THURSDAY, JANUARY 23, 1890.

THE FUTURE INDIAN CIVIL SERVICE EXAMINATIONS.

THE importance of obtaining a satisfactory position for future science candidates in these examinations is now very great. We have not only to consider the need there is that the men selected should represent every side of modern thought and culture, but also to bear in mind the influence of such examinations on the development of education at home. It is unfortunately notorious that candidates offering science in the examinations conducted by the Civil Service Commission stand, as a rule, at a great disadvantage. The marks allotted to science subjects have often been relatively small, and even when outside pressure has secured the allotment of a fair proportion of marks to science, the methods adopted in conducting the examinations have, as has been pointed out in our columns and elsewhere, frequently been such as to prevent good candidates from actually obtaining an equitable proportion of them.

Now as the Commissioners, year by year, deal with thousands, we might say with tens of thousands, of candidates of various types and ages; and as their influence is by no means confined to the actual candidates examined, it is plain that we have in this organization a body whose influence, for good or ill, on education in this country is enormous. Therefore we regard it as most urgent that those who are familiar with this question should press the facts of the present case not only on the attention of the Civil Service Commission, but also at the India Office and on the notice of the public. We are happy to know, indeed, that the subject is being energetically taken up by a number of distinguished graduates of Cambridge. But the forces on the other side are very strong, and past experience of the action of the Commission has made it plain that the representatives of science have a serious task before them.

In their Report for 1888, the Commissioners have been at some pains to convince the public that their examinations have had a minimum disturbing effect on the ordinary course of education. For example, they show that at several recent examinations for Class I. clerkships in the home services, all, or nearly all, the successful candidates have been men of University education. The Commissioners should carry their investigations somewhat deeper, and ascertain how far these selected candidates represent all classes of University graduates. We have done this so far as opportunity has permitted; and the results of our investigation in the case of the Class I. clerkships (which alone we have at present examined, as it only affects the present question) do not bear out the contention of the Commissioners, but go to show that the examinations concerned are very distinctly calculated either to disturb the course of education or to fail to select men representing all the chief types of University culture.

From our results, which are given below, it is easy to foresee what it is that is to be feared under the coming scheme. For in the competition for Class I. clerkships, the major limit of age, twenty-four, is not far removed from that about to be adopted for future Indian Civil servants of the highest class. And in them, as we learn will be the case in the future examinations for the Indian service, no limit is placed on the number of subjects that may be selected from those which are examined.

We have before us the results of a number of these competitions held during the last ten or eleven years, and they show, as might have been expected from the scheme of marks, that science men are practically excluded. We have ascertained as far as possible the degrees taken by the successful candidates, and out of thirty we find that twenty-two have taken their degrees in classics, seven in mathematics, and one in natural science; whilst the marks of forty others, whose degrees could not be ascertained, show a similar preponderance of classical men. Now, when it is remembered that many men take honours in science at Oxford, that the number who do so at Cambridge is approaching that of those who take classical honours, and that scholarships are now given for science in considerable numbers at both Universities, it is plain that a scheme which is likely to produce such results as those we have quoted ought on no account to be adopted for the Indian Civil Service. Such a one-sided system of selection is not fair to the various classes of candidates, and it is not fair to the dependency which they will be charged to administer. The plain fact is that in the competition for the home services, the marks assigned to classics, mathematics, and science respectively are scarcely fair to mathematics, and very distinctly unfair to science. These branches of learning have been placed upon a far more equal footing at our Universities, and science candidates may fairly claim more equal treatment from the Commissioners in competitions such as those which we are now considering. In the examinations for first-class appointments in the home services, there is the enormous difference of 375 marks against science, out of 1250 in the effective mark values of classics and science. On a recent occasion the difference between the highest and lowest on the list of successful candidates was no more than 158, and although this is indeed a very exceptional case, it shows how enormous the effect of such a difference may be when the candidates are at all evenly matched.

Such a boycotting of the men of scientific training is deplorable enough in the selecting of men for the home services, but in the case of the future administrators of our Indian dependency it would be far more unfortunate. There, if anywhere, men of every type should play their part in the national work. The Cambridge men of science are doing their best to avert the catastrophe that we fear. We hope they will be supported promptly, universally, and energetically by their scientific brethren, both great and small.

THE SHAN STATES.

A Thousand Miles on an Elephant in the Shan States. By Holt S. Hallett. (London and Edinburgh: William Blackwood and Sons, 1889.)

