THURSDAY, JULY 3, 1890.

LIFE OF SEDGWICK.

I.

The Life and Letters of the Reverend Adam Sedgwick, LL.D., D.C.L., F.R.S., Fellow of Trinity College, Cambridge, Prebendary of Norwich, Woodwardian Professor of Geology, 1818-73. By John Willis Clark, M.A., F.S.A., and Thomas McKenny Hughes, M.A., F.R.S. Two Volumes. (Cambridge: University Press, 1890.)

BETTER late than never! Geologists have waited for seventeen years for a life of Sedgwick, though the biographies of Murchison, Lyell, and Darwin, two of whom survived him, have all been published. The delay, as is admitted in the preface, requires some explanation: whether that is really furnished may be doubted. This at least is clear, that it has not been due to Mr. Clark, since he only undertook his portion of the work, and that the major one, in 1886. The delay is the more to be regretted because not a few of those who could remember Sedgwick in the days of his full vigour have passed away, and, as Mr. Clark observes, "a number of interesting letters which he is known to have written, and which were long carefully preserved, have either been destroyed or cannot now be traced. These remarks apply specially to the earlier years." Still, Mr. Clark has had at his disposal a large amount of material, from which he has drawn a picture no less vivid than accurate—as we feel sure those who knew the original will admit—of a man of remarkable genius and almost unique personality. He has told us the story of Sedgwick's life, he has woven into it Sedgwick's letters, and the result is a book which is worthy to be classed with the two best biographies, at any rate of recent date, of distinguished sons of Cambridge—those of Charles Kingsley and Charles Darwin.

This book has its value as a chronicle of the development of geology into a distinct and independent branch of science, but this is not its only interest. True, it is a record of a life comparatively uneventful. It was not often that Sedgwick's geological studies conducted him beyond the limits of the British Isles. His Continental journeys were restricted to the western half of Europe, and did not include Spain or Scandinavia, but his friends were numerous and notable. His life extended over a period of our national history of unusual interest. He remembered vividly the great incidents of the "struggle for life and death with France." He heard the death peal rung for Nelson and for Wellington: he had shared in the domestic strife of the Reform Bill, and had witnessed the blunders of the Crimea and the peril of India. His sympathies were as quick as they were wide, and he was not only a frequent letter writer, but also a master of that almost forgotten art. Hence these volumes contain much that will be interesting to others than geologists. They are the record, not of a life devoted solely to one special study, but of a man of varied interests and rare enthusiasm, of unusual eloquence and exceptional descriptive powers. Not the least valuable part of the work is Sedgwick's own account (extracted from a privately printed pamphlet) of the manners and customs of the dalesmen of the Sedbergh district, among whom he was born, whither he constantly returned, and which he loved to the last hour of his life.

This book brings before us Sedgwick as a man and as a geologist, a division which corresponds with the work of its joint authors. Though the two characters made up the one personality, and a distinction between them must be to some extent arbitrary, this may be adopted, as a matter of convenience, in endeavouring to give some idea of the varied contents of these volumes.

Adam Sedgwick was born in the year 1785, the fourth child of the Rev. Richard Sedgwick, vicar of Dent, an old-world village, by a tributary of the Lune, among the great hills of Western Yorkshire. He was a member of one of the families of "statesmen" which had been settled in Dent for more than three centuries. Till he was sixteen years old he was taught at the Grammar School, partly by his father; then he was sent to school at Sedbergh; thence he went, in his twentieth year, to Trinity College, Cambridge, after a few months' tuition by John Dawson, a country surgeon (he had ushered Sedgwick into the world) who had become eminent as a mathematician, as teacher no less than as investigator. Sedgwick's work at Cambridge was interrupted by an attack of typhoid fever which nearly proved fatal, but, notwithstanding this, he obtained a scholarship in his College, and the fifth place among the Wranglers in the Mathematical Tripos of 1808. Private pupils and reading for his Fellowship employed him for the next two years, the latter being obtained in the year 1810. The double work proved a severe strain to Sedgwick's constitution. The great importance which has always been attached at Trinity College to the examination for fellowships has its advantages and its disadvantages; the one as affording an opportunity for remedying ill-fortune at the time of the degree and widening the field of choice; the other as giving an advantage to the wealthy, and pressing heavily on those who must combine work for a living with study for an examination. Not a few of the latter have paid for success by permanent injury to health. Among these, it appears, Sedgwick must be reckoned. During the next three years he was out of health, and in 1813 came a complete breakdown. Consumption was apprehended; but at last his naturally strong constitution triumphed, and he was able to return to Cambridge and take part in the regular tuition of the College. In 1816 he was ordained. Three years later came the great crisis of his life—the Woodwardian Professorship of Geology, hitherto little more than a sinecure, became vacant, and Sedgwick declared himself a candidate. His prospects of success at first did not seem great, for he had little, if any, knowledge of the subject, and was opposed, not only by a member of his own College, but also by the Rev. G. Gorham, of Queens' College, who was reputed to have devoted much attention to geology, though he does not appear to have published anything. But the opponent from within the walls of Trinity retired, and then Sedgwick had an easy victory over the other. Cambridge—perhaps Oxford also—has often been rather eccentric in her elections to professorships, and prone to act on the maxim "*Omne ignotum pro magnifico*." But on this occasion the leap in the dark was more than justified.

Neither of Sedgwick's opponents afterwards made any name as geologists, though the second of them lived to fight a battle for religious freedom in the Church of England.

At once Sedgwick threw himself heart and soul into his subject. Geology at that time signified little more than an excrescential growth from mineralogy, which became the less scientific the further it departed from its support. Still, the Geological Society of London had already been founded full ten years; and the men were now hard at work who were to roll away the reproach from geology, and lay its foundations on the sure ground of observation and induction. Neptune had failed to extinguish the torch of Pluto, and the Wernerians were retreating before the Huttonians; William Smith had already published his wonderful maps, and had set in order, almost single-handed, the newer rocks of England; but below the base of the Carboniferous system a great field for research still remained, in which the generation of Sedgwick's more immediate contemporaries were destined to win their laurels.

Sedgwick's first geological journeys were in Derbyshire and Staffordshire, in the Isle of Wight, and on the coast of Suffolk. But the learner quickly became an investigator. Even in 1818 he began to attack the problems presented by the older rocks of the south-west of England; thence he turned aside to examine Eastern Yorkshire and Durham. Difficult problems seemed from the first to have for Sedgwick a peculiar fascination, and in 1822 he grappled with those presented by the Lake District. In 1827 began his association with Murchison, whom he accompanied in a geological tour to Scotland, and joined in a paper on the results. The following summer saw them companions in their notable researches in Germany and the Tyrol, which produced another joint communication. By this time Sedgwick's merits had been recognized by his election to the Presidency of the Geological Society.

The year 1831 brought two important crises in Sedgwick's life—the one the offer of a valuable living from the Lord Chancellor, the other the beginning of his work in North Wales. That offer he declined, making a mistake, as several of his friends thought—an opinion to which his biographer inclines. Probably Sedgwick would have been a healthier man in a country rectory—for the climate of Cambridge was not suitable to him—and a happier man in married life. But science, we think, would have lost. It might not have been so with some men, but it was Sedgwick's nature to throw himself with all his heart into whatever work he undertook; so that in all probability the interest felt for his parishioners and his home circle would gradually have extruded geology from his thoughts. In this case science would have had to wait some time for the unravelling of much complicated stratigraphy; the collections of the Woodwardian Museum might have remained in a comparatively impoverished condition, and the University would have lost the quickening action of Sedgwick's influence on generations of its students.

Next year Sedgwick took a new departure in authorship. A College Commemoration sermon, which he had been asked to print, increased under his hands, with a prefatory head and a commentarial tail, till the "Discourse on the Studies of the University of Cambridge" expanded into a book, and became, as he phrased it, "a grain of wheat between two millstones." In 1834 he was made a Prebendary of Norwich, a preferment which, though its duties often seriously interrupted his scientific work, was a welcome addition to his income, which up to that time had hardly sufficed for the numerous calls upon it.

For the next six years his work in the field was less and his papers rather fewer; henceforth interruptions obviously became more frequent. The rearrangement of his fine geological collections, for which at last a museum had been provided; political incidents, in which he took an active interest; visits to and from distinguished friends, which became more numerous as his fame increased—all these proved, as they always prove, detrimental to work which requires steady and continuous application. But as the scientific interest of the book wanes a little, its general interest increases. Graphic sketches of notable personages appear more frequently in Sedgwick's letters, which come nearer to being a journal of his life. They bring out also—for many of them are written to young folks—all the tenderness of his nature: they intersperse fatherly advice with accounts of his doings, now grave, now comic. One moment he pulverizes a scientific foe; the next, gives his niece a ludicrous lesson on the pronunciation of Welsh. The election of Prince Albert to the Chancellorship of the University of Cambridge, in which Sedgwick took a leading part, still further interfered with his devotion to science, for it led to his acting as the Prince's secretary in Cambridge, and holding a place on a Commission for the Reform of the University. This, however, is a gain to the book, for his private letters give many interesting details of the Royal visit to Cambridge, and especially of the home life of the Queen and Prince Albert at Osborne.

After a time, about the year 1851, the Silurian question, presently to be noticed, spurred Sedgwick into renewed activity in his old field of work, but led to the unhappy result of his alienation from Murchison and his estrangement from the Geological Society. The burden of years, however, was now beginning to make itself felt, for in 1855, when he reviewed the controversy in his introduction to McCoy's "Description of British Palæozoic Fossils," he attained the age of threescore and ten. Henceforth the path of his life became sadder; one by one friends passed away, the infirmities of age increased, and though at times the old fire flashed up, and for a while the racy phrase and eloquent speech would return, he now felt, as most must feel, something of the *pœna diu viventibus*. Still he was able, up to about 1863, to take occasionally an active part in passing events, though more and more he was compelled to avoid excitement and fatigue, and thus his life at Cambridge was often lonesome. During the last ten years he sometimes suffered severely; almost he might have described himself as "sans teeth, sans eyes," sans ears, though happily not "sans everything," for the mind, as his letters show, continued unclouded, though, of course, sometimes that memory, once so marvellously retentive, failed a little. No part of the book is more tender, none more sympathetic, than the account of Sedgwick's last years. Early in 1873 came the closing scene, in the rooms in Trinity, which had been for so many years his chief home.

"There was no change till about midnight," writes his niece, "and then we saw the shadow of death come softly over his face, and we knew that he had passed into the dark valley, and that the end was near; but there was no pain; only quiet sleep. His breathing again grew more faint and soft; and without a sigh, just as the clock in the great court of Trinity chimed a quarter past one, his spirit returned to God."

Sedgwick's original scientific work will be sketched in another notice. This may conclude with a word on the man himself. A stalwart figure with rugged features and brown complexion, a flashing eye, and a grand pose of the head, which always reminde me of an eagle. He called himself—men called him—ugly. This I never could understand. Few were better tellers of a story: his memory of striking details, his sense alike of humour and of pathos, were so strong. As a lecturer he was discursive, but suggestive—one who stimulated and fertilized rather than who trained. His speeches were marked by a curious play of fancy, unexpected transitions from grave to gay, and occasional bursts of eloquence, which our greatest orators might have been glad to own. As a writer he was often diffuse, sometimes laboured—the results of hurried work or unsystematic arrangement; yet he broke out occasionally into passages of singular force and vigour. For instance, the concluding paragraphs of his preface to the "Catalogue of Cambrian and Silurian Fossils"—his last contribution to literature—are worthy, in my judgment, of a place among the best extracts from English literature. He was sometimes strong and even narrow in his prejudices, as will appear hereafter; he was impetuous in temper, fierce in the fray, positively ripping up an incompetent antagonist; yet he was commonly the most genial and placable of men; he was tender as a woman to those who sorrowed and who suffered, and was the idol of little children.

We may close the present notice with the words with which Mr. Clark concludes his own part of the biography—the words of one of Sedgwick's intimate friends:—

"He was transparent and straightforward—the very soul of uprightness and honour—tender and affectionate—most generous and kind. He had a hatred of all duplicity and meanness. He was entirely unsuspicious of evil, unless it was forced upon his notice; and he expected and believed everyone to be as straightforward and truthful as he was himself. I do not think that any man was so beloved by his friends as he was."

T. G. BONNEY.

(*To be continued.*)

GÉRARD'S "ÉLECTRICITÉ."

Leçons sur l'Électricité, professées à l'Institut Électrotechnique Montefiore annexé à l'Université de Liége. Par Eric Gérard, Directeur de cet Institut. (Paris: Gauthier-Villars, 1890.)

THE author of this book says in his preface that when he took charge of the classes in electric technology at Liége he felt the want of a text-book which would give a clear and definite account of electrical phenomena without requiring more extensive mathematical knowledge than his pupils might be expected to possess. We think that in this respect the experience of most teachers of electricity will coincide with that of M. Gérard. There are very few text-books on electricity in which the happy mean between utter vagueness and methods requiring the use of high mathematical knowledge has been hit; this, however, has been done so successfully in the book before us, that we think the difficulty to which we have just alluded will be almost removed. In this book we have the main outlines of electricity explained in language at once intelligible and precise, and without introducing more mathematics than every student of the subject ought to be competent to follow. In a subject like electricity, where forces have to be compared, the geometrical properties of bodies of various shapes utilized, &c., it is evident that if any numerical results at all are to be attained, some mathematics must be introduced; the question as to how much mathematical knowledge should be expected of students who, as a working hypothesis, may be assumed not to have any special aptitude for that study is one on which opinions will differ. For our part, we think that, even regarding it solely from the point of view of the engineer or physicist, such students ought to be advised to acquire an elementary knowledge of the differential and integral calculus; the possession of this knowledge will make many parts of the subject easy which without it would be difficult, and the time spent in acquiring the mathematics will be much more than saved in the time spent over the physics. In the book before us the mathematics are as plain and straightforward as possible. At the same time, M. Gérard, very wisely we think, does not scruple to use the elements of the differential and integral calculus.

The work contains more than 500 pages, of which about 200 are devoted to the theory of Dynamos. The remainder consists of an exceedingly clear and accurate description of electrical phenomena, the subject throughout being treated from Maxwell's point of view. The book is brought well up to date, and contains an account of most of the recent researches in electricity and magnetism; we think, however, it would have been improved by references to the places of publication of the original papers in which these researches are described, so that a student who wishes for a more detailed description than could be given in an elementary text-book might be able to refer to the original authorities for himself.

A most excellent feature of the book is that M. Gérard does not treat the subject as if an investigation was complete when it had led to a relation between a number of symbols. He applies the equations he gets to actual cases, and thus familiarizes the student with the magnitude of the quantities with which he is dealing. He commences the book with Sir William Thomson's maxim, which is so excellent in physics, though its application to other subjects might possibly cause consternation, that "we cannot understand a phenomenon until we can express it in numbers," and he acts up to the spirit of this maxim all through the book.

The book is well and clearly printed, and the author has realized the fact that it is more important that the diagrams in a text-book of physics should be explanatory than that they should be elegant.

There are one or two points which we think might be corrected in a new edition, which we are sure will soon be required. The deformation of dielectrics under electric forces, which is cited as a proof of Maxwell's theory of stress in the medium, is rather an obstacle than a support to the theory, as some dielectrics are strained in one way, and others in the opposite, while, on Maxwell's theory, the strain should all be of one kind. The statement on p. 97, that the sparking distance increases very much more rapidly than the increase in the difference of potential between the electrodes, should have been limited to the case where the electrodes are pointed; it is not true when the dimensions of the electrodes are large compared with the sparking distance. The proof of the expression for the electromotive force due to induction, on p. 170, does not seem to us to be sound; and the method of measuring the coefficient of self-induction of a coil was really invented by Maxwell, and given by him in his paper on the "Dynamics of the Electric Field," though it is not in the "Electricity and Magnetism."

We must, in conclusion, congratulate the author on having written one of the best treatises on elementary physics which it has ever been our good fortune to read.

J. J. T.

THE ART OF PAPER-MAKING.

The Art of Paper-Making. By Alexander Watt. (London: Crosby Lockwood and Son, 1890.)

THE author of this work, in the preface, expresses his thanks to certain gentlemen who have been good enough to conduct him through their mills and explain to him the various operations performed therein. From this we gather that the author is not only not a practical paper-maker, but that, up to the time of writing the book, he had but a limited and general knowledge of the subject. These conclusions are amply justified by a perusal of the book. This want of practical knowledge can hardly be wondered at, as the writer is already an authority on such widely different subjects as soap-making, leather manufacture, electro-metallurgy, electro-deposition, &c.

On the other hand, there is evidence that on the whole the author has devoted some considerable time to the reading up of his subject, though in many cases he has not consulted the latest authorities. For example, in speaking of the properties of cellulose, he quotes the opinions expressed by Mr. Arnot in his Cantor Lectures for 1877, since which time several additions have been made to our knowledge. We should have preferred to see more space devoted to this branch of the subject, as on the proper understanding of the properties of cellulose the scientific manufacture of paper depends.

Some of the statements with regard to cellulose are inaccurate and misleading, as for example, that "hydrochloric acid converts it into a fine powder without altering its composition," and again, that "nitric acid forms substitution products of various degrees, according to the strength of acid employed." As a matter of fact, ordinary nitric acid does not form nitro-substitution products with cellulose.

