

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