MR. HALLETT'S journeys in Burmah, Siam, and the Shan States, in search of the best path to connect Burmah with China and Siam, were performed partly by boat, and partly on the back of elephants.

The problem before him was a difficult one, owing to the geography of Central Indo-China being unknown at the time of his visit. He has filled up a great blank in the map of this interesting region, and has proved that a practicable route for the railway exists, chiefly through great and fertile plains, to the populous parts of the Chinese province of Yunnan, and thence through Southern into Central China. The project has been for some years before the public, and has received the unanimous support of the manufacturing and mercantile communities, who have constantly, through the Chambers of Commerce, pressed the matter upon the attention of the Government. The Siamese section of the line, and several important branches, are now being surveyed and estimated for the King of Siam by English engineers, and are likely soon to be taken in hand.

The handsome volume before us contains an excellent index map of Southern China and Indo-China, five route maps, and nearly a hundred original illustrations. The index map shows clearly the projected Anglo-Siamese system of lines, and its continuation into Central China, together with the proposed branch to Pakhoi, the Southern Chinese seaport. On the same map are shown the rival lines which the French propose to construct in order to draw the trade of Southern and Central China and of the Shan States to a French port in Tonquin. The route maps, which are beautifully executed from Mr. Hallett's survey, have the population, geology, and height above sea-level of the country noted on them, which greatly increases their value. Apart from its commercial and geographical aspect, the book will prove of great interest to the politician and the general reader. It gives the account of an able, intelligent, and careful inquirer on the spot, concerning the position of the frontier of the British and Siamese Shan States at the time we annexed Upper Burmah, and it indicates the districts claimed by our new subjects which were then forcibly occupied by the Siamese. It describes the mode of government and the condition of the people in Siam and its Shan States, countries which are now being brought into close political and commercial relations with us. It treats of the threatened absorption of Siamese territory by the French, and shows how vast is our present stake in the country. It points out how imperative it is that we should pay close attention to the proceedings of the French, and safeguard our interests, which include the only known practicable route for the railway connection of Burmah with the populous and fertile regions of Southern and Western China.

The author expresses himself fluently and concisely. His descriptions of scenery, people, and wayside incidents, are extremely good, and the story of the journey is lightly, brightly, and amusingly told. He was exceptionally fortunate in his companions, and had no trouble in gaining the good-will and assistance of everyone he met during his travels. Dr. Cushing and Dr. McGilvary, who joined the party as interpreters, were masters of the Shan language, and, being missionaries, took a great interest in the welfare of the people. They had made a careful study of their manners and customs, and, having previously traversed the Shan States in various directions, were well known to the chiefs, nobles, and officials of the country. Another missionary, Mr. Wilson, who had resided at Zimmé for several years, afforded Mr. Hallett great assistance in collecting statistics and particulars of the trade of the country, and information about the religions, superstitions, and folk-lore of the various races. In the preface, Mr. Hallett gives an interesting history of the races found in Indo-China, and during his travels he collected several of their vocabularies. The aborigines of Lower Indo-China appear to have been Negritos, probably akin to those of the Andaman Islands and the hills of the Malay Peninsula. Other dwarf races of Negrito origin were met with on the journey, belonging to the Ka tribes in the neighbourhood of Luang Prabang. These are probably of the same stock as the Trao in Cochin China and one of the native races in Formosa, and are, in all likelihood, akin to the Tiao, a race of pygmies with whom the Chinese became acquainted when they entered North-Eastern China more than 4000 years ago. The Bau Lawa tribes met by him in the Shan States, and found in the hills as far south as the latitude of Bangkok, as well as the Mon race in Lower Burmah and the Cham or people of Cambodia, migrated into their present habitat at an early period, and are Mongoloid tribes of a race with Malaysian affinities. This Mon race is represented in Western Bengal and Central India by the Kolarian tribes. They are probably descendants of the Ngu stock, including the Pang, Kuei, and Miao tribes, who, with the Shan, Yang or Karen, and King or Chin tribes, formed the chief part of the population of Central and Southern China during the struggle for empire—604–220 B.C.