Under the head of the "Recognition of Vegetable Fibres by the Microscope," esparto—perhaps the most important raw material used in this country—is not even mentioned. The author's descriptions of the various mechanical appliances used in paper-making are, with one or two exceptions, accurate and fairly complete. In describing the chemical processes involved, however, the author occasionally gets out of his depth. For instance, he recommends certain qualities of rags to be boiled with 30 per cent. of caustic soda. At first we thought this was a misprint for 3 per cent., but on referring to the source of the information, we found that the author had quoted correctly. Again, we are told that the neutralization of chlorine in pulp by hyposulphite, which the author says is sometimes called thiosulph*i*te, is effected when the liquor ceases to redden litmus paper.

In giving directions for the sizing of paper, the author appears to have left out a number of decimal points. According to him 100 parts of pulp require 10–12 parts of rosin, and 20–30 parts of starch, and from 30–50 parts of kaolin. In the interest of the consumer it is satisfactory to know that such numbers are impossible.

In the chapter containing directions for the testing of alkalies, alum, &c., the following extraordinary statement occurs: "There are two principal methods of analyzing or assaying alkalies by means of the test acid—namely, volumetric, or by volume, and gravimetric, or by weight, in which a specific gravity bottle, capable of holding exactly 1000 grains of distilled water, is used."

Another instance of looseness of style occurs in the statement that "the proportion of caustic soda per cwt. of rags varies to the extent of from 5 to 10 per cent. of the former to each cwt. of the latter."

The general plan of the book also shows want of careful preparation; for example under the head of "Action of Acids on Cellulose," the author discusses the action of the strongly alkaline solution of cuprammonium.

In speaking of the origin of the wood-pulp process, the author champions the right of his father to be regarded as the pioneer. Similarly, with regard to electrolytic bleaching, we are told that the modern Hermite process, which has been successfully applied to the bleaching of paper pulp, is the outcome of an invention patented by his brother in 1851. It is perfectly true that in this patent the electrolysis of chlorides was claimed, but this in no way diminishes the credit due to those who have based on this principle a practical and successful manufacturing process.

OUR BOOK SHELF.

A Contribution to the Natural History of Scarlatina, derived from Observations on the London Epidemic of 1887–88. By D. Astley Gresswell, M.A., M.D. Oxon. (Oxford: Clarendon Press, 1890.)

THIS volume constitutes Dr. Gresswell's dissertation for the degree of Doctor of Medicine at Oxford, and is published "as a mark of distinction" by the University. It is the result of some six months clinical work at the South-Western Fever Hospital of the Metropolitan Asylums Board, and the author is to be congratulated alike upon the large number of carefully recorded observations which he has made, and upon the evidence his book affords of his careful study of the literature of scarlatina.

Between September 1887 and February 1888 Dr. Gresswell had charge of nearly 600 fever patients, and the statistical tables with which his treatise abounds are thus based on no inconsiderable number of cases. After some general considerations with respect to the disease, certain special symptoms are passed in review, particular attention being devoted to their relation to season. Then follows an exhaustive discussion of scarlatinal albuminuria. Perhaps the most striking fact brought out in the book is the contrast presented in regard to this symptom between the patients admitted during October and November, and those admitted during December and January. While albumen was discovered previous to "getting up for the first time" in only rather more than 50 per cent. of the latter group of cases, it was found in every such case investigated in the two earlier months. This universal occurrence of albuminuria in the first three weeks of the disease, during the height of the epidemic, is eminently noteworthy; as Dr. Gresswell says, it could not have been "a mere casual incident of pyrexial origin," nor could he account for it by differences of sex, age, stage of illness on admission, or treatment. All observers of the scarlatina of the latter half of 1887 seem to have been impressed with the unusually frequent occurrence of albumen in the urine. Dr. Sweeting referred it to overcrowding; Dr. Gresswell inclines to consider it as accounted for by the change in the character of the disease during the progress of the epidemic.

Although the chapter on "postural albuminuria" is of considerable interest, much of its subject-matter is not immediately connected with the natural history of scarlatina, while an important question like secondary sore throat is very briefly dealt with. Two cases of "reversio eruptionis" are quoted, but in one, as Dr. Gresswell admits, there is but scant evidence that the child had scarlatina on admission.

Attention is particularly devoted throughout to the variations in the phenomena of the disease in their relation to season, and the concluding section of the work contains some interesting suggestions with regard to this topic. The author upholds the view that variations in the life-history of the micro-organism of scarlatina lie at the root of the matter, but surely he goes rather far afield when he alludes to the possibility of the "interfertilization of different kinds of microbes."

The hope may be entertained that Dr. Gresswell will not lack imitators in selecting this particular branch of study as the subject of dissertation for the M.D. degree. There is abundant scope for research at the Asylums Board hospitals, and if the work be as full of interest as it is in the example before us, it cannot fail to redound to the credit of the worker.

Le Soleil; les Étoiles. By Gabriel Dallet. (Paris: Firmin-Didot et Cie., 1890.)

THE chapters on the constellations, in this work, are of a very comprehensive character. That devoted to a description of instruments of observation contains a fair amount of useful information, whilst tables of parallaxes and proper motions, double and variable stars, and other interesting objects visible in our hemisphere, compiled from the British Association Catalogue, *Connaissance des Temps*, and *L'Annuaire du Bureau des Longitudes*, are plentifully and properly distributed throughout, and render the work what it purports to be, an "Astronomie Pratique." The author is, however, evidently not at home when writing on spectroscopy, and is considerably behind the recent developments in that branch of astronomy. As an example of this deficiency we would cite his assertion that the spectrum of the Orion nebula consists of three bright lines, as discovered by Dr. Huggins in 1864, although recent observations have increased the number visible to nine, and the photographic spectrum shows many times this amount.

The author seems also to have very vague ideas as to the origin of the universe. He says:—"Notre soleil et ses planètes ont dû se trouver au centre d'une nébuleuse, mais la matière cosmique qui la formait comprenait une variété considérable d'éléments chimiques qui ne se présentent pas dans nébuleuses proprement dites"; a conclusion which leads him to write:—"Nous pouvons dire avec M. Huggins que les nébuleuses à spectre gazeux sont des systèmes ayant une structure et une organisation à part, et qui sont d'un ordre différent de celui dont notre soleil, avec ses planètes, faisait partie dans la nébuleuse primitive"; although in justice to Dr. Huggins it should be said that he has now rejected the conviction that "the nebulæ which give a gaseous spectrum are systems possessing a structure, and a purpose in relation to the universe, altogether distinct and of another order from the great group of cosmical bodies to which our sun and the fixed stars belong."

Little spectroscopy other than this is included in the work, observations of sun-spots and prominences being mainly considered from a pictorial point of view. There is no doubt, however, that the twelve maps of the heavens will be of service to amateur astronomers, and that the ninety-three illustrations are in general well chosen. We should be glad, therefore, to see the slight inaccuracies that we have indicated eliminated in a future edition.

Father Perry, F.R.S. By Aloysius L. Cortie, S.J. (London: The Catholic Truth Society, 1890.)

THE author of this little book was a friend of the late Father Perry, and is, therefore, most capable of writing a sketch of his life and work, and few lives could afford more of the material which makes such a sketch interesting.

The programme of work undertaken by the deceased astronomer ten years ago at Stonyhurst College Observatory was comprehensive. It included the daily drawing of the sun when possible, the measurement of the depth of the chromosphere, the heights of prominences, and observations of sun-spot spectra, and this programme was faithfully adhered to up to the time of his death. The method of obtaining the drawings of sun-spots which have appeared in the Memoirs of the Royal Astronomical Society is described, and the reproduction of two of the largest spots shows how much can be effected by means of the pencil. These drawings are of great importance, and supplement solar photographs. The main object in making them was to throw light upon the theories of the mode of formation of spots, and to find, if possible, the clue to the connection between terrestrial magnetism and solar activity. This discussion however, was cut short by death.

A copy of the photograph of the solar corona, from the observation of which Father Perry was carried to his death-bed, testifies more than volumes of words to the character of the man whose life is before us, and the long list of published papers and the expeditions in which he took part speak of his industry. A few of his notes on faculae and veiled spots are appended, and render this volume of 112 pages something more than a biography.

Prodomus Faunæ Mediterraneæ sive Descriptio Animalium maris Mediterranei incolarum quam comparata silva rerum quatenus innotuit adjectis locis et nominibus vulgaribus eorumque auctoribus in commodum Zoologorum congessit Julius Victor Carus. Vol. I. Pars II., Vol. II., Pars I. (Stuttgart: E. Schweizerbart'sche Verlagshandlung.)

SOME five years ago we welcomed the appearance of the first part of Prof. J. Victor Carus's "Prodomus Faunæ Mediterraneæ" (NATURE, vol. xxxi. p. 201); since then, two additional parts have been published. The second completes vol. i., and contains the Arthropods; it was published early in 1885. The third part, the first of vol. ii., was published late in last year, and contains the Brachiostomata and Mollusca.

Beyond the record of the appearance of these parts, and the expression of our hope that the author will speedily hasten the completion of his work, the usefulness of which will be greatly increased thereby, we have nothing to add to our previous notice.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spiny Plants in New Zealand.

IN Mr. Wallace's recent work on "Darwinism," reference is made to the absence of spiny and prickly plants in oceanic islands in disproof of Prof. Geddes's theory that spines are an indication of the ebbing vitality of a species. Mr. Hemsley's remarks on the subject are quoted, and an explanation of the occurrence of spines in our only species of *Rubus* and in *Aciphylla* is given. In regard to the former it is stated (p. 433, colonial edition):—"In New Zealand the prickly *Rubus* is a leafless trailing plant, and its prickles are probably a protection against the large snails of the country, several of which have shells from two to three and a half inches long." The explanation seems to me to be a very unsatisfactory one, and indeed to be quite incorrect. The snails referred to (*Placostylis bovinus, Paryphanta Busbyi*, and *P. Hochstetteri*) are very uncommon; I do not know that they occur at all in the South Island. The *Rubus*, on the other hand, is everywhere a most abundant and aggressive plant, springing up especially in bush clearings, whether made by fire or by the axe alone. It is also incorrect to speak of it as a *leafless* trailing plant. Sir Joseph Hooker, who is the first authority on the New Zealand flora, has united all the forms of *Rubus* found in these islands into one polymorphic species, and even the most inveterate species-makers have never yet successfully disputed his dictum. It must, however, be acknowledged that *four* if not *five* very distinct varieties are included under the common name of *Rubus australis*. Of these only the variety *cissoides* of the "Flora Novæ-Zealandiæ" is leafless, its leaves being reduced to prickly midribs. All the other forms are leafy, some densely so, and these are by far the most abundant.

The true explanation of the prickles is most probably that they serve as climbing organs. No doubt all the developments of the epidermis in the larger species of the genus *Rubus* served primarily for protection against grazing animals. This is evidently the case in the common raspberry. But even in the various forms of the European blackberry or bramble, the prickles seem to help the plants in their scrambling growth to overtop those shrubs among which they grow. This is very evidently the case with our New Zealand bramble, or "bush-lawyer," as it is suggestively termed. It is a plant which grows especially at the edges of the bush or in clearings, and it quickly climbs over the plants among which it lives. If we take hold of a petiole (the stems have no prickles) we find it provided on the under side with a line of strong prickles, all curved downwards so as to give them good holding power. Their catch is further improved by the sharp bend in a direction opposite to their curvature which the petiole and petiolules take. One has only to attempt to pull a "lawyer" down from the plant on which it is climbing to see that the snail-hypothesis is not the correct one.

Any explanation of the formidably spinous leaves of *Aciphylla* is at the best hypothetical. Perhaps the theory that they may have gained their spines to prevent them from being trodden down or eaten by the Moas, is as good as any other. In a paper on the origin of the New Zealand flora, published in vol. xiv. of the Transactions of the N.Z. Institute, I have made reference (p. 496) to the scarcity of spiny and prickly plants. It is there shown that in cases where such defensive modifications occur the plants are either wide-spread in their distribution, having probably, before spreading into these islands, acquired their characters in other regions where they were of service; or that they belong to genera having extensive distribution. I have also pointed out that in pungent-leaved plants, such as species of *Leucopogon, Archeria*, &c., the strictly endemic species have lost the pungent tips. The same remark holds as to the barbed spines of *Acæna*, which serve to distribute the seeds, probably by mammalian agency. Of the seven described species two have a wide distribution outside of these islands, and have strong barbs. Two endemic species have the barbs not so well developed, while in the other three species—also endemic—they are wanting altogether.

Can anyone offer any suggestion as to the formidable nature of the stinging-hairs of our common nettle—*Urtica ferox?* In *U. incisa* and *U. australis* the stinging-hairs are few in number and feeble in their urticating properties. But *U. ferox* is a species confined, as far as I know, to these islands, and it has developed a formidable array of large and very poisonous hairs. It is worthy of remark that though so strongly protected in one direction it is particularly liable to insect attacks, it being often very difficult to find a perfect leaf. I cannot suggest any adequate explanation.
GEO. M. THOMSON.

Dunedin, N.Z., May 14.

Drowned Atolls.

As Captain Wharton speaks of the Macclesfield Bank as the so-called "drowned atoll" of the China Seas, it may be interesting to note that in the recent survey of it there were found no less than 15 genera, including 27 species, of living corals growing in depths from 21 to 44 fathoms, the dredge at each haul always bringing up living specimens, and of these only four were found growing on the more shallow rim of the Tizard Bank.
P. W. BASSETT-SMITH.

As my opinion is that all the submerged atolls are in vigorous growth, I concur, of course, in Mr. Bassett-Smith's view, in the paragraph above, that the term "drowned," as indicating "dead," is a misnomer; and I inserted the words "so-called" to express this. The examination of the Macclesfield and Tizard Banks strongly supports this view.
W. J. L. WHARTON.

The Essex Bagshots.

MR. H. W. MONCKTON has done good service in calling the attention of geologists to the section through Brentwood Common (NATURE, vol. xlii. p. 198); and I am glad to say that I entirely agree with the interpretation of the section which he has suggested. The classification of all these beds as "Lower Bagshot" is in fact but a repetition of the error committed in former years in the Newbury country (see *Q.J.G.S.*, vol. xliv. pp. 178, 179). Lithological and palæontological evidence now concur to prove what seemed to me in the highest degree probable when the discovery of fossils in the Bagshot Beds at Frierning was announced in the new edition of the "Geology of London" last year, and what I suggested on general grounds three years ago (see *Geological Magazine*, March 1887, p. 115); namely, that in the Essex area there is an attenuation of the lower sands implying a transgressive relation of the "Bagshots" to the London Clay, such as has been shown by me (*Q.J.G.S.*, vols. xliii. and xliv.) to occur along the northern margin of the Bagshot area from Englefield Green to Farley Hill, south of Reading.
A IRVING.

Wellington College, Berks, June 30.

A Remarkable Appearance in the Sky.

THE remarkable appearance in the sky noted by your correspondent in NATURE of June 26 (p. 198), as observed in Sussex, on night of 17th inst., was also well seen here. I enclose sketches which afford an approximate idea of the phenomenon as observed on both the 17th and 25th inst. The former was the first conspicuous occurrence here this season of those "luminous boreal night-clouds," of which sketches have been forwarded to NATURE by the writer for some years past, but from another locality of residence at a higher elevation. This may account for failure of earlier observation during the present year. The luminous forms have become less definite, the outlines being faint and nebulous, as contrasted with the bright and definite cirro-form cloudlets seen when first noted, at considerably higher altitudes above the northern horizon.

Kensington, June 28.
D. J. ROWAN.

DARKEST AFRICA.[1]

IT would be out of place in these pages to discuss Mr. Stanley's remarkable narrative of a remarkable expedition so far as the main purpose of that expedition is concerned. It is nearly four years since the interest in the position and fate of Emin Pasha reached its height in this country. The pages of NATURE and the columns of the daily press of the time will afford evidence of the universality and intensity of that interest, and of the reality of the belief that Emin and his people were in imminent danger of being exterminated by the Mahdists. Mr. Stanley insists on the ideal of Emin's conduct and character which was universally accepted at the time, as those of a hero who, in the face of danger and at the risk of death, loyally clung to his post and remained faithful to his duty and the people who regarded him as their leader and chief. As a man who had during his twelve years' sojourn in the Equatorial provinces made large contributions to science, the scientific world was naturally interested in his safety. Substantial evidence of what Emin has done for science may be seen in our own Natural History Museum. To rescue and relieve the pioneer of science and of civilization was the one object of the Expedition with the leadership of which Mr. Stanley was entrusted. It is evident from his narrative that the object was ever before his eyes, and that all else was subordinate. Through dangers innumerable and sufferings that might have daunted all but the boldest and truest spirits, the purpose for which the Expedition was organized was accomplished. Emin and all of his people who cared to accompany him were rescued, and that just in time; for, according to the latest reports, the Mahdists are now swarming on the shores of Albert Nyanza. That Emin presented himself to Mr. Stanley in a light somewhat different from the ideal; that the Governor was reluctant to leave; that most of his people were disloyal and demoralized wretches who might have been left to the tender mercies of the Mahdi, with whom they could easily have made terms; that there were other features about the expedition that may leave room for criticism, do not affect the general result. Mr. Stanley has once more proved his supremacy as a man of action, as a leader whose single aim is to accomplish what he undertakes. Even were Emin as full of blemishes as he is represented in Mr. Stanley's narrative, no one need regret the Expedition sent to his relief; it has helped to keep alive the sentiments of chivalry and humanity in the midst of a civilization in danger of becoming too materialistic, and given opportunity for the exercise of those noble qualities which make us proud of our race.