Other interesting tribes, known as La-Hu and Kiang Tung La-Wa, were met with by Mr. Hallett; and these are said to belong to the same white race as ourselves. They had already settled about the southern bend of the Hoang-ho at the time when the Chinese tribes arrived on the borders of China after their long journey from the neighbourhood of Chaldæa. Part of these various races have been gradually amalgamated with the Chinese, who have doubtless received from them and other races much of their folk-lore and superstitions. It may therefore prove highly interesting to compare the habits, customs, folk-lore, and superstitions of these early inhabitants of China with those of the Chinese. Many of the customs and superstitions must have been widespread at an early date. Mr. Hallett notices the strong similarity between some of the customs and superstitions of the Finnish tribes and those of the Shans. The book is rich in legends connected with various events which are said to have happened in the country. Some of these relate to the time when the Lawa were conquered or driven into the hills by the Shans; others relate to events which have since happened in the country; and the remainder are adaptations from Buddhistic stories, or refer to the guardian spirits of the country, or to romantic incidents that have occurred. The guardian spirits universally worshipped by the Shans are, strange to say, the spirits of ancient Lawa kings and queens reigning in the country at the time when wars were carried on between the Lawa and the Shans. Some of these local Sivas are believed to have ogre propensities, and formerly human sacrifices were offered up to them. Even the year previous to Mr. Hallett's visit, the execution of several criminals was hurried on in order to appease the local

Lawa spirits, so that they might be induced to allow the water needed for the irrigation of the fields to flow down from the hills. Human sacrifices at the obsequies of their chiefs were offered by the Shans up to the middle of the sixteenth century, when the States became feudatory to Burmah. At the time the chiefs were buried, elephants, ponies, and slaves were interred with them. The continuance of this custom was strictly prohibited by the Burmese Emperor Bureng Naung. Besides the legends, many humorous stories and fables are current amongst the people, specimens of which are given in the book.

Buddhism, with the Shans, as with the Chinese, is merely a cloak covering the belief in ancient superstitions, ancestral worship, and spirit worship of the people. Even the images of Buddha in the temples are believed to be inhabited by the spirits of deceased monks, and when an abbot, celebrated for his learning and virtue, dies, it is the custom for those who have spent their monastic life under his instruction to prepare a shrine for him in some part of their house, or, if still in the monastery, in their dormitory, where flowers and food are placed for the acceptance of the spirit of their deceased teacher. If he is treated with neglect or disrespect, he may become a spirit of evil towards his former pupils. This custom probably arises from the monks being celibate, and therefore having no children to carry on the ancestral worship of the family. Another peculiar practice in relation to the images of Buddha is the transferring to him of some of the attributes of the Kwan-yin, the Chinese Goddess of Mercy, the offspring of the lotus flower, who terminates the torment of souls in purgatory by casting a lotus flower on them. In China, miniature offerings are laid before this goddess as a hint for her to convey the articles implied by their likenesses to the spirits of friends or relations. The offerings, frequently accompanied by a scroll stating who the articles are for, consist of miniatures—cut out of paper—of money, houses, furniture, carts, ponies, sedan-chairs, pipes, male and female slaves, and all that one on this earth might wish for in the way of comfort. In Siam and the Shan States, there being no temple of this goddess, Buddha, who is generally depicted as sitting on a lotus flower, is besought to do her work, and similar things are heaped on his altar, but cut out of wood, or formed of rags or any kinds of rubbish, as paper is not easily obtainable. The whole country outside the villages is, according to the Shans, infested with jungle demons, the spirits of human beings who have died when absent from their homes. These endeavour to cause the death of others by the same means as caused their own. Their victims have to join the company or clan of demons to which the successful demon belongs. Thus the clan increases in numbers, and is ever becoming more potent for mischief. The people believe in divination, charms, omens, exorcism, sorcery, mediums, witchcraft, and ghosts. Witch-hunting rages throughout the country, and villages are set apart in which those accused of witchcraft must reside. Mr. Hallett noticed that the elephant-drivers every evening placed pieces of lattice-work on tall sticks stuck in the ground on the paths leading to and from the camp; and on inquiry he learned they were to entangle any evil spirit that might wish to enter the camp and injure the party. The Shans consider such precautions fully sufficient to ward off their malignant foes. The spirits, in their opinion, have as little intelligence as the birds of the air, and any scare-crow device will keep them at a distance. The spirits of those who die from abortion, miscarriage, or childbirth are much dreaded by the widower. If the child dies with the mother, its spirit joins hers in its rambles, endeavouring to harm the living. The first object of their search is the husband and father, whose death they do all they can to accomplish. Sometimes the man endeavours to escape by becoming a monk in a monastery far from his home. This belief, like most of the superstitions in Indo-China, is also current in China.