The truth is that no two men could be more dissimilar in character and conduct than are Emin and Mr. Stanley. They seem quite incapable of understanding each other; the one has no sympathy with the other's pursuits. Stanley is, before everything, a man of action, who goes direct to the accomplishment of whatever purpose he undertakes; Emin is a student of Nature, a man of science, who, by force of circumstance, had become ruler of a province, and military leader. As a man of science he may be too much given to making allowances to be fitted for a post where quickness of decision and rapidity of action were necessary, and where he had to deal with people with whom force was the only remedy. Whatever may be his weaknesses, science at least cannot regret the rescue of one of her most devoted disciples. With all Mr. Stanley's apparent contempt for science and her students, he himself has been one of her most successful pioneers.

It is hard to say whence Mr. Stanley has obtained his notion of the character of scientific men; and we are not disposed to take his verdict too seriously, when we remember the circumstances under which his book was written, and the many irritating conditions to which he had without doubt been subjected by the conduct of Emin and his people. The most satisfactory feature about the passage in which he flouts at science and its votaries is its inconsistency. This and other passages in his book, in which Mr. Stanley deals with science, only show that he is not equally strong all round; that, notwithstanding the valuable contributions he has made to science in this and his previous writings, he himself is not largely endowed with the scientific spirit.

While we are disposed to be critical, may we refer to one or two other passages in Mr. Stanley's book which seem to us to show that he had not quite recovered that equanimity which was so bitterly tried, even down to the arrival at Bagamoyo? Speaking of the fine race of the Wahuma, he scoffs at "some philological *nidderings*" for classing them and many other tribes in Central and South Africa under the common name of *Bantu*, which, as he truly tells us, simply means men. If Mr. Stanley intends by this to protest against the implication that, because a variety of peoples speak a certain type of language, therefore they must all be of common descent, he is quite justified. But that the languages over a large area of Central and South Africa have all a certain family likeness there can be little doubt; and the term Bantu is quite as useful as any other to express this fact. Possibly Mr. Stanley might be able to suggest a better term. In his chapter on the tribes of the grass land, where the fine Wahuma race is dominant, Mr. Stanley has some most suggestive and interesting remarks on the various types of African peoples, and on the immigration which must have taken place at an early period from Asia into Africa. In its ethnology, as in so many other respects, this strange continent presents many puzzles for the student of science to solve. Mr. Stanley's recent journey was, to a large extent, through the borderland which forms a sort of meeting-ground for various types of peoples; and the contributions he has made to ethnology will cover a multitude of flouts at science and its votaries. The many interesting details he gives concerning the pigmies that pestered his column so much on its march through the forest form one of the most prominent features of his narrative. Prof. Flower has so recently (NATURE, vol. xxxviii. pp. 44 *et seq.*) fully discussed the whole subject of pigmy races, that we need only refer the reader to Mr. Stanley's pages in confirmation of Prof. Flower's views. In his own graphic and peculiar way, Mr. Stanley claims a high antiquity for these tiny folks; and in this he is supported by the evidence adduced by Prof. Flower. Mr. Stanley himself, on his greatest journey of all, heard of these pigmies about the great bend of the Congo; on his last journey he found the forest swarming with them. Outside the sunless gloom of the forest they pine and die. They are naturally timid, and continually on the offensive against all comers. But when treated kindly they become devoted to their benefactors, and serve them faithfully even to their own hurt. Full details of the various dimensions of these pigmies are given from Emin's notes (vol. ii. p. 150); but we may quote here what Mr. Stanley says about the first of these pigmies whom he had an opportunity of inspecting. A man and a woman were brought to him at the Avatiko plantation, on the Ituri. The man was apparently about 21. Mr. Bonny conscientiously measured him, with the following result:—

"Height, 4 ft.; round head, 20¼ in.; from chin to back top of head, 24¼ in.; round chest, 25½ in.; round abdomen, 27¾ in.; round hips, 22½ in.; round wrist, 4½ in.; round muscle of left arm, 7½ in.; round ankle, 7 in.; round calf of leg, 7¾ in.; length of index finger, 2 in.; length of right hand, 4 in.; length of foot, 6¼ in.; length of leg, 22 in.; length of back, 18½ in.; arm to tip of finger, 19¾ in.

"This was the first full-grown man we had seen. His

[1] "In Darkest Africa: or the Quest, Rescue, and Retreat of Emin, Governor of Equatoria." By Henry M. Stanley. Two Vols. (London: Sampson Low and Co., 1890.)

colour was coppery; the fell over the body was almost furry, being nearly half an inch in length. His head-dress was a bonnet of a priestly form, decorated with a bunch of parrot feathers; it was either a gift or had been stolen. A broad strip of bark covered his nakedness. His hands were very delicate, and attracted attention by their unwashed appearance."

The chapter on the forest in the second volume, abounds with information concerning the various tribes which inhabit the forest region. There is a family likeness among all the varieties. With regard to the pigmies, Mr. Stanley maintains there are two distinct types (Batwa and Wambutti), which differ as much from each other as a Turk would from a Scandinavian. The Batwa have longish heads and long narrow faces, reddish small eyes, set close together, which give them a somewhat ferrety look, sour, anxious, and querulous. The Wambutti have round faces, gazelle-like eyes, set far apart, open foreheads, which give one an impression of undisguised frankness, and are of a rich, yellow, ivory complexion. The Wambutti occupy the southern half of the Ituri region, the Batwa the northern, and extend south-easterly to the Awamba forest on both banks of the Semliki river, and east of the Ituri. The women are agriculturists and the men hunters. Though their nomad habits are often annoying to the forest tribes of larger make, yet the latter find the pigmies exceedingly useful as scouts who give warning of the approach of the enemy. As might have been expected, the forest peoples are all of lighter complexion than the inhabitants of the open grass lands. With regard to the poison of the arrows of these pigmies, Mr. Stanley does not insist so strongly on its insect origin as he did in his letter to the Royal Geographical Society. The poison, he states, seems to be made from a species of arum. It is evident from these allusions that Mr. Stanley's contributions to a knowledge of the ethnology of the region are of great interest; indeed, they entitle him to be classed among those students of science whom he professes to despise.

The great forest, in which so much of the time of the Expedition was spent, and which entailed upon it so much suffering and so many losses, pervades the whole work; and one might even trace its depressing influences upon Mr. Stanley's style in the earlier chapters of the book. There are several points of great scientific interest connected with the forest. Mr. Stanley refers to Prof. Drummond in terms unnecessarily severe, because in his book on "Tropical Africa" he describes the type of African

Cascades of the Nepoko.

forest as quite different from that of Brazil. But Prof. Drummond can only be taken as referring to that part of Africa with which he is perfectly familiar, the Lake Nyassa region, where as in East Africa generally the "forest" is of the open park-like character, with dense patches here and there. But the fact is, we are apt to forget that Africa is a great continent covering some 11 million square miles, and that its surface presents a great variety of features. Here is how Mr. Stanley puts it:—

"Nyassaland is not Africa, but itself. Neither can we call the wilderness of Masai Land, or the scrub-covered deserts of Kalahari, or the rolling grass land of Usukuma, or the thin forests of Unyamwezi, or the ochreous acacia-covered area of Ugogo, anything but sections of a continent that boasts many zones. Africa is about three times greater than Europe in its extent, and is infinitely more varied. You have the desert of deserts in the Sahara, you have the steppes of Eastern Russia in Masai Land and parts of South Africa, you have the Castilian uplands in Unyamwezi, you have the best parts of France represented by Egypt, you have Switzerland in Ukonju and Toro, the Alps in Ruwenzori—you have Brazil in the Congo basin, the Amazon in the Congo River, and its immense forests rivalled by the Central African forest which I am about to describe.

"The greatest length of this forest, that is from near Kabambarré in South Manyuema to Bagbomo on the Welle-Makua in West Niam-niam, is 621 miles; its average breadth is 517 miles, which makes a compact square area of 321,057 square miles. This is exclusive of the forest areas separated or penetrated into by campo-like reaches of grass land, or of the broad belts of timber which fill the lower levels of each great river basin like the Lumani, Lulungu, Welle-Mubangi, and the parent river from Bolobo to the Loika River.

"The Congo and the Aruwimi Rivers enabled us to penetrate this vast area of primeval woods a considerable length. I only mean to treat, therefore, of that portion which extends from Yambuya in 25° 3½′ E. L. to Indesura, 29° 59′ = 326½ English miles in a straight line."

Mr. Stanley's description of an African tropical forest is also worth quoting:—

"Imagine the whole of France and the Iberian peninsula closely packed with trees varying from 20 to 180 feet high, whose crowns of foliage interlace and prevent any view of the sky and sun, and each tree from a few inches to four feet in diameter. Then from tree to tree run cables from two inches to fifteen inches in diameter, up and down in loops and festoons and W's and badly-formed M's; fold them round the trees in great tight coils, until they have run up the entire height, like endless anacondas; let them flower and leaf luxuriantly, and mix up above with the foliage of the trees to hide the sun, then from the highest branches let fall the ends of the cables reaching near to the ground by hundreds with frayed extremities, for these represent the air roots of the Epiphytes; let slender cords hang down also in tassels with open thread-work at the ends. Work others through and through these as confusedly as possible, and pendent from branch to branch—with absolute disregard of material, and at every fork and on every horizontal branch plant cabbage-like lichens of the largest kind, and broad spear-leaved plants—these would represent the elephant-eared plant—and orchids and clusters of vegetable marvels, and a drapery of delicate ferns which abound. Now cover tree, branch, twig, and creeper with a thick moss like a green fur. Where the forest is compact as described above, we may not do more than cover the ground closely with a thick crop of phrynia, and amoma, and dwarf bush; but if the lightning, as frequently happens, has severed the crown of a proud tree, and let in the sunlight, or split a giant down to its roots, or scorched it dead, or a tornado has been uprooting a few trees, then the race for air and light has caused a multitude of baby trees to rush upward—crowded, crushing, and treading upon and strangling one another, until the whole is one impervious bush.

"But the average forest is a mixture of these scenes. There will probably be groups of fifty trees standing like columns of a cathedral, grey and solemn in the twilight, and in the midst there will be a naked and gaunt patriarch, bleached white, and around it will have grown a young community, each young tree clambering upward to become heir to the area of light and sunshine once occupied by the sire. The law of primogeniture reigns here also."

What is the real extent of the continuous forest area? Is the forest of Mr. Du Chaillu in the Ogowé region, and that in which Livingstone wandered between Tanganyika and Nyangwé, really part of the same great forest through which the Ituri flows? The two slave-raiding parties which Mr. Stanley met on the Ituri, and which had come

View of the South End of Albert Nyanza.

north from Kibongé on the Upper Congo, journeyed through dense forest the whole way, meeting with not a patch of open grass. That the forest may be almost continuous from about Nyangwé to the Ituri, and for some distance northwards, is probable enough. But that there is one continuous forest from the Lower Ogowé to the plateau above Lake Albert is highly improbable. Indeed, from the observations of De Brazza and of Mr. Stanley himself on the Lower Congo, and in the country between that and the Ogowé, we know that there does exist much open country there. Even in the region with which Mr. Stanley specially deals—the region along the Ituri and to the north and south—it must be remembered that it has been traversed only along one or two lines. Considering the close network of rivers which characterize the region, it is probable enough that over a very great area we have one dense forest. Readers of Schweinfurth, Emin, and Junker, will remember the "gallery" forests which they describe to the north and north-east of Mr. Stanley's route; forests lining the banks of the rivers, and stretching for several miles from their banks. It may be, then, that in the Ituri region, with its many rivers, we have a series of gallery forests which have coalesced or overlapped into one continuous forest. With the rapidly progressing opening-up of Africa, this is a problem that cannot remain long unsolved. At the same time it should be remembered that even in the Amazonian basin the forest is by no means continuous, but gives way in many places to great stretches of open land.

Mr. Stanley was here in what is probably the rainiest region of all Africa. We were at first disposed to believe that most of the moisture found its way westwards from the Indian Ocean. But this is a point on which Mr. Stanley made many careful observations, and his conclusion that the great rain-bearing winds come from the Atlantic must meantime be accepted. At the same time it is to be hoped that the Government of the Congo Free State will establish a series of observing-stations over as wide an area as possible, and so collect data which will be useful not only to science, but of service to its own economic interests. One great service rendered by Emin Pasha was the daily series of observations which he carried on at Lado for several years, and which render that station the one place in Central Africa for which we have trustworthy meteorological data. Emin carried on his observations during the whole period he was with Mr. Stanley, down to Bagamoyo, and it is to be hoped that these will one day be given to the world.

About the prevailing plateau character of the whole country traversed by Mr. Stanley there can be no doubt. Some of its remarkable features are well brought out in many of the fine illustrations which adorn the book. The importance of this feature in the opening up of the centre of the continent under the guidance of Europeans is evident. The magnificent grassy plateau between Lake Albert and the edge of the forest, where the Expedition lived many weeks while waiting for Emin and his people, seems really a fine country from this point of view. What could be accomplished by partially clearing the forest may be seen from the planting operations at Fort Bodo, where Lieutenant Stairs and Dr. Parke lived for many months, and where they grew large crops of maize, bananas, tobacco, and other cultures. Here is a description of the country as seen from the plateau above Lake Albert:—

"Yesterday Jephson and I had examined the summits of the hills, and in one of the hollows we had discovered tree ferns, standing eight feet high, with stalks eight inches in diameter. We also brought with us a few purple flowering heliotropes, aloes, and rock ferns for the Pasha. All this has inspired him with a desire to investigate the flora for himself.

"These hills have an altitude varying from 5400 to 5600 feet above the sea. The folds and hollows between these hills are here and there somewhat picturesque, though on account of the late grass burnings they are not at their best just now. Each of the hollows has its own clear water rillet, and along their courses are bamboos, tree ferns, small palms, and bush, much of which is in flower. From the lively singing of the birds I heard

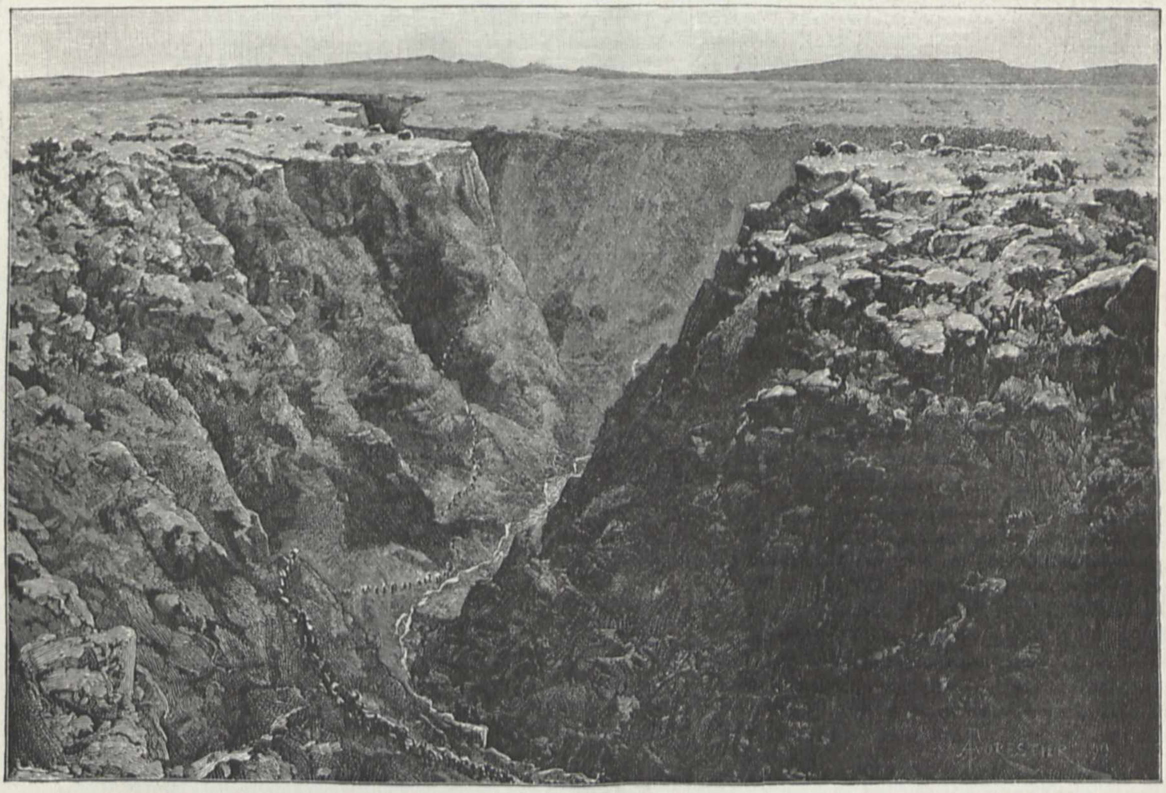
Ruwenzori: from Karimi. (From a Photograph.)

yesterday, it was thought likely this insatiable collector might be able to add to his store of stuffed giant-larks, thrushes, bee-eaters, sun-birds, large pigeons, &c. Only four specimens were obtained, and the Pasha is not happy.

"In a bowl-like basin, rimmed around by rugged and bare rocks, I saw a level terrace a mile and a half long by a mile wide, green as a tennis lawn. Round about the foot of this terrace ran a clear rivulet, through a thick bank of woods, the tops of which just came to the level of the terrace. It has been the nicest site for a mission or a community of white men that I have seen for a long time. The altitude was 5500 feet above the sea. From the crest of the rocky hills encircling it we may obtain a view covering 3000 square miles of one of the most gloriously beautiful lands in the world. Pisgah, sixty miles westward, dominates all eminences and ridges in the direction of the forest world; Ruwenzori, 18,000 to 19,000, white with perpetual snow, eighty miles off, bounds the view south; to the east the eye looks far over the country of Unyoro; and north-east lies the length of the Albert Nyanza."

The instructive map prepared by Stanford from Mr. Stanley's observations affords an excellent idea of the physical features of the region traversed, and especially of the new features to the south of Lake Albert. This is even more strikingly brought out in the bird's-eye view of the region presented in one of the plates. The sudden fall from the plateau down to the level of Lake Albert, over 2000 feet, is remarkable. It is not quite so marked on the southern lake, which is not so much of the nature of a ravine; it may be because the lake has much diminished in size. That both lakes have greatly shrunk is evident; but that they ever formed one lake is a point that can only be established by a series of careful observations. The same may be said as to the real nature of the change of level; is it permanent, or is it only of the nature of an oscillation of level, as is the case with other African lakes? What, again, are the forces which have been at work to produce these lake-chasms, and raise the magnificent mountain-mass of Ruwenzori? It may well be that the same forces have been at the bottom of both features, though possibly not in the precise fashion that Mr. Stanley would seem to indicate. There is here, evidently, a splendid field for geological research, and science has therefore every reason to wish that all this region may soon be restored to civilizing influences—included, if possible, within the sphere of the British East African Company. The volcanic mountain-mass of Ruwenzori, with its many snow-covered peaks and deeply scored sides, really covers a considerable area, with outlying peaks, like Gordon Bennett and Mackinnon, east and north-east. Both it and Lake Albert Edward are surrounded by a range or escarpment, 5500 to 6500 feet high. Stretching all the way south-east almost to the borders of Lake Victoria Nyanza, the table-land is much cut up by ravines, sometimes assuming a cañon-like shape, and marked here and there with peaks like Mfumbiro, 10,000 feet. On the Semliki itself, which joins Lakes Albert and Albert Edward, we find a forest, very similar to that on the Ituri, stretching some little distance up the lower slopes of Ruwenzori. The following description of the Semliki forest is worth quoting:—

"About a mile from Mtarega the grassy strip to which we had clung in preference was ended, the forest had marched across the breadth of the Semliki Valley, and had absorbed the Ruwenzori slopes to a height of seven thousand feet above us, and whether we would or no, we



Expedition winding up the Gorge o. Karya-muhoro.

had to enter the doleful shades again. But then the perfection of a tropical forest was around us. It even eclipsed the Ituri Valley in the variety of plants and general sappiness. There were clumps of palms, there were giant tree-ferns, there were wild bananas, and tall, stately trees all coated with thick green moss from top to root, impenetrable thickets of broad-leafed plants, and beads of moisture everywhere, besides tiny rillets oozing out every few yards from under the matted tangle of vivid green and bedewed undergrowth. It was the best specimen of a tropical conservatory I had ever seen. It could not be excelled if art had lent its aid to improve nature. In every tree-fork and along the great horizontal branches grew the loveliest ferns and lichens; the elephant-ear by the dozen, the orchids in close fellowship, and the bright green moss had formed soft circular cushions about them, and on almost every fibre there trembled a clear waterdrop, and everything was bathed by a most humid atmosphere. The reason of all this was not far to seek; there were three hot-water springs, the temperature of which was 102°. This tract of forest was also in the cosiest fold of the snow mountains, and whatever heat a hot sun furnished on this place was long retained."

Mr. Stanley may be said in this expedition to have put the final touch to the definite delimitation of the Congo and the Nile basins. It looks only a few steps from the sources of the Ituri and its feeders, which go to swell the Congo, to the edge of the escarpment whose feet are lapped by the waters of Lake Albert, which sends its tribute to the Nile. That the Southern Muta Nzige (Lake Albert Edward) belongs to the Nile and not to the Congo system is finally proved. Mr. Stanley, who seems to have been still in a fighting mood while he was writing his book at Cairo, severely castigates the map-makers for ignoring the work of the cartographers of ancient times. We need not quarrel with his manner of opening up a subject of great interest. What were the relations of Egypt, and therefore of ancient Europe, with Central Africa? It is certainly a noteworthy fact that, even in the oldest maps (whatever was the real nature of these maps), we find the Nile coming out of two lakes, and we find a range of mountains somewhere in the neighbourhood, called the Mountains of the Moon. It is not to be supposed that the people of Africa were less restless in ancient times than they are now, nor that the Egyptians did not make efforts to find out where their great river came from. Expeditions into the heart of Africa we read of in Herodotus and elsewhere. However the knowledge came—probably obtained through traders or from natives brought down as slaves to Egypt—there can be no doubt that the Ptolemaic maps of Africa bear some distant resemblance to reality. But all became much exaggerated as time went on. The maps of Africa became overcrowded with features the authority for which it was impossible to find out; the "Mountains of the Moon" stretched themselves right across the continent. That snowy Ruwenzori, Kilimanjaro, and Kenia formed the original nucleus out of which these mountains were evolved there can be little doubt. But modern discoveries have proved how unlike the maps of Africa, before d'Anville swept them clean, were to the reality, and how essential it was to make a new start. No one has done more than Mr. Stanley himself to fill the map of Africa with authentic features.

Mr. Stanley's pages teem with facts and suggestions of interest to science; we have only touched upon a few of

South-west Extremity of Lake Victoria Nyanza.

the more prominent topics referred to in the work. Here, for example, are some curious data with regard to the distribution of malaria:—

"On the plateau of Kavalli and Undussuma, Messrs. Jephson, Parke, and myself were successively prostrated by fever, and the average level of the land was over 4500 feet above the sea.

"On descending to the Nyanza plain, 2500 feet lower, we were again laid up with fierce attacks.

"At Banana Point, which is at sea-level, ague is only too common.

"At Boma, 80 feet higher, the ague is more common still.

"At Vivi, there were more cases than elsewhere, and the station was about 250 feet higher than Boma, and not a swamp was near it.

"At Stanley Pool, about 1100 feet above sea-level, fever of a pernicious form was prevalent.

"While ascending the Congo with the wind astern we were unusually exempted from ague.

"But descending the Upper Congo, facing the wind, we were smitten with most severe forms of it.

"While ascending the Aruwimi we seldom thought of African fever, but descending it in canoes, meeting the wind currents, and carried towards it by river-flow and paddle, we were speedily made aware that acclimatization is slow.

"Therefore it is proved that from 0 to 5000 feet above the sea there is no immunity from fever and ague; that over forty miles of lake water between a camp and the other shore are no positive protection; that a thousand miles of river course may serve as a flue to convey malaria in a concentrated form ; that if there is a thick screen of primeval forest or a grove of plantains between the dwelling-place and a large clearing or open country there is only danger of the local malaria around the dwelling, which might be rendered harmless by the slightest attention to the system ; but in the open country neither a house nor a tent is sufficient protection, since the air enters by the doors of the house, and under the flaps, and through the ventilators to poison the inmates.

"Hence we may infer that trees, tall shrubbery, a high wall or close screen interposed between the dwelling-place and the wind currents will mitigate their malarial influence, and the inmate will only be subjected to local exhalations.

"Emin Pasha informed me that he always took a mosquito curtain with him, as he believed that it was an excellent protector against miasmatic exhalations of the night.

"Question, might not a respirator attached to a veil, or face screen of muslin, assist in mitigating malarious effects when the traveller finds himself in open regions?"

As a matter of fact, we believe a veil or a mosquito curtain is found a useful preventive in malarial regions.

Mr. Stanley gives some natural history notes which he obtained from Emin. Here, for example, is a statement which he gives in Emin's own words, but which notwithstanding is somewhat astounding :—

"The forest of Msongwa is infested with a large tribe of chimpanzees. In summer-time, at night, they frequently visit the plantations of Mswa Station to steal the fruit. But what is remarkable about this is the fact that they use torches to light the way! Had I not witnessed this extraordinary spectacle personally, I should never have credited that any of the Simians understood the art of making fire.

"One of these same chimpanzees stole a native drum from the station, and went away pounding merrily on it. They evidently delight in that drum, for I have frequently heard them rattling away at it in the silence of the night."

The importance of this fact with regard to fire-using (it is not stated that they are fire-making) chimpanzees need not be pointed out. We cannot doubt the accuracy of Mr. Stanley's report, nor the trustworthiness of Emin's observation ; but we should like to have more details.

Great expectations have been formed of Mr. Stanley's narrative of one of the most remarkable African expeditions on record. These expectations have not been disappointed. The reader who merely seeks for the excitement of adventure will find what he seeks in almost every page. We have written enough to prove that the student of science and the geographer will find the narrative teeming with novel and suggestive facts. There are no doubt a few marks of haste and fatigue on the part of the author; but the work is altogether worthy of Mr. Stanley's brilliant record, and entitles him, let us once more say, to be ranked among the foremost pioneers of science in "Darkest Africa."

By the courtesy of Messrs. Sampson Low and Co. we are able to give a few specimens of the 150 illustrations which add so much to the beauty and value of the book, which from the point of view of get-up is entirely creditable to all concerned. J. S. K.

PROBLEMS IN THE PHYSICS OF AN ELECTRIC LAMP.[1]

II.

AT this stage it will perhaps be most convenient to outline briefly the beginnings of a theory proposed to reconcile these facts, and leave you to judge how far the subsequent experiments confirm this hypothesis. The theory very briefly is as follows:—From all parts of the incandescent carbon loop, but chiefly from the negative leg, carbon molecules are being projected which carry with them, or are charged with, negative electricity. I will in a few moments make a suggestion to you which may point to a possible hypothesis on the manner in which the molecules acquire this negative charge. Supposing this, however, to be the case, and that the bulb is filled with these negatively-charged molecules, what would be the result of introducing into their midst a conductor such as this middle metal plate which is charged positively? Obviously, they would all be attracted to it and discharge against it. Suppose the positive charge of this conductor to be continually renewed, and the negatively-charged molecules continually supplied, which conditions can be obtained by connecting the middle plate to the positive electrode of the lamp, the obvious result will be to produce a current of electricity flowing through the wire or galvanometer, by means of which this middle plate is connected to the positive electrode of the lamp. If, however, the middle plate is connected to the negative electrode of the lamp, the negatively-charged molecules can give up no charge to it, and produce no current in the interpolated galvanometer. We see that on this assumption the effect must necessarily be diminished by any arrangement which prevents these negatively-charged molecules from being shot off the negative leg or from

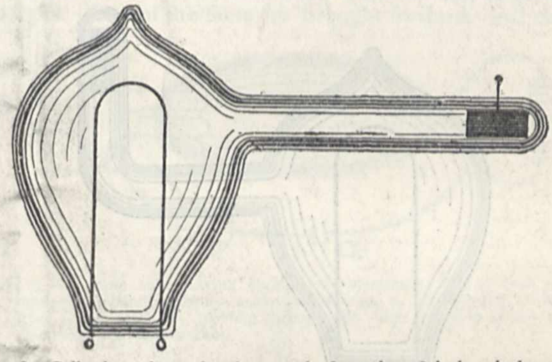


FIG. 8.—Collecting plate placed at end of a tube, 18 inches in length, opening out of the bulb.

striking against the middle plate. Another obvious corollary from this theory is that the "Edison effect" should be annihilated if the metal collecting plate is placed at a distance from the negative leg much greater than the mean free path of the molecules.

Here are some experiments which confirm this deduction. In this bulb (Fig. 8) the metal collecting plate, which is to be connected through the galvanometer with the positive terminal of the lamp, is placed at the end of a long tube opening out of and forming part of the bulb. We find the "Edison effect" is entirely absent, and that the galvanometer current is zero. We have, as it were, placed our target at such a distance that the longest range molecular bullets cannot hit it, or, at least, but very few of them do so. Here again is a lamp in which the plate is placed at the extremity of a tube opening out of the bulb, but bent at right angles (Fig. 9). We find in this case, as first discovered by Mr. Preece, that there is no "Edison effect." Our molecular marksman cannot shoot round a corner. None of the negatively charged molecules can reach the plate, although that plate is placed at a distance not greater than would suffice to produce the effect if the bend were straightened out. Following out our hypothesis into its consequences would lead us to conclude that the material of which the plate is made is without influence on the result, and this is found to be the case. Many of the foregoing facts were established

[1] Friday Evening Discourse delivered at the Royal Institution by Prof. J. A. Fleming, M.A., D.Sc., on February 14, 1890. Continued from p. 201.

by Mr. Preece as far back as 1885, and I have myself abundantly confirmed his results.

We should expect also to find that the larger we make our plate, and the nearer we bring it to the negative leg of the carbon, the greater will be the current produced in a circuit connecting this plate to the positive terminal of the lamp. I have before me a lamp with a large plate placed very near the negative leg of the carbon of a lamp, and we find that we can collect enough current from these molecular charges to work a telegraph relay and ring an electric bell. The current which is now working this relay is made up of the charges collected by the plate from the negatively charged carbon molecules which are projected against it from the negative leg, across the highly perfect vacuum. I have tried experiments with lamps in which the collecting plate is placed in all kinds of positions, and has various forms, some of which are here, and are represented in the diagrams before you; but the results may all be summed up by saying that the greatest effects are produced when the collecting plate is as near as possible to the base of the negative end of the loops, and, as far as possible, incloses, without touching, the carbon conductor. Time will not permit me to make more than a passing reference to the fact that the magnitude of the current flowing through the galvanometer when connected between the middle plate and the positive terminal of the lamp often "jumps" from a low to a high value, or *vice versâ*, in a remarkable manner, and

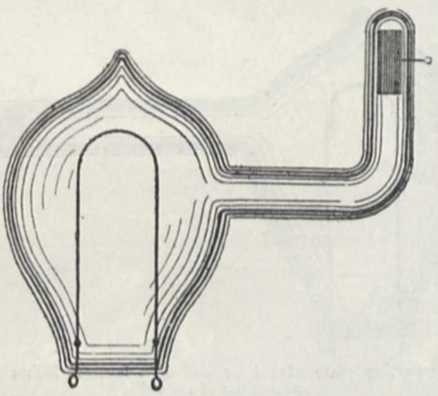


Fig. 9.—Collecting plate placed at end of an elbow tube opening out of the bulb.

that this sudden change in the current can be produced by bringing strong magnets near the outside of the bulb.

Let us now follow out into some other consequences this hypothesis that the interior of the bulb of a glow-lamp when in action is populated by flying crowds of carbon atoms all carrying a negative charge of electricity. Suppose we connect our middle collecting plate with some external reservoir of electric energy, such as a Leyden jar, or with a condenser equivalent in capacity to many hundreds of Leyden jars, and let the side of the condenser which is charged positively be first placed in connection through a galvanometer with the middle plate (see Fig. 10), whilst the negative side is placed in connection with the earth. Here is a condenser of two microfarads capacity so charged and connected. Note what happens when I complete the circuit and illuminate the lamp by passing the current through its filament. The condenser is at once discharged. If, however, we repeat the same experiment with the sole difference that the negatively charged side of the condenser is in connection with the middle plate then there is no discharge. The experimental results may be regarded from another point of view. In order that the condenser may be discharged as in the first case, it is essential that the negatively charged side of the condenser shall be in connection with some part of the circuit of the incandescent carbon loop. This experiment with the condenser discharged by the lamp may be then looked upon as an arrangement in which the plates of a charged condenser are connected respectively to an incandescent carbon loop and to a cool metal plate, both being inclosed in a highly vacuous space, and it appears that when the incandescent conductor is the negative electrode of this arrangement the discharge takes place, but not when the cooler metal plate is the negative electrode of the charged condenser. The negative charge of the condenser can be carried across the

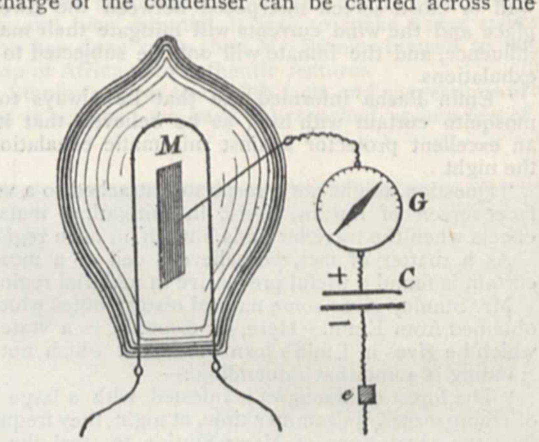


Fig. 10.—Charged condenser C discharged by middle plate M, when the positively charged side of condenser is in connection with the plate and other side to earth *e*.

vacuous space from the hot carbon to the colder metal plate, but not in the reverse direction.