With reference to the condition of the people in the Shan States, Mr. Hallett says:—

"Nowhere in the Shan States is misgovernment and oppression of the people so rampant as in Siam. Taxation in the Shan States is exceedingly light; and the people are not placed under grinding Government masters, but have the power to change their lords at their will; they are not compelled to serve for three months in the year without receiving either wages or food; amongst them gamblers, opium-smokers, and drunkards are looked down upon and despised, and libertinism is nearly unknown. The only loose women seen by me in the Shan States were a few Siamese, who had taken up their quarters at Zimmé, the head-quarters of the Siamese judge."

Referring to Siam, he gives a fearful description of the oppression ruling in the country, and he says:—

"If it were not for slavery, serfdom, vexatious taxation and for the vices of the people, the Siamese might be a happy race. Living as they do chiefly upon vegetables and fish; in a country where every article of food is cheap; where a labourer's wages are such as to enable him to subsist upon a fourth of his earnings; where a few mats and bamboos will supply him with materials for a house sufficient to keep out the rays of the tropical sun and the showers in the rainy season; where little clothing is needed, and that of a cheap and simple kind; where nine-tenths of the land in the country is vacant, without owners or inhabitants—surely such a people might be contented and happy. The land is so fertile and the climate is so humid, that every cereal and fruit of the tropics grows there to perfection. Yet among the common people it is seldom a man or woman can be found who is not the slave of the wealthy or the noble. The Government battens on the vices of the people by granting monopolies for gambling, opium, and spirits. Government places the people under unscrupulous and tyrannical Government masters—merciless, heartless, and exorbitant leeches—who, unless heavily bribed, force the peasantry to do their three months' *corvée* labour at times and seasons that necessarily break up all habits of industry, and ruin all plans to engage in successful business. Government imposes taxes upon everything grown for human requirements in the country: fishing-nets, stakes, boats, spears, and lines, are all taxed. The Government net is so small that even charcoal and bamboos are taxed to the extent of one in ten, and firewood one in five, in kind. Fancy the feelings of an old woman, after trudging for miles to market with a hundred sticks of firewood, when twenty of the sticks are seized by the tax-gatherer as his perquisite! There is a land-tax for each crop of annuals sown, and paddy and rice are both subject to tax; so that three taxes can thus be reaped from one cereal. The burdensome taxation is levied in the most vexatious manner that can be conceived; for the taxes are let out to unscrupulous Chinamen, who are thus able to squeeze, cheat, and rob the people mercilessly. It is no use appealing from the tax-gatherer to the officials.

Money wins its way, and justice is unknown in Siam. Everyone who has not a friend at Court is preyed upon by the governors and their rapacious underlings. Such being the present state of Siam, one is not surprised to learn that the majority of its inhabitants, besides being slaves and selling their children, are libertines, gamblers, opium smokers or eaters, and given to intoxicating beverages."

Mr. Alabaster, the confidential adviser of the King of Siam, told Mr. Hallett that nine-tenths of the non-Chinese inhabitants of Bangkok were slaves; that 'squeezing" was so universal amongst the nobility, officials, and monopolists, that no man could become rich in the country unless he purchased an appointment, and thus became one of the rulers; and that justice in the courts was a farce—the heaviest purse, or the most powerful person, invariably winning the case; besides which, if a man was believed to be in possession of money, false charges were brought against him, directly or indirectly, by the officials, in order to wring the money out of him. Everyone that he questioned in Bangkok was of opinion that the state of the people could not be much worse than it was at the time of his visit. According to an inspector of police in Siamese employ, the magistrates in that city have the reputation of being the biggest liars in the country, and the police are said to be the greatest thieves, and so unsafe are the people from false charges and lawsuits, that they willingly become the slaves of the powerful in order to gain their protection.

The whole volume is replete with interesting information; we heartily commend it to the attention of our readers.

THE LESSER ANTILLES.

The Lesser Antilles. A Guide for Settlers in the British West Indies and Tourists' Companion. By Owen T. Bulkeley. (London: Sampson Low, Marston, Searle, and Rivington, Limited, 1889.)

SINCE Mr. Froude wrote on the West Indies, numerous books and pamphlets have been produced, either to show he was entirely wrong, or to supplement in some important particular the information he gave respecting these islands. The author of the little book before us took note of Mr. Froude's lament that all hand-books to the West Indies "were equally barren" of facts connected with the higher interest which the islands possess for Englishmen, and he seeks to supply the deficiency.

Although it is evident that Mr. Bulkeley has not an intimate knowledge of all the islands concerned, this is no great disparagement—especially when we recall their comparative isolation, and the general ignorance which exists even in the West Indies themselves in regard to the affairs of their neighbours.

The facts stated are generally trustworthy, and the hints given to visitors and intending settlers are likely to be useful. There are a moderately good map and some twenty illustrations, most of which, however, are already familiar to us. Although usually grouped together, the several islands in the Lesser Antilles differ much more from each other than is usually supposed. One end of the chain, at the Virgin Islands, touches 19° N. lat., while the other end at Trinidad is in 10° N. lat. Hence, the extreme points of the Lesser Antilles are about six hundred miles apart, and there is such a diversity of soil and climate that each island really requires separate treatment.

There is still much misconception in the mind of the British public as regards the healthiness of these islands, and also as regards their suitability for settlers with a small capital. If there were someone in this country whose business it was to give accurate information respecting the West Indies, they would probably be greatly benefited.

The revival of interest in these islands, and the large number of people who annually visit them, are facts which have naturally led to the production of a guide-book. Mr. Bulkeley has, however, aimed at producing something more than a guide-book. The greater part of the volume is devoted to a minute description of the physical features, and the circumstances of the several islands, and this is followed by information for intending settlers, with the view of inducing those who have capital to invest to make their homes in these islands. While we cannot endorse all Mr. Bulkeley's statements on this latter point, it is only right to say that none of them are positively misleading, and at all times they are discussed with a modesty, and an evident desire to arrive at a right conclusion, that disarms criticism.

Besides the sugar-cane and cocoa-nut palms, there are industries connected with fruits, fibres, spices, annatto, arrow-root, pepper, maize, medicinal plants, scent-producing plants, coca, ramie, tea, tobacco, and many others well suited to the soil and climate.

It is well known that in former days large fortunes were made by sugar planters in the West Indies. Now, however, even the best estates do little more than give a small return on the capital invested, while many cannot even do this. It would be unwise, therefore, for the West Indies to confine their attention exclusively, or, indeed, largely, to the sugar-cane. Already a change is taking place. Jamaica has pimento, coffee, tropical fruits, cinchona, dye-woods, annatto, cacao; Trinidad has cacao, cocoa-nuts; Grenada is almost exclusively cacao and spices; Montserrat is noted for its lime plantations and lime-juice; while Dominica exports concentrated lime-juice, cacao, cocoa-nuts, as well as oranges to the neighbouring islands. The tendency is for the cultivation of the West Indies to become more and more diversified, and it is well it should be so.

With such good markets for produce of all kinds in the United States and Europe, it is evident that West Indian planters could regain much of their former prosperity if only they adapted themselves to the new order of things. To assist them in the development of new industries, Government botanical gardens are in course of being established, under the auspices of Kew, in every island, and from these new plants and information respecting their cultivation are being widely distributed. In such a work enterprising governors, such as the late Sir Anthony Musgrave, and the present Governor of Trinidad, Sir William Robinson, and others, have taken an active part. It is not, however, as regards industrial subjects only that interest in the West Indies has revived of late. The publication of Grisebach's "Flora of the British West Indian Islands" in 1864 (one of the series of colonial flora projected by the late Sir William Hooker) was for a long time the only effort made in the cause of botanical science in this part of the world. Since that time, both the fauna and flora have received systematic attention in this country and in the United States, and after a lapse of nearly two hundred years we are beginning to have a clear idea of the distribution of life in the Caribbean Archipelago.

A Joint Committee of the Government Grant Committee of the Royal Society and of the British Association, has been engaged for the last three years in investigating ascertained deficiencies in the fauna and flora. Almost every page of Mr. Bulkeley's work affords ample evidence of the aid he has received, directly or indirectly, from the botanical efforts of recent years. More, however, might have been said of the special plants which are characteristic of the several islands, and which contribute so large a share to the interest of daily life in them.

It is to be hoped the day is not far distant when this first unpretentious guide-book to the Lesser Antilles will be followed by others, not less interesting, but still more fully meeting the requirements of those who may visit them for pleasure, or go to them in the hope of pursuing some of the numerous industries opened to settlers in these beautiful islands. D. M.

A TEXT-BOOK OF HUMAN ANATOMY.

A Text-book of Human Anatomy, Systematic and Topographical. Including the Embryology, Histology, and Morphology of Man, with special reference to the requirements of Practical Surgery and Medicine. By Alex. Macalister, M.A., M.D., F.R.S., Professor of Anatomy in the University of Cambridge. (London: Charles Griffin and Co., 1889.)