This experimental result led me to examine the condition of the vacuous space between the middle metal plate and the negative leg of the carbon loop in the case of the lamp employed in our first experiment. Let us return for a moment to that lamp. I join the galvanometer between the middle plate and the negative terminal of the lamp, and find, as before, no indication of a current. The metal plate and the negative terminal of the lamp

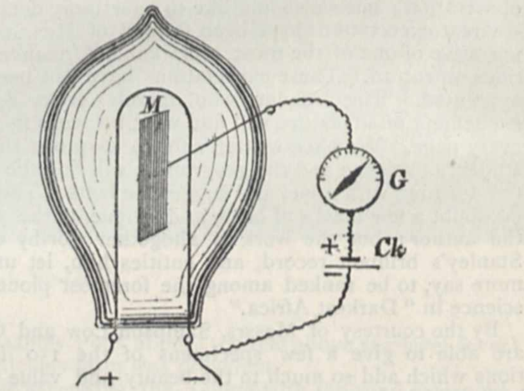


Fig. 11.—Current from Clark cell *Ck* being sent across vacuous space between negative leg of carbon and middle plate M. Positive pole of cell in connection with plate M through galvanometer G.

are at the same electrical potential. In the circuit of the galvanometer we will insert a single galvanic cell having an electromotive force of rather over one volt. In the first place let that cell be so inserted that its negative pole is in connection with the middle plate, and its positive pole in connection through the galvanometer with the negative terminal of the lamp (see Fig. 11). Regarding the circuit of that cell alone, we find that it consists of the cell itself, the galvanometer wire, and that half-inch of highly vacuous space between the hot carbon conductor and the middle plate. In that circuit the cell cannot send any sensible current at all, as it is at the present moment connected up. But if we reverse the direction of the cell so that its positive pole is in connection with the middle plate, the galvanometer at once gives indications of a very sensible current. This highly vacuous space, lying between the middle metal plate on the one hand, and the incandescent carbon on the other, possesses a kind of unilateral conductivity, in that it will allow the current from a single galvanic cell to pass one way but not the other. It is a very old and familiar fact that in order to send a current from a battery through a highly rarefied gas by means of metal electrodes, the electromotive force of the battery must exceed a certain value. Here, however, we have indication that if the negative electrode by which that current seeks to enter the vacuous space is made incandescent the current will pass at a very much lower electromotive force than if the electrode is not so heated.

A little consideration of the foregoing experiments led to the conclusion that in the original experiment, as devised by Mr. Edison, if we could by any means render the middle plate very hot, we should get a current flowing through a galvanometer when it is connected between the middle plate and the negative electrode of the carbon. This experiment can be tried in the manner now to be shown. Here is a bulb (Fig. 12) having in it two carbon

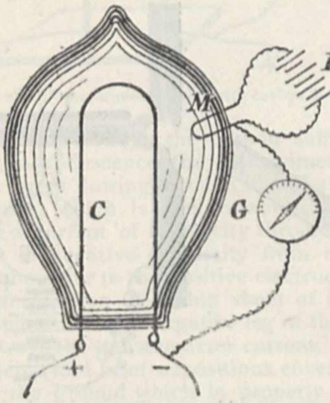


FIG. 12.—Experiment showing that when the "middle plate" is a carbon loop rendered incandescent by insulated battery B, a current of negative electricity flows from M to the positive leg of main carbon C across the vacuum.

loops; one of these is of ordinary size, and will be rendered incandescent by the current from the mains. The other loop is very small, and will be heated by a well-insulated secondary battery. This smaller incandescent loop shall be employed just as if it were a middle metal plate. It is, in fact, simply an incandescent middle conductor. On repeating the typical experiment with this arrangement, we find that the galvanometer indicates a current when connected between the middle loop and either the positive *or* the negative terminal of the main carbon. I have little doubt but that if we could render the platinum plate in our first-used lamp incandescent by concentrating on it from outside a powerful beam of radiant heat we should get the same result.

A similar set of results can be arrived at by experiments with a bulb constructed like an ordinary vacuum tube, and having small carbon loops at each end instead of the usual platinum or aluminium wires. Such a tube is now before you (see Fig. 13), and will not allow the current from a few cells of a secondary battery to pass through it when the carbon loops are cold. If, however, by means of well-insulated secondary batteries we render both of the carbon loop electrodes highly incandescent, a single cell of a battery is sufficient to pass a very considerable current across that vacuous space, provided the resistance of the rest of the circuit is not large. We may embrace the foregoing facts by saying that if the electrodes, but especially the negative electrode, which form the means of ingress and egress of a current into a vacuous space are capable of being rendered highly incandescent, and if at that high temperature they are made to differ in electrical potential by the application of a very small electromotive force, we may get under these circumstances a very sensible current through the rarefied gas. If the electrodes are cold a very much higher electromotive force will be necessary to begin the discharge or current through the space. These facts have been made the subject of elaborate investigation by Hittorf and Goldstein, and more recently by Elster and Geitel. It is to Hittorf that I believe we are indebted for the discovery of the fact that by heating the negative electrode we greatly reduce the apparent resistance of a vacuum.

Permit me now to pave the way by some other experiments for a little more detailed outline of the manner in which I shall venture to suggest these negative molecular charges are bestowed. This is really the important matter to examine. In seeking for some probable explanation of the manner in which these wandering molecules of carbon in the glow-lamp bulb obtain their negative charges, I fall back for assistance upon some facts discovered by the late Prof. Guthrie. He showed some years ago new experiments on the relative powers of incandescent bodies for retaining positive and negative charges. One of the facts he brought forward[1] was that

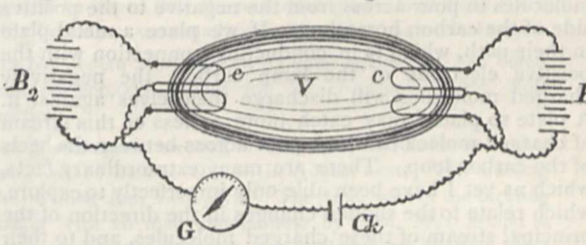


FIG. 13.—Vacuum tube having carbon loop electrodes, *c c*, at each end rendered incandescent by insulated batteries, B_1 B_2, showing current from Clark cell, *Ck*, passing through the high vacuum when the electrodes are incandescent.

a bright red-hot iron ball, well insulated, could be charged negatively, but could not retain for an instant a positive charge. He showed this fact in a way which it is very easy to repeat as a lecture experiment. Here is a gold-leaf electroscope, to which we will impart a positive charge of electricity, and project the image of its divergent leaves on the screen. A poker, the tip of which has been made brightly red-hot, is placed so that its incandescent end is about an inch from the knob of the electroscope. No discharge takes place. Discharging the electroscope with my finger, I give it a small charge of negative electricity, and replace the poker in the same position. The gold leaves instantly collapse. Bear in mind that the extremity of the poker, when brought in contiguity to the knob of the charged electroscope, becomes charged by induction with a charge of the opposite sign to that of the charge of the electroscope, and you will at once see that this experiment confirms Prof. Guthrie's statement, for the negatively charged electroscope induces a positive charge on the incandescent iron, and this charge cannot be retained. If the induced charge on the poker is a negative charge, it is retained, and hence the positively charged electroscope is not discharged, but the negatively charged electroscope at once loses its charge. Pass in imagination from iron balls to carbon molecules. We may ask whether it is a legitimate assumption to suppose the same fact to hold good for them, and that a hot

[1] "On a New Relation between Electricity and Heat," *Phil. Mag.*, vol. xlv. p. 308 (1873).

carbon molecule or small carbon mass just detached from an incandescent surface behaves in the same way and has a greater grip for negative than for positive charge? If this can possibly be assumed, we can complete our hypothesis as follows:—Consider a carbon molecule or small collection of molecules just set free by the high temperature from the negative leg of the incandescent carbon horseshoe. This small carbon mass finds itself in the electrostatic field between the branches of the incandescent carbon conductor (see Fig. 14). It is acted upon inductively, and if it behaves like the hot iron ball in Prof. Guthrie's experiment it loses its positive charge. The molecule then being charged negatively is repelled along the lines of electric force against the positive leg.

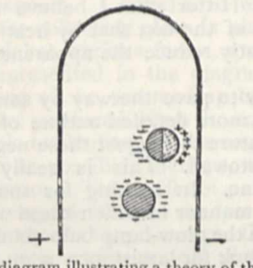


FIG. 14.—Rough diagram illustrating a theory of the manner in which projected carbon molecules may acquire a negative charge.

The forces moving it are electric forces, and the repetition of this action would cause a torrent of negatively-charged molecules to pour across from the negative to the positive side of the carbon horseshoe. If we place a metal plate in their path, which is in conducting connection with the positive electrode of the lamp carbon, the negatively charged molecules will discharge themselves against it. A plate so placed may catch more or less of this stream of charged molecules which pour across between the heels of the carbon loop. There are many extraordinary facts, which as yet I have been able only imperfectly to explore, which relate to the sudden changes in the direction of the principal stream of these charged molecules, and to their

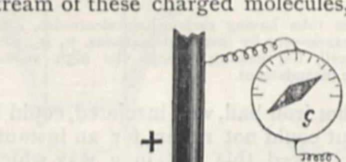


FIG. 15.—Electric arc projected by magnet against a third carbon, and showing a strong electric current flowing through a galvanometer, G, connected between the positive and this third carbon.

guidance under the influence of magnetic forces. The above rough sketch of a theory must be taken for no more than it is worth, viz. as a working hypothesis to suggest further experiments.

These experiments with incandescence lamps have prepared the way for me to exhibit to you some curious facts with respect to the electric arc, and which are analogous to those which we have passed in review. If a good electric arc is formed in the usual way, and if a third insulated carbon held at right angles to the other two is placed so that its tip just dips into the arc (see Fig. 15), we can show a similar series of experiments. It is rather more under control if we cause the arc to be projected against the third carbon by means of a magnet. I have now formed on the screen an image of the carbon poles and the arc between them, in the usual way. Placing a magnet at the back of the arc, I cause the flame of the arc to be deflected laterally and to blow against a third insulated carbon held in it. There are three insulated wires attached respectively to the positive and to the negative carbons of the arc, and to the third or insulated carbon, the end of which dips into the flame of the arc projected by the magnet. On starting the arc this third carbon is instantly brought down to the same electrical potential as the negative carbon of the arc, and if I connect this galvanometer in between the negative carbon and the third or insulated carbon, I get, as you see, no indication of a current. Let me, however, change the connections and insert the circuit of my galvanometer in between the positive carbon of the arc and the middle carbon, and we find evidence, by the violent impulse given to the galvanometer, that there is a strong current flowing through it. The direction of this current is equivalent to a flow of negative electricity from the middle carbon through the galvanometer to the positive carbon of the arc. We have here, then, the "Edison effect" repeated with the electric arc. So strong is the current flowing in a circuit connecting the middle carbon with the positive carbon that I can, as you see, ring an electric bell and light a small incandescent lamp when these electric-current

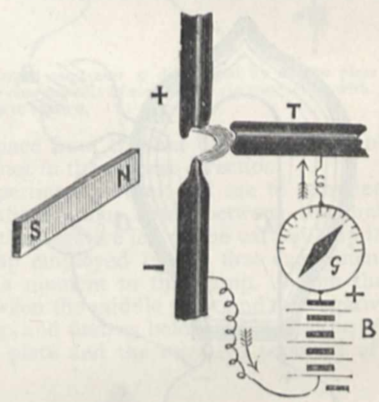


FIG. 16.—Galvanometer G and battery B inserted in series between negative carbon of electric arc and a third carbon to show unilateral conductivity of the arc between the negative and third carbons.

detectors are placed in connection with the positive and middle carbons.

We also find that the flame-like projection of the arc between the negative carbon possesses a unilateral conductivity. I join this small secondary battery of fifteen cells in series with the galvanometer, and connect the two between the middle carbon and the negative carbon of the arc. Just as in the analogous experiment with the incandescent lamp, we find we can send negative electricity along the flame of the arc one way but not the other. The secondary battery causes the galvanometer to indicate a current flowing through it when its negative pole is in connection with the negative carbon of the arc (see Fig. 16), but not when its positive pole is in connection with the negative carbon. On examining the third or middle carbon after it has been employed in this way for some time, we find that its extremity is cratered out and converted into graphite, just as if it had been employed as the positive carbon in forming an electric arc.

Time forbids me to indulge in any but the briefest remarks on these experiments; but one suggestion may be made, and that is that they seem to indicate that the chief movement of carbon molecules in the electric arc is *from* the negative *to* the positive carbon. The idea suggests itself that, after all, the cratering out of the positive carbon of the arc may be due to a sand-blast-like action of this torrent of negatively charged molecules which are projected from the negative carbon. If we employ a soft iron rod as our lateral pole, we find that, after enduring for some time the projection of the arc against it, it is converted at the extremity into *steel*.

Into the fuller discussion as to the molecular actions going on in the arc, the source and nature of that which has been called the counter-electromotive force of the arc, and the causes contributing to produce unsteadiness and hissing in the arc, I fear that I shall not be able to enter, but will content myself with the exhibition of one last experiment, which will show you that a high vacuum, or, indeed, any vacuum, is not necessary for the production of the "Edison effect." Here is a carbon horseshoe-shaped conductor, not inclosed in any receiver (see Fig. 17). Close to the negative leg or branch, yet not touching it, we have adjusted a little metal plate. The sensitive galvanometer is connected between this metal plate and the base of the other or positive leg of this carbon arch.

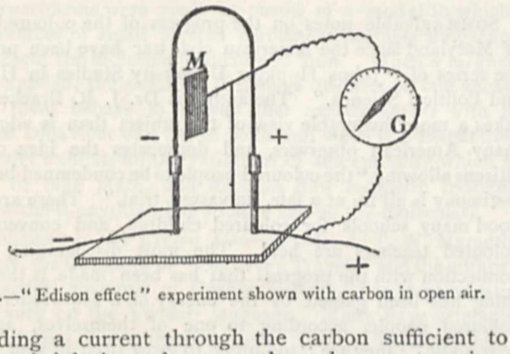


FIG. 17.—"Edison effect" experiment shown with carbon in open air.

On sending a current through the carbon sufficient to bring it to bright incandescence, the galvanometer gives indications of a current flowing through it, and as long as the carbon endures, which is not, however, for many seconds, there is a current of electricity through it equivalent to a flow of negative electricity from the plate through the galvanometer to the positive electrode of the carbon. The interposition of a thin sheet of mica between the metal plate and the negative leg of the carbon loop entirely destroys the galvanometer current.[1]

These experiments and brief expositions cover a very small portion of the ground which is properly included within the limits of my subject. Such fragments of it as we have been able to explore to-night will have made it clear that it is a region abounding in interesting facts and problems in molecular physics. The glow-lamp and the electric arc have revolutionized our methods of artificial lighting, but they present themselves also as subjects of scientific study, by no means yet exhausted of all that they have to teach.

NOTES.

PROF. E. RAY LANKESTER, F.R.S., has been elected Deputy Linacre Professor of Human and Comparative Anatomy, Oxford.

TO-DAY a meeting will be held at the Mansion House in support of the International Congress of Hygiene and Demography, which is to be held in London in 1891. The Prince of Wales has consented to act as President of the forthcoming Congress; and it is expected that the meetings will be "of great magnitude and importance." Many delegates have already been appointed, and other nominations are being received daily. It is necessary, therefore, that a definite organization should be formed, and that a fund should be raised for the defraying of expenses.

[1] This last experiment is due to my assistant, Mr. A. H. Bate.

ON Wednesday next, July 9, Prof. T. McKenny Hughes F.R.S., will deliver a lecture in the saloon of the Mansion House on the question, "Is there coal in the south-east of England?" The Lord Mayor will preside, and will be supported by the "Coal Search Committee." This Committee has been formed for the purpose of taking steps to discover whether there really are good coal-fields in the south-east of England, and, if so, to what extent. It consists of scientific and commercial men, and their services are gratuitous. Among the members are Prof. Boyd Dawkins, Colonel Godwin-Austen, Prof. A. H. Green, Dr. Henry Hicks, Mr. W. H. Hudleston, Prof. Edward Hull, Dr. A. Irving, Prof. J. W. Judd, Sir John Lubbock, Prof. Meldola, Mr. F. W. Rudler, Prof. W. J. Sollas, Mr. J. J. H. Teall, Mr. W. Topley, Mr. W. Whitaker, and Dr. H. Woodward.