WHEN it was announced some time ago that the Professor of Anatomy in the University of Cambridge was engaged in writing a systematic work on Human Anatomy, its publication was looked for with anticipation and interest. Prof. Macalister deservedly enjoys a high reputation as a man of remarkable culture in many branches of knowledge, and as an anatomist in the comprehensive meaning of the term. Curiosity was excited, therefore, as to the mode in which he would treat the subject: whether he would follow the old lines pursued by so many of those who have preceded him in the writing of text-books, or if he would strike out a new path for himself.

In his preface he tells us that he has endeavoured to give a comprehensive account of the Anatomy of Man studied from the Morphological standpoint. Accordingly, we find that, after a few explanatory paragraphs on the meaning of terms used in description, he proceeds to state his conception of a Cell. His definition is so comprehensive that he regards it in its simplest form as a minute speck of protoplasm without either nucleus or cell-wall; and, in this respect, he may be said to coincide with the view held by Stricker in his well-known article on the Cell. He then briefly describes the process of Karyokinesis, and very properly states that the study of the specialization of the products of cell multiplication is the only trustworthy guide to the solution of the many morphological problems which Human Anatomy presents. This very naturally leads to an account of the Development of the Embryo, which is, however, compressed into so few pages that we doubt whether a beginner can derive from it a clear conception of the very elaborate set of changes which lead from the simple laminated blastoderm to the form of the fœtus at the time of birth.

A chapter on Histology or tissue-anatomy comes next in order. He groups the tissues into five classes—epithelial or surface limiting; connective or skeletal; nervous or sensory; muscular or contractile; blood and lymph or nutritive. This classification is both simple and convenient, and is much to be preferred to the grouping into cellular, fibrous, membranous and tubular tissues, sometimes adopted. In the course of this chapter he in part fills up some of the gaps in the section on embryology, by describing the development of the nervous and vascular systems.

The skeleton is next described, and following the plan pursued by Prof. Humphry in his well-known treatise, and by Hyrtl, Gegenbaur, Krause, and others in their systematic works, he describes the joints and ligaments along with the bones with which they are associated. This arrangement, undoubtedly, has certain advantages more especially in the direction of economizing space in description.

About one-third of the work, extending to 248 pages, is occupied with the chapters to which we have just referred, and the remaining two-thirds is devoted to an account of the soft parts, including the anatomy of the brain and organs of sense. In this, the larger division of his text-book, Prof. Macalister alters his mode of treating the subject, and departs from the method which systematic writers are in the habit of pursuing.

The rule, almost without exception, has been to describe in separate chapters the muscular, vascular, nervous, alimentary, respiratory, and genito-urinary systems, so as to bring before the student in a continuous series all those organs which possess corresponding properties. To some extent, therefore, the arrangement adopted in our text-books of systematic anatomy has had a physiological basis.

Dr. Macalister has not followed this plan. He has adopted an arrangement on a topographical basis, *i.e.* according to the method pursued in the dissecting-room, in which the student works out for himself the constituent parts of the body as he displays them in the course of his dissections. This method of studying the anatomy of the human body is, as everyone will admit, of enormous importance—indeed, we may say of primary value—to the practitioner of medicine and surgery. But it is the custom of the schools to distinguish between the analytical or dissecting-room method, in which the body is picked to pieces by the dissector himself, and the synthetical or systematic method, in which the body is, as it were, built up by the teacher for the student. This custom is the fruit of long experience, for whilst giving full value to the topographical or regional aspect of anatomy, it enables the teacher to show to the student the continuousness of such systems as the vascular, nervous, and alimentary, and to point out their physiological relations. For it should be kept in mind that anatomy is the basis of physiology, as well as the foundation of that side of medical and surgical practice which is based on a sound knowledge of regional anatomy. The incomplete recognition of the physiological aspect of anatomy is, we think, the weak part of the book, and it is especially shown in the scanty notice which is taken of the action of the muscles and their association with the movements of the joints.

To enable both these lines of anatomical study to be pursued, the student is accustomed to employ at least two text-books; the one in connection with his systematic work, the other as a guide to the dissection of the body. Prof. Macalister apparently expects, as, indeed, he states in his preface, that his text-book should stand in the place of the two customarily employed. We doubt, however, whether this expectation will be fulfilled. For his text-book, in addition to what is essential in topographical description, by containing an