A NEW scientific Society (Die Deutsche zoologische Gesellschaft, on the lines of the Anatomische Gesellschaft) has just been founded. Early in May, nine representatives of zoology in German Universities issued a circular inviting brother zoologists to unite in forming a Zoological Society. On May 28 a preliminary meeting was held at Frankfurt, and zoologists from nearly a dozen German Universities were present. At present there are fifty-four members, and the next meeting is to be held on August 1, when a President will be chosen. The invitations to this meeting will be issued early in July. Applications for membership may be sent to Prof. Bütschli (Heidelberg), Prof. Victor Carus (Leipzig), or Prof. Spengel (Giessen). The foundation of this Society is a step in the right direction, and it is to be hoped that the new Zoologische Gesellschaft will speedily become as cosmopolitan as the sister anatomical one.

THE Norwegian Storthing, by 73 votes against 39, has voted a grant of 200,000 kroner for Dr. Nansen's North Pole Expedition.

THE third summer meeting of University Extension and other students will be held at Oxford in August next. The meeting will be divided into two parts. The first part of the meeting will begin with an inaugural address by Prof. Max Müller at 8.30 p.m. on Friday, August 1, and will end on Tuesday evening, August 12. The second part of the meeting will begin on Wednesday morning, August 13, and end on Tuesday evening, September 2. This period will be devoted to quiet study. The courses of lectures will be longer than those delivered during the first part of the meeting, and will deal in greater detail with the subjects then introduced.

SIR HENRY W. ACLAND has published a letter on "Oxford and Modern Medicine." It is addressed to Dr. James Andrew, and was printed originally for private circulation. In the preface the author expresses an earnest hope that "the broad and yet precise study of material science and of nature may prosper at Oxford, as part of the whole rauge of University thought, and that in the haste for technical education our physicians may not be relegated as some now desire into a professional class or clique by themselves, but be as formerly a living part of the whole of the scientific and literary University."

THE third International Shorthand Congress will be held at Munich from August 7 to 17. The centenary of F. X. Gabelsberger, the originator of modern German shorthand, will be celebrated by those who attend the meetings, and a bronze statue of him will be unveiled.

ACCOUNTS which have reached the *Times* from the Weatherby district, in Yorkshire, agree as to the occurrence of distinct earthquake shocks on Wednesday, June 25, about 10.30 p.m., and again on Thursday morning about four o'clock. Mr. John Emmet, of Boston Spa, sixteen miles from Leeds, states that shocks were experienced, not only at Boston Spa, but at Wighill, Clifford, Thorp Arch, Weatherby, and other places, and he adds, "Crockery was heard to shake, and some of it was broken. Those who had retired to bed felt their houses and beds shaking, and rushed into the street. . . Those who were abroad in the street had to lay hold of something to keep them from falling."

MESSRS. MACMILLAN AND Co. have nearly ready for publication two works of great interest to students of ornithology, both of American origin. The first is a treatise on the "Myology of the Raven," intended as an introduction to the study of the muscular system in birds, by Dr. R. W. Shufeldt, of the Smithsonian Institution. The second is a revised re-issue, in one volume of convenient size, of the very valuable monographs on field ornithology and on general ornithology which were prefixed to Dr. Elliott Coues's monumental "Key to North American Birds." Part I., on field ornithology, contains the necessary instructions for the observation and collection of birds in the field, and for the preparation and preservation of specimens for scientific study. Part II. is a technical treatise on the classification, the zoological characters, and the anatomical structure of the class of Birds, in which the examples cited in illustration of the principles of ornithology have for the most part been re-drawn by the author from British instead of American birds.

MESSRS. D. MARPLES AND Co., Liverpool, have issued the presidential address delivered by the Rev. Henry H. Higgins at the meeting of the Museums Association, lately held at Liverpool. In the course of the address he gives an interesting account of the principal kinds of fittings and apparatus used in the Liverpool Museum.

MESSRS. MAWSON, SWAN, AND MORGAN propose to issue a lithographed facsimile of an old manuscript volume of apothecaries' lore and household recipes, which was discovered some years ago amongst the papers belonging to the old firm of Gilpin and Company, chemists, Pilgrim Street, Newcastle. Careful examination, in which some of the curators of the British Museum have assisted, shows that the manuscript dates from about the time of Queen Elizabeth, additions having been made from time to time, in various handwritings, up to the middle of last century.

UNDER the auspices of the Royal Dublin Society, and partially aided by the Government, a scientific investigation of Irish fishing grounds is now being carried on upon the south-west and west coasts of Ireland. The Rev. W. Spotswood Green, Her Majesty's Inspector of Fisheries, Dublin, and Prof. A. C. Haddon, of Dublin, organized the expedition, which is expected to last four or five months. The screw steamer *Fingal*, of Glasgow, 160 tons register, chartered for the cruise, left Queenstown on May 7, having on board Mr. Green, Prof. Prince, Mr. T. H. Poole, of Cork, special surveyor to the expedition, and a crew of seamen experienced in trawl, net, and line fishing. Prof. Prince, who has conducted elaborate investigations upon the embryology of food-fishes at St. Andrews, and later on, Mr. E. W. L. Holt, also of St. Andrews Marine Laboratory, superintended the zoological department until Prof. Haddon was able to join the steamer. Dr. R. Scharff, of the Science and Art Museum, Dublin, and other gentlemen have temporarily assisted on board. The *Fingal* has been specially fitted up for the work. Several beam trawls (including patent forms), a quantity of mackerel nets, thirteen miles of long lines, large tow-nets (after Prof. McIntosh's pattern), microscopes and instruments for zoological and physical research, are included among the appliances. The coast from Cape Clear to Killybegs Bay (Donegal) has already been traversed, and about thirty stations have been tested and results of value obtained. In the open sea and in inshore waters the eggs and larval stages of mackerel, ling, gurnard, haddock, turbot, witch, and other species of food-fishes have been obtained, and a great variety of invertebrates, including some rare echinoderms, annelids, molluscs, &c., have been brought up in the dredge and trawl, the greatest depth tested up to this time being about 100 fathoms. The estuary of the Kenmare river, Dingle Bay, Smerwick, Birterburg, and Roundstone Bays, and the harbour of Clifden, proved to be very rich in invertebrate forms, specimens of *Synapta inhærens*, being abundant, while *Bonellia*, *Priapulus*, and many rare molluscs, *Lyonsia*, *Philine*, and various nudibranchs were procured. Copepods, larval crustaceans, medusæ, echinoderms, and ascidians occurred in such quantities as to frequently cause great inconvenience. A fine example of *Orthagoriscus mola*, nearly 9 feet in dorso-ventral measurement, was shot by Mr. Green and secured, and the rare Pleuronectid, *Arnoglossus gröhmanii*, was obtained in Clifden Harbour, the second specimen captured in British seas. Deep-sea dredgings will be taken, and it is expected that the reports, to be presented at the end of the cruise to the Royal Dublin Society, to the Irish Fishery Department, and the Government, will be of unusual scientific interest.

SOME valuable notes on the progress of the coloured people of Maryland since the American civil war have been printed in the series of "Johns Hopkins University Studies in Historical and Political Science." The author is Dr. J. R. Brackett. He takes a more favourable view of the subject than is adopted by many American observers, and deprecates the idea of good citizens allowing "the coloured people to be condemned before the testimony is all in, at a fair, unbiassed trial." There are now a good many schools for coloured children, and conventions of coloured teachers are held. The most discouraging fact in connection with the progress that has been made is that everything has been gained by the energy of a few leaders. The coloured people, according to one of themselves, are "too spasmodic"; they are "too prone to grow tired in well doing."

THE Town Gardening Committee of the Manchester Field Naturalists' Society, to which we lately alluded, has been vigorously prosecuting its work. The esplanade in front of the Manchester Infirmary and Albert Square, in which the Town Hall stands, are now decorated with seventy-five beautiful specimens of holly and aucuba, whose bright green leaves show up with good effect against the darkened stone of the neighbouring buildings. The plants have been placed in substantial but movable boxes 3 feet square and 4½ feet in height. The Parks Committee of the Manchester Corporation, of which Mr. Chesters-Thompson is chairman, has shown a laudable anxiety to carry out the plans suggested, and has contributed the greater part of the £500 already spent by the two committees on plants. It is hoped next year to carry on tree-planting on a large scale in the open spaces and streets of Manchester, and with a view to ensuring success under the extremely unfavourable atmospheric conditions peculiar to the city, the Town Gardening Committee is occupied in collecting all information relating to the subject, and will shortly issue a pamphlet of recommendations to those actually engaged in the work. Dr. Bailey, of Owens College, will contribute an essay on the effect of noxious gases on plants, and Dr. Poisson, of the Museum in Paris, will send a detailed account of the progress and experience gained in tree-planting in French towns. Several of our most distinguished botanists have also consented to act as corresponding members of the committee. It is probable that the movement will spread rapidly over the north of England, as the committee has already received official and unofficial requests for information about the work from Liverpool, Carlisle, Leek, and many other towns. The honorary secretary, Mr. C. J. Oglesby (16 Kennedy Street, Albert Square, Manchester), will be glad to receive additional information from anyone who may have had experience in the cultivation of trees and plants in manufacturing towns.

AMONG the papers read at the closing meeting of the Royal Society, was one by Prof. Ewing, of the Dundee College, entitled, "Contributions to the Molecular Theory of Induced Magnetism," in which experiments of a novel and curious kind were described, leading to an important conclusion. Prof. Ewing has examined experimentally Weber's theory of molecular magnets, according to which the molecules of iron are always magnets, which point anyhow in an unmagnetized piece, but are turned round to point one way when the iron is magnetized. It is well known that in the development of this theory by Maxwell and others there has been much difficulty in reconciling the results of the theory with what is known about the magnetic quality of iron and steel, and many arbitrary assumptions have been suggested in order to make the theory fit the facts. Prof. Ewing's experiments have removed this difficulty, showing that no arbitrary assumptions are necessary, and that the known character of the magnetizing process may be deduced from the molecular theory in its simplest form. The experiments were made by means of a model in which a large number of small pivoted permanent magnets are grouped to represent the molecular structure of iron. When a magnetic field is applied, the action of the small magnets on one another makes them behave in a way that exactly agrees with the observed behaviour of a bar of solid iron when it is magnetized. The model exhibits all the variations of susceptibility which are known to take place, and explains how magnetic hysteresis occurs without anything like friction among the molecules.

ACCORDING to the *Ceylon Observer*, Mr. A. T. W. Marambe, of Kandy, the translator of "Gulliver's Travels" and the author of "A Practical Synopsis of Ceylon History," has in preparation a little work on the Veddah language. Many have attempted this task before, but without success. Besides Veddah songs, a description of habits and customs, &c., the book will have a completer list of words than has hitherto appeared.

AN exceptionally pretty and instructive series of new experiments, upon the action of carbon heated to whiteness in the electric arc on various gaseous compounds, are described in the current number of the *Berichte* by Prof. Lepsius, of Frankfurt. Perhaps the most important are a group of four experiments illustrating the relative combining powers of the four elements iodine, sulphur, phosphorus, and carbon. The apparatus employed consists of a specially modified Hofmann eudiometer, one limb of which is 40 mm. in diameter and 300 mm. long, and the other longer limb narrower and furnished with a mercury reservoir at its upper end. The wider limb, which is the reaction-tube, is furnished with a stop-cock at the top, and just below this are two tubuli through which the adjustable carbon poles are inserted. At the base of the wider limb a second stop-cock is placed so as to permit of the adjustment of the mercury. The gas to be experimented upon is introduced into the apparatus at the upper stop-cock by allowing mercury to run out at the base. Four such eudiometers are arranged in a row, and 100 c.c. of gas introduced into each. Into the first, hydriodic acid is introduced; into the second, sulphuretted hydrogen; into the third, phosphuretted hydrogen; and into the fourth, marsh-gas. The gases thus stand at the same level in each of the four reaction-tubes. The current from a battery whose electromotive force should amount to 60–80 volts is then allowed to pass between the carbon poles, which are, of course, in contact at first, and then gradually drawn away until the maximum arc is obtained. Each reaction may be performed separately, or all four may be allowed to proceed simultaneously by adopting an arrangement in multiple arc. In hydriodic acid the brilliant arc light is tinted a magnificent purple and the whole space above the mercury becomes filled with violet vapour of iodine. Notwithstanding the considerable heating effect of the discharge, the volume of gas perceptibly diminishes, the liberated iodine rapidly depositing in minute crystals upon the walls of the tube. So rapid, indeed, is the diminution in volume, that mercury requires to be poured into the reservoir to prevent the entrance of air into the reaction-tube. In a very few minutes the reaction is complete, and the mercury ceases to rise. In sulphuretted hydrogen the light is coloured blue, and copious clouds of sulphur are produced, which settle upon the walls in the form of a white transparent coating. The volume of gas is considerably augmented, owing to the expansion by heat, and the reaction is likewise completed in a very brief space of time. In phosphuretted hydrogen the arc glows with a dazzling red light; the volume visibly augments at a rapid rate, and red clouds of phosphorus are thrown off, the glass walls being covered with red phosphorus, among which are to be found notable quantities of the ordinary yellow variety. The mercury attains its maximum height in the narrow limb in a minute at most from the moment of switching on the current. In the case of marsh-gas, the whiteness of the arc appears at first to be rendered more intense, and is surrounded by dense black clouds of carbon, which form a striking background. The upper part of the vessel, however, soon becomes covered with an opaque deposit, which perceptibly diminishes the brilliancy of the light. The volume appears to increase by leaps and bounds, and in a few seconds attains its maximum. At the end of the experiment, after cooling, the volume of hydrogen left in the first case is 50 c.c., in the second 100 c.c., in the third 150 c.c., and in the fourth case 200 c.c., thus showing in a most striking manner that an atom of iodine combines with one atom of hydrogen, sulphur with two, phosphorus with three, and carbon with four atoms of hydrogen.

THE additions to the Zoological Society's Gardens during the past week include a Bosman's Potto (*Perodicticus potto*) from West Africa, presented by Mr. P. S. S. Radcliffe; a Harnessed Antelope (*Tragelaphus scriptus* ♂), a —— Antelope (*Cervicapra* sp. in. ♂), two Marabou Storks (*Leptoptilus crumeniferus*) from Gambia, West Africa, presented by Dr. Percy Rendall; an English Wild Bull (*Bos taurus*, var.) from Chartley, Staffordshire, presented by the Earl Ferrers; a Ring-tailed Coati (*Nasua rufa* ♀) from Buenos Ayres, presented by Mr. C. W. Blacklock; two Tigers (*Felis tigris* ♂ ♀) from India, presented by H.R.H. the Duke of Clarence and Avondale; a Wedge-tailed Eagle (*Aquila audax*) from Australia, presented by Captain Salvin; an Alligator (*Alligator mississippiensis*) from the Mississippi, presented by Mr. Alexander Finlay; two Nightingales (*Daulias luscinia*), British, presented by Mr. J. Young, F.Z.S.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on July 3 = 16h. 47m. 29s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 4373	—	Greenish-blue.	17 58 19	+66 37
(2) 387 Birm.	5 6	Reddish-yellow.	16 40 33	+ 8 47
(3) π Herculis	3	Yellow.	17 11 12	+36 56
(4) ε Herculis	3·4	Bluish-white.	16 56 6	+31 5
(5) 202 Schj.	8	Very red.	17 23 15	−19 24
(6) V Boötis	Var.	Reddish-yellow.	14 25 20	+39 21

Remarks.

(1) This is the planetary nebula famous in the history of astronomy as the first nebula which was examined by the spectroscope. The nebula, though small, is remarkably bright, and the lines in its spectrum are at least as bright as those in the nebula of Orion. The three principal lines in the green, and the hydrogen line at G, are seen without any difficulty.

Vogel mapped two faint lines near λ 518 and 554, but these require confirmation. With a 10-inch refractor I have had no great difficulty in glimpsing these fainter lines, but I was unable to confirm their positions. The line at 518 is very suggestive of carbon, and that at 554 of manganese, and, if possible, comparisons with these substances should be made where a large aperture is available. I have very little doubt also, from my own observations, that there are many lines between F and G. Another observation of importance will be that of the character of the brightest line. Observers differ very considerably on this point, some maintaining that it is perfectly sharp on both edges, aud others that it is softened off on the more refrangible edge. For this observation it is not desirable to use high dispersion. In the General Catalogue the nebula is described thus:—"A planetary nebula; very bright; pretty small; suddenly brighter in the middle to a very small nucleus." Webb compares the telescopic appearance of the nebula with that of a star out of focus.

(2) Vogel describes the spectrum of this star as a very fine one of the solar type (Class II.*a*), whereas Dunér calls it Group II. According to the latter observer the banded spectrum is feebly developed, 2, 3, and 7 being very narrow, and the remaining bands appearing only as lines. From these observations it is not possible to say whether the star belongs to an early species of the group or a late one. In either case the bands would be narrow, but if the star be at an early stage the bright carbon flutings ought to be very manifest, and if at a late stage, there ought to be dark lines in addition to the narrow bands. Vogel may have mistaken the narrow bands for lines.

(3 and 4) These are stars of the solar type and of Group IV. respectively. The usual detailed observations are required in each case.

(5) This star, according to Dunér, has a well-marked spectrum of Group VI., the blue zone, however, being very feeble. The green and yellow zones are separated by a wide and dark band; the bands 4 and 5 are not visible. Further details or peculiarities should be looked for.

(6) This variable has a well-marked spectrum of Group II. (Dunér). The range is but small—7·0–9·4 in a period of 266 days—and it will be interesting to ascertain whether the bright hydrogen lines appear at maximum as in stars of greater range. Dunér states that though the spectrum is not a very bright one, its characteristics are by no means difficult to observe. There will be a maximum about July 6.

A. FOWLER.

ANNULAR ECLIPSE OF JUNE 17.—The number of the *Comptes rendus* for June 23 contains observations of this eclipse made at various Observatories. The Emperor of Brazil took the time of second contact at Nice Observatory; MM. Charlois, Javelle, and Perrotin those of first and last contact. At Lyons Observatory, M. Gonnessiat made some measures of the position-angle of the shadow. M. Trépied at Algiers succeeded in taking 26 photographs, the times of first and last contact also being noted. The maximum of the eclipse was indicated on the curves of a self-registering thermometer by a fall in temperature of 1°·4. Clouds prevented good observations at Meudon, but four photographs were taken by M. Trouvelot. M. de la Baume went from Meudon Observatory to Canea to observe the eclipse, and a telegram was received from him by M. Janssen stating that the weather was favourable, and that he had been able to obtain photographs of the ring and of its spectrum. M. Janssen also noted that one of the objects of the expedition to Canea was to obtain a photographic spectrum of the annulus, in order to see if the spectrum of the extreme edge of the sun's disk showed the bands of oxygen, and from the telegram received it seems probable that the question will be settled. The photographs obtained at Meudon show the granular structure of the solar surface so well visible during an eclipse, and the granulation can be traced right up to the edge of the moon, thus affording another proof of the excessive rarity of the lunar atmosphere.

YARNALL'S STAR CATALOGUE.—The Catalogue of stars observed at the United States Naval Observatory during the years 1845 to 1877, and prepared for publication by Prof. M. Yarnall, has been revised and corrected, and the stars renumbered by Prof. Edgar Frisby. In preparing this edition a re-examination of all annonymous stars has been made; the named stars have been compared with those of existing catalogues, the names being changed whenever necessary, and new names that existed previous to the publication of the Catalogue have been supplied. The errata in previous editions, pointed out by Profs. Holden, Krueger, and Millosevich, and Dr. Peters, have also been corrected, and the many notes to the Catalogue referring to the mistakes in the second edition, and the changes that have been made, indicate that the task of revision has not been a light one. As the object of the revision was merely for the purpose of correcting mistakes, no observations have been added or any unfinished observation completed, excepting such as were observed but omitted from the Catalogue, the apparent additions being found in some of the published volumes or in an unfinished state in the observing-books. The stars in the Catalogue have all been compared with standard catalogues as far as possible, and Prof. Frisby confidently believes that most of the mistakes have been corrected.

PHOTOGRAPHS OF THE SURFACE OF MARS.—Prof. W. H. Pickering, in the June number of the *Sidereal Messenger*, makes some remarks on fourteen photographs of the planet Mars taken by Mr. Wilson. Seven negatives were taken on April 9, between 22h. 56m. and 23h. 41m. G.M.T., and seven more were taken on April 10, between 23h. 20m. and 23h. 32m. Thus the same face of the planet was presented in both cases. Distinct and identifiable spots and markings are well shown in all the photographs, but in those taken on the latter date the white spot surrounding the south pole is seen considerably larger. It has been known for some years that the size of these polar spots varied gradually from time to time, apparently diminishing in the summer and increasing in the winter of their respective hemispheres. This, however, appears to be the first time that the precise date and approximate extent of one of these accessions has been observed. The appearances described are said to be so conspicuous upon each of the fourteen photographs that no one who had once seen them would have any difficulty in deciding on which of the dates any particular plate was taken.

LIGHTNING SPECTRA.—Mr. W. E. Woods, of Washington, has used a Browning's pocket spectroscope to study the spectrum of lightning during a thunderstorm (*Sidereal Messenger*, June 1890). In several instances he observed what appeared to be bright lines superposed on a faint continuous spectrum; and in each case, when the continuous spectrum was bright enough to be seen, shaded flutings were visible. It is, however, much to be regretted that no diagram or statement as to the approximate position of the lines and fluting is given.

THE MARINE BIOLOGICAL ASSOCIATION.

AT the annual general meeting of the Marine Biological Association, held at the rooms of the Royal Society on Wednesday, June 25, the following Report was submitted by the Council, and unanimously adopted. We omit only the list of those who went as a deputation to the Chancellor of the Exchequer on May 15.

The Council has met nine times during the past year, and the attendance has been fully up to the average of previous years.

The business transacted by the Council has had reference—

(1) To the maintenance and general efficiency of the Laboratory.

(2) To the prosecution of special investigations on economic subjects.

(3) To the financial position of the Association.

(1) It was found necessary to alter the communications between the storage reservoirs and the pumps of the Laboratory at Plymouth, and orders were given to Messrs. Leete, Edwards, and Norman, to supply a new valve-box, connection-pipes, &c. The cost of these alterations has been considerable, but it is satisfactory to note that the results have been very beneficial, and have produced a marked improvement both in the working of the pumps and in the water in circulation.

The Director reports that there was some little trouble over the sea-water in June and July 1889, during the hot weather, and during the alterations to the supply-pipes, which prevented more than one of the storage reservoirs being in use; but that since then, and especially after the alterations were completed, the water has been of admirable quality, and all the animals have done remarkably well.

Great improvement has lately been effected in the Aquarium at a very trifling cost, by hanging curtains between the top of the fronts of the tanks and the ceiling, so that all the light reaching the spectator must pass through the tanks. Previous to this there appears to have been an excess of light in the tanks, and the fishes now appear to be much more comfortable, and keep nearer to the glass fronts.

The following fishes, molluscs, and crustacea have spawned in the tanks during the past year:—

The Plaice (*Pleuronectes platessa*).
The Flounder (*Pleuronectes flesus*).
The Pouting (*Gadus luscus*).
The Poor Cod (*Gadus minutus*).
The Rockling (*Motella tricirrata*).
The Lucky Proach (*Cottus bubalis*).
The Spotted Dog-fish (*Scyllium canicula*).
Chiton cinereus.
The Whelk (*Buccinum undatum*).
The Purple (*Purpura lapillus*).
The Sea-hare (*Aplysia punctata*).
The Sea-lemon (*Archidoris tuberculata*).
Goniodoris nodosa.
The Lobster (*Homarus vulgaris*).
The Crawfish (*Palinurus vulgaris*).
The Shrimp (*Crangon vulgaris*).
The Prawn (*Palæmon serratus*).
Idotea tricuspidata and *emarginata*,

as well as other species not so well known.

The *personnel* of the staff and servants remains unchanged, with the exception of the fisherman, W. Roach, who left in October. His place has been filled by E. G. Heath, a trawl fisherman of great experience.

The Council sanctioned the purchase, in July 1889, at a cost of £250, of a small steam-launch, the *Firefly*, which has been of great service. Being half-decked, and only 38 feet long, this launch is only suitable for local expeditions, and its purchase in no wise diminishes the necessity for a sea-going steam-vessel for carrying on investigations on food-fishes. The *Firefly* is very economical in coal and water, and has entailed no extra expense in working. The Association now possesses three boats, the *Firefly*, the *Mabel*, a three-ton hook and line fishing-boat presented by Mr. Bourne, and the *Anton Dohrn*, a rowing-boat bought in 1889.

Trawling, dredging, surface netting, and shore hunting have been carried on continuously during the year, and examples of interesting species, many of which are new to the district, have been added to the list since the last Report.

The standard collection of species is making good progress, the collection of Decapod Crustacea being remarkably complete.

(2) The researches on food-fishes and crustacea carried on under the direction of the Council have made considerable progress.

The Director of the Association, Mr. G. C. Bourne, has continued his observations on the pelagic fauna in the neighbourhood of Plymouth, and was also able, through the courtesy of Captain Aldrich, R.N., to make an expedition off the south-west coast of Ireland in H.M.S. *Research* in July last, for the purpose of comparing the surface fauna at the entrance of the Channel with that of the Channel itself. Some interesting observations have been made in connection with the presence of multicellular floating algæ in spring months and the presence of mackerel, which it is hoped may lead to practical results.

The Director has made observations and collected notes on the destruction of immature fish in various localities, and has been able, with the kind co-operation of the medical staff of the Deep Sea Mission to Fishermen, to arrange an extensive inquiry into the presence of immature fish in deep waters in the North Sea, their movements and destruction by beam trawling. This inquiry is in progress, and promises to be full of interest.

In connection with the destruction of immature soles in the estuary of the Thames, the Director has been making arrangements for keeping young soles in inclosed ponds with the view of rearing them to a marketable size, as is done in the Adriatic. For various reasons these experiments have been delayed, and are not yet in progress.

Experiments are also being made on the possibility of cultivating soles in fresh water, and it has been proved that the adult sole may be kept in fresh water.

In conjunction with Dr. G. H. Fowler, the Director has studied the natural history of the oyster, and through the kindness of Lord Revelstoke he has been able to arrange a series of practical inquiries on the natural history and propagation of the oyster in the River Yealm.

The Naturalist of the Association, Mr. J. T. Cunningham, has been chiefly occupied during the past year with a treatise on the common sole, which is now ready for publication.

Mr. Cunningham also has gathered much valuable information about the occurrence of the anchovy in English waters, and the possibility of an English anchovy fishery. A full account of the anchovy is given in the last number of the Journal, vol. i. No. 3.

In the early spring of this year, Mr. Cunningham made several expeditions to procure the ova of soles and other flat-fishes. He was able to secure and artificially fertilize a much larger number of soles' ova than on any previous occasion, and the fertilized ova were successfully hatched and the larvæ reared, up to the period of the absorption of the yolk-sac, in the aquarium.

On March 13 this year the plaice in the aquarium were found to be breeding. The Director and Mr. Cunningham collected a large number of their fertilized ova and transferred them to suitable hatching apparatus. The ova hatched out by March 18, and the larvæ were kept alive in specially isolated tanks till April 2. By this time the yolk-sac was completely absorbed, but the larvæ, although apparently healthy, could not be induced to feed. They died off very suddenly, evidently for want of food, on April 3 and 4, having lived fifteen days after hatching.

A second batch of ova was procured on March 28, and the eggs were hatched out on April 3 and 4. These larvæ were placed in a tank and fed with the pelagic organisms caught in the tow-net. They paid no attention to this food, so on April 22 they were fed with crushed crab, which they appeared to like, for on the following day their intestines could be seen full of food. In spite of this they began to die on April 24, and all were dead by the 26th.

Thus in the second experiment the larvæ were kept alive twenty days after hatching, a considerably longer period than in previous experiments at Plymouth, and, what is more important, they were induced to feed. These experiments show that some steps have been made towards success. None of the larvæ underwent metamorphosis, but Mr. Cunningham has procured some young plaice, flounders, and brill, already "flattened," and these are thriving in the tanks and feeding regularly.

Arrangements have been made with the Fishery Board for Scotland for carrying on an investigation on the food of the common sole, in connection with the work done by the Board on the food of other fishes.

Mr. W. Bateson was working on the sense-organs and habits of fishes, with the view of showing the possibility of using artificial or preserved baits in sea-fishing, from April to October 1889. The results of Mr. Bateson's investigations have been published in the Journal, vol. i. No. 3.

Mr. Weldon continued his investigations on the artificial rearing of lobsters last year. His experiments were apparently turning out successfully, when an accident caused the loss of his larvæ and apparatus. This year the artificial rearing of lobsters is being proceeded with by means of a different form of apparatus suggested by Dr. Fowler's successful method of raising the young of *Idotea*.

In addition to his experiments on lobsters, Mr. Weldon is engaged on important scientific investigations on the variation and natural history of the Decapod Crustacea, his expenses being, as before, met by the grant of £150 from the Government Grant Fund of the Royal Society, intrusted in 1887 by the Government Grant Committee to the President of the Association, the Hon. Secretary, Prof. Moseley, and Mr. Sedgwick.

The following gentlemen and ladies have been engaged on independent scientific researches in the Laboratory since the date of the last Report:—

Dr. G. H. Fowler (Studies in Descent), Mr. M. C. Potter (Marine Algæ), Mr. S. F. Harmer (Development of *Polyzoa*), Mr. T. T. Groom (*Cirrhipedia*), the Rev. Canon A. M. Norman, D.C.L. (Crustacean Fauna), Mr. A. O. Walker (*Amphipoda*), Prof. T. Johnson (*Florideæ*), Mr. A. E. Shipley (*Gephyrea*), Dr. Hans Driesch, Jena (Heliotropism in *Hydroidea*), Mr. P. C. Mitchell (Histology of *Tunicata*), Mr. T. H. Riches (Nephridia of *Mollusca* and *Crustacea*), Mr. Herbert Thompson (Development of *Crustacea*), Miss Marion Greenwood, Newnham College, Cambridge (Physiological Studies), Miss L. Ackroyd, Newnham College, Cambridge (Morphology of *Nebalia*).

(3) Among the receipts of the past year the Council have to acknowledge the following subscriptions and donations:—£100 from Lord Revelstoke; £100 from Sir Henry Thompson; £100 from the Grocers' Company; £200 from the Fishmongers' Company (annual grant for five years); £500 from H.M. Treasury (annual grant for five years).

From annual subscriptions and compositions £143 was received, £61 interest on investments, and £150 for rent of tables and sale of specimens.

The expenditure, as shown in the Treasurer's account presented herewith, amounted to £2992, of which £398 was paid to Mr. Inglis for balance of his fees as engineer, £417 for structural alterations and additions, £112 for bait investigation, and £250 for a steam-launch.

The Association now has in hand, in cash and invested, £1398 2*s.* 11*d.*

The Council have great pleasure in acknowledging the generous assistance which has lately been afforded to the Association by the Fishmongers' Company, by Mr. J. P. Thomasson, M.P., and Mr. Frank Crisp.

The Fishmongers' Company, in addition to substantial grants which they have already made to the Association, have undertaken to contribute £400 per annum to the funds of the Association for a period of five years from the present date.

Mr. J. P. Thomasson has kindly offered a sum of £250, to enable the Council to retain the services of the Naturalist, Mr. J. T. Cunningham, for another year.

Mr. Frank Crisp has kindly given a sum of £120 (£60 per annum for two years) to meet the expenses of special investigations on the culture of sea fishes in inclosed ponds. The Council take this opportunity of placing on record their appreciation of the interest and confidence shown in the work of the Association by these liberal donations.

The thanks of the Association are due to Prof. Haeckel for a copy of his work on the *Siphonophora*; to Colonel Richardson, R.A., for a number of ichthyological works from the library of the late Sir J. Richardson; to Mr. J. W. Clark for back numbers of the Philosophical Transactions of the Royal Society and other books; to Messrs. J. and A. Churchill for the current numbers of the *Quarterly Journal of Microscopical Science*; and to Messrs. Agassiz, Giard, Marion, the United States Fish Commission, the Naples Zoological Station, the officers of the Norwegian North Atlantic Expedition, and other individuals and societies for copies of their publications.

The Council desire to express the indebtedness of the Association to the Council of the Royal Society for kindly permitting the Association to hold the periodical meetings of the Council and Association in their rooms.

In July and August 1889, the Council was in correspondence with the Fishery Board for Scotland and the Fisheries Department of the Board of Trade, with reference to the possibility of procuring scientific information on the alleged destruction of immature fish by beam trawling in deep waters.

Subsequently the Council determined to make an application to H.M. Treasury for a further grant of money in aid of special researches on food-fishes. The Chancellor of the Exchequer kindly consented to receive a deputation on the subject on May 15. . . .

The Council regret to have to announce that Prof. Huxley, who since the foundation of the Association has been its President, has found it necessary to withdraw from the office which he has held with so much honour and advantage to the Association. The Council desire to express their warm appreciation of the eminent services rendered by Prof. Huxley to the Association, and their great regret that he should be unable to continue his office.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

VICTORIA UNIVERSITY.—Last Saturday was Degree-day; the ceremony, presided over by Principal Rendall, the Vice-Chancellor, took place in the Manchester Free-Trade Hall. In the course of his speech, the Vice-Chancellor gave the following details as to the progress of the University:—

"A three-fold scheme for certificates, technical, commercial, and literary, has replaced the narrower project for technical certificates alone, and will be the means of giving University direction and attachment to numerous organizations which have hitherto lacked clearness of aim or recognition of results. The Manchester Chamber of Commerce has entrusted the examinations for its commercial certificate to the University. The local lectures scheme continues to thrive vigorously. In the last three sessions 21 courses, with an average attendance of 130, the large majority in or near Manchester, have been delivered under University auspices. The three colleges of the University are taking action, more or less concerted, for the establishment of day training colleges for primary teachers under the provisions of the new Education Code. Thus step by step the University is comprehending her mission and entering upon her heritage. Those who are forwarding the work may feel that impatience for quick returns which comes of convictions confident and energetic, but the observer and the historian will agree that in content and scope Victoria University has advanced with unparalleled rapidity. In all the colleges of the University building is in progress or in contemplation. At University College the Victoria Building for the arts department is advancing towards completion; at Yorkshire College funds have been raised for the erection of a medical department and other needed extensions; at Owens College further enlargement of the Medical School buildings is now under consideration."

As at Cambridge, the women students have done remarkably well this year, three out of four "first classes" in the B.A. honours schools and the Thomasson Prize for English Essay falling to their share.

ST. ANDREWS UNIVERSITY.—A Scholarship of the value of £30 a year has just been placed at the disposal of Prof. Percy Frankland at University College, St. Andrews University, by Miss E. F. Forster, of London. It is intended that the student holding the same shall devote the whole of his time to the prosecution of original research. The Scholarship, which will be known as "The Forster Research Scholarship," has been awarded for this year to Mr. John MacGregor, M.A.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 12.—"On the Position of the Vocal Cords in Quiet Respiration of Man, and on the Reflex-Tonus of their Abductor Muscles." By Felix Semon, M.D., F.R.C.P., Assistant Physician in charge of the Throat Department of St. Thomas's Hospital, and Laryngologist to the National Hospital for Epilepsy and Paralysis, Queen Square. Communicated by Prof. Victor Horsley, F.R.S.

The final conclusions arrived at by the author are as follows:—

(1) The glottis in man is wider open during quiet respiration (inspiration and expiration) than after death or after division of the vagi or recurrent laryngeal nerves.

(2) This wider opening during life is the result of a permanent activity of the abductors of the vocal cords (posterior crico-arytænoid muscles), which therefore belong not merely to the class of accessory, but of regular respiratory, muscles.

(3) The activity of these muscles is due to tonic impulses, which their centres receive from the neighbouring respiratory centre in the medulla oblongata. It is very probable that these impulses rhythmically proceed to the respiratory centre from the stimulation of certain afferent fibres contained mainly, but not exclusively, in the trunks of the pneumogastric nerves, and that they are in the respiratory centre changed into tonic impulses. The regular activity of the abductors of the vocal cords during life, therefore, belongs to the class of reflex processes. The permanent half-contraction of these muscles, in which form their tonic innervation is manifested, can be further increased, in concord with the general laws of the mechanism of respiration, by either volition or other reflex influences.

(4) In spite of their extra-innervation, the abductors of the vocal cords are physiologically weaker than their antagonists.

(5) These antagonists, the adductors of the vocal cords, have primarily nothing at all to do with respiration, and ordinarily serve the function of phonation only. Their respiratory functions are limited to—

(*a*) Assistance in the protection of the lower air passages against the entry of foreign bodies.

(*b*) Assistance in the modified and casual forms of expiration known as cough and laughing.

Physical Society, June 6.—Prof. W. E. Ayrton, F.R.S., President, in the chair.—Mr. H. Tomlinson, F.R.S.. read a paper on the effect of change of temperature on the Villari critical points of iron. This, he said, was a continuation of the paper he read before the Society on March 21, and the method employed was the same as then described (see *Phil. Mag.*, vol. xxviii. p. 394). Since then, however, he has made experiments at various temperatures up to 285° C., the temperature being determined from the resistance of a platinum wire whose temperature coefficient was carefully determined. The following table shows some of the results obtained with a well-annealed iron wire 1 mm. in diameter, which had been repeatedly heated up to 300° C., and cooled to the temperature of the room until the temporary permeability with various loads attained constant values at both temperatures.

Magnetizing force in C.G.S. units.	Load in kilogrammes for which permeability is the same as for unloaded wire at temperature				
	12° C.	76° C.	167° C.	244° C.	285° C.
2·84	4·7	5·0	5·3 and 12	5·7 and 10	None
3·70	2·5	3·2	3·6	4·2 ,, 11·5	4·7 and 9·9
4·8	1·8	2·5	2·7	—	3·1 ,, 12·3
7·69	None	None	None	None	None
10·40	,,	,,	,,	,,	,,
15·32	,,	,,	,,	,,	,,

Curves from which these numbers were obtained are given in the paper, and in these the load in kilogrammes, and percentage change of temporary permeability are plotted. From these curves and table it will be seen that if the first points in which the curves cut the load-line be considered, then at all temperatures the Villari values increase as the load decreases. If, however, the second points be taken, the critical values increase both with load and temperature. In both cases the Villari value is increased by rise of temperature. From the curves it follows that rise of temperature reduces the total variation of permeability produceable by loading. A table showing the temporary permeability of the unloaded wire at the various temperatures accompanies the paper.—A paper on the diurnal variations of the magnet at Kew, by W. G. Robson and S. W. J. Smith, was communicated by Prof. Rücker. In some preliminary remarks the Professor pointed out the great advisability of having the results of magnetic observations at various Observatories reduced and published in the same manner, and for the same periods. In order that this may be effected, the methods of reduction must be trustworthy, but not very elaborate. The Greenwich plan is too laborious to be generally adopted, but the method suggested by Dr. Wild (Rep. Brit. Ass., 1885, p. 78), in which the mean diurnal variation is obtained from measurements on five quiet days in each month, is feasible. With a view to further testing the trustworthiness of this method, the work described in the paper was undertaken. Mr. Whipple had made a comparison of the two methods for the years 1870–71–72, with the result shown in the following table :—

Minutes of arc.

$$K_s - K_w = 0{\cdot}7$$
$$G - K_s = 1{\cdot}2$$
$$G - K_w = 1{\cdot}6$$

where K_s is the mean diurnal range at Kew as obtained by Sabine's method, K_w that obtained by Wild's method, and G that obtained at Greenwich by the Greenwich method. He also found that the mean hourly differences followed some definite law. The authors undertook the reduction of the Kew observations according to Wild's method for the years 1883, 1886–87 ; the first was chosen as being a year of maximum sun-spots. The results give—

Minutes of arc.

1883 ... $G - K_w = 1{\cdot}5$
1886 ... $G - K_w = 1{\cdot}2$
1887 ... $G - K_w = 1{\cdot}9$

There is thus a difference of nearly two minutes in the variations at the two places, and this cannot all be accounted for by the method of reduction. Another peculiarity is that the range, as calculated by Wild's method, is greater by about 0'·5 than that obtained by the Greenwich method, although the latter includes days of moderate disturbance. The total range at both places has diminished by about 1'·6 between 1883 and 1887. The paper is accompanied by tables and curves plotted from the differences in the mean hourly readings at Greenwich and Kew for each of the above 6 years, and a marked similarity exists between all of them. The mean of the 6 curves differs in no case by more than 0'·4 from the curve for any year. It is thus possible to calculate the Greenwich values from the Kew numbers ; and as these latter are published about two years sooner than the former, this fact may be very important. Referring to the reduction of results, Prof. Rücker said that the Stonyhurst observers and Prof. Mascart were willing to adopt Wild's method ; Falmouth, he hoped, would follow suit, and Greenwich had been asked to publish their results in both ways. Mr. Whipple said that, before recording-instruments were available, and the numbers were obtained from separate experiments, the labour involved was considerable, and a single large disturbance or magnetic storm might vitiate the result of a whole year's work. Methods were therefore adopted to eliminate these disturbances ; of these, that used by Sabine may be particularly mentioned. Although declination records have now been obtained for a considerable number of years, the cause of the variations still remains unknown. They do not seem to be dependent on temperature or on astronomical facts. He considered it valuable to obtain magnetic data from different parts of the earth, but comparisons were only possible when all are published on the same plan. This, he hoped, would result from the efforts of Profs. Rücker and Adams. When this is accomplished, the observations on magnetic force will need treatment ; this work will be laborious, and the aid of volunteers like Messrs. Robson and Smith would be of great service. Prof. W. G. Adams said he was glad to see the satisfactory nature of the work which had just been brought before the Society. Usually, the mass of figures to be dealt with was so large that the mere reduction was a great undertaking. If, however, the difference between results obtained by the Greenwich and Wild's method was not more than 0'·4, it may be possible to make out the causes of the variations from observations reduced on Wild's plan. He himself would put more faith in horizontal force observations, and wished they could be worked out by some ready method. He hoped the one adopted in America, of obtaining mean curves by photography, might prove satisfactory. Prof. Perry asked if a machine could not be made to do the work. Mr. Whipple said such machines had been used by the Meteorological Office, but they were so elaborate and expensive that clerical work was just as cheap. The method of photographing mean curves had been tried at Kew, but it was open to the objection that accidental disturbances, such as those produced by the movement of iron in the vicinity and the approach of cabs, &c., were not eliminated. Mr. Boys, referring to the use of integrators, said that, for an harmonic analyzer, his disk-cylinder pattern was preferable to the ball-disk-cylinder integrators of J. Thomson, for it was much cheaper, and had less inertia. The President said the movement initiated by Prof. Rücker would be of great service if it resulted in the numbers obtained at the various magnetic Observatories being published in the same way. It was a great advantage to have such men, who were not permanently attached to an Observatory, to take up the subject and suggest improvements. The heads of such institutions were usually too much employed in making the necessary reductions to have time for devising improved methods. In his opinion, greater freedom should be allowed to the chiefs of Observatories, for it should be borne in mind that the object of observations is not to produce volumes of figures, but to increase our knowledge. Referring to the reduction of observations, he thought the voluntary services of senior physical students should be more generally accepted, and to this end he suggested that properly recommended persons should be allowed to spend some time in Observatories as honorary assistants. This would be of great use to the students themselves, and an advantage to the Observatories, for the reduction of observations could then be expedited. As regards the accidental disturbances referred to by Mr. Whipple, he contended that regulations should be adopted to render them impossible.

Zoological Society, June 17.—W. T. Blanford, F.R.S., in the chair.—Mr. Sclater exhibited and made remarks on a mounted head of a Pallah Antelope, obtained by Captain F. Cookson, on the Cunene river, in South-western Africa, which was distinguished by its black face from the ordinary form of the Cape Colony.—Mr. Sclater also exhibited a large photograph of Grévy's Zebra (*Equus grevyi*), taken from the specimen in the

Natural History Museum at Paris by Mr. Gambier Bolton.—A specimen of Pallas's Plover (*Ægialitis asiatica*), obtained in May last near Great Yarmouth, and now in the Norwich Museum, was exhibited; and a note upon its occurrence by Mr. T. Southwell was read to the meeting.—A communication was read from Prof. F. Jeffery Bell containing some notes received from Mr. Edgar Thurston, of the Madras Museum, on the habits of the Pennatulids of the genus *Virgularia*.—A communication was read from M. P. A. Pichot, containing exact particulars of the locality on the Lower Rhone in which the Beaver is still found in its native state.—Mr. W. Bateson read a paper on some cases of repetition of parts in animals, and exhibited a series of specimens illustrative of this subject.—Mr. Henley Grose Smith gave an account of the Diurnal Lepidoptera collected by Mr. W. Bonny, of the Emin Relief Expedition, on the river Aruwimi, Central Africa.—A communication was read from Mr. W. L. Distant, containing descriptions of some Hemiptera collected by Mr. W. Bonny during the same expedition.—A communication was read from Mr. H. W. Bates, F.R.S., on some of the Coleoptera collected by Mr. W. Bonny during the same expedition.—Mr. Herbert Druce read the descriptions of ninety-five new species of Lepidoptera Heterocera from Central and South America.—Mr. G. A. Boulenger pointed out the secondary sexual characters in the South African Tortoises of the genus *Homopus*.—A communication was read from Mr. W. L. Sclater, containing a series of critical notes on the Indian species of the family Muridæ.—A communication was read from Mr. J. T. Cunningham, containing some notes on the secondary sexual characters of the genus *Arnoglossus*. The author showed that the so-called *Arnoglossus laterna* is only the female of *A. lophotes*.—Mr. R. Bowdler Sharpe read the sixth part of his series of notes on the Hume Collection of Birds. The present communication treated of the Coraciidæ of the Indian region, and contained descriptions of three new species.—A communication was read from Miss E. M. Sharpe, containing an account of a collection of Lepidoptera made by Mr. Edmund Reynolds on the rivers Tocantins and Araguaya, and in the province of Goyaz, Brazil.—Mr. Edmund S. Hall gave an account of the occurrence of a persistent right posterior cardinal vein in a Rabbit.—This meeting closes the present session. The next session (1890-91) will commence in November 1890.

PARIS.

Academy of Sciences, June 23.—M. Hermite in the chair.—On the partial eclipse of the sun on June 17, by M. J. Janssen.—Theory of the motion of fluids near to the wide opening of a delivery pipe, where the liquid threads have not acquired their normal inequalities of velocity, by M. J. Boussinesq.—Comparison of the theoretical figure of a storm given in the *Comptes rendus* of June 9 with the facts known to navigators, by M. H. Faye.—The work and progress of the Arago Laboratory in 1890, by M. de Lacaze-Duthiers.—On the visible and photographic spectrum of the great nebula of Orion, by Dr. W. Huggins.—On the distribution of *Salmo quinnat* on the Mediterranean coasts of the south-east of France, by MM. A. F. Marion and F. Guitel.—On the glycolytic power of blood and of chyle, by MM. R. Lépine and Barral.—Observations of Brooks's comet (March 19, 1890) made at Bordeaux Observatory, by MM. G. Rayet, Picart, and Courty. Observations of position are given extending from May 19 to June 20, being in continuation of those published in the *Comptes rendus* of March 31, April 8, and May 19.—Elements and ephemeris of the new minor planet (293) discovered at Nice Observatory on May 20, by M. Charlois.—Partial eclipse of the sun of June 17, in the morning, observed at Nice, by M. Perrotin.—Observation of the eclipse of the sun of June 16-17, made with the Brunner equatorial of Lyons Observatory, by M. Gonnessiat.—On the partial eclipse of June 16-17 (Algiers Observatory), by M. Ch. Trépied.—The solar eclipse of June 17, by M. E. L. Trouvelot. (For eclipse observations see Our Astronomical Column.)—On the international zero of altitude, by M. Ch. Lallemand.—On a direct-reading dynamometer, by M. G. Trouvé.—Reciprocal action of alkaline haloid salts and mercurous salts, by M. A. Ditte.—On some phosphates of lithium, beryllium, lead, and uranium, by M. L. Ouvrard. A number of double phosphates formed by the action of molten alkaline phosphates upon the carbonates of lithium and glucinum and the oxides of lead and uranium are described; among them occurs a double phosphate of beryllium and sodium corresponding in composition with the recently discovered mineral beryllonite.—Combinations of double chlorides of phosphorus and iridium with arsenious chloride, by M. G. Geisenheimer. By heating the constituents in a sealed tube to 250°, ruby-red prismatic crystals of $2(Ir_2P_3Cl_{15}).5AsCl_3$ are formed.—On the sub-fluoride of silver, by M. Guntz. The existence of a sub-fluoride of silver was indicated by the analyses of a precipitate produced on the negative pole when subjecting a hot saturated solution of silver fluoride to electrolysis, employing a very strong current and silver electrodes. The pure salt is obtained in quantity by heating finely divided silver with a saturated solution of silver fluoride on a bath to a temperature of from 50°-90°. Analyses of the product prove it to be the sub-fluoride of silver Ag_2F.—A contribution to the study of ptomaïnes, by M. Œchsner de Coninck.—On the preparation of wine ferments, by M. A. Rommier.—On the sense of smell in star-fishes, by M. Prouho. The author concludes that star-fishes excited by the presence of a bait are guided by sensations perceived by the extremities of their arms. The sense of smell is not diffuse in star-fishes, but is localized in the limbs useless for locomotion at the back of the ocellary plate.—The photographic registration of the chlorophyll function by the living plant, by M. Timiriazeff.—On the hypersthene andesites and labradorites of Guadaloupe, by M. A. Lacroix.—On the vertical circulation in the deep ocean, by M. J. Thoulet.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Three Years in Western China: A. Hosie (Philip).—Encyclopædia of Photography, Part 1: W. E. Woodbury (Iliffe).—Advanced Physiography (Physiographic Astronomy): J. Mills (Chapman and Hall).—A Manual of Orchidaceous Plants, Part 6 (Veitch).—Text-book of Physiological and Pathological Chemistry: G. Bunge, translated by Dr. L. C. Wooldridge (K. Paul).—In Darkest Africa, 2 vols.: H. M. Stanley (S. Low).—The Aborigines of Tasmania: H. Ling Roth (K. Paul).—Ostéologie Ropuch (Bufo Laur.): Prof. Dr. F. Bayer (V. Praze).—Uhlonosné Útvary v. Tasmanii; Prof. Dr. O. Feistmantel (V. Praze).—Abhandlungen der Math. Naturw. Classe der K. B. Gesellschaft der Wissenschaften, 1889-90, vii. Folge, 3 Band (Prag).—Annales de l'Observatoire de Moscou, ii. Série, vol. 2, Livre 1 and 2 (Moscou).—Annales de l'Observatoire de Nice, Tome 3, Texte et Atlas.—Sun-dial, adjustable for all Latitudes (Philip).—A Theory of the Sun's Radiation of Heat: W. Goff (Stanford).—Publication of the Leander McCormick Observatory of the University of Virginia, vol. 1, Part 4, Double Stars 1885-86 (Virginia).—Mind and Matter: O. Barnard (J. Heywood).—Proceedings of the Society for Psychical Research, June (K. Paul).—Journal of the Royal Microscopical Society, June (Williams and Norgate).—Records of the Geological Survey of India, vol. xxiii. Part 2.—Annalen des K. K. Naturhistorischen Hofmuseums, Band 5, No. 2 (Wien, Hölder).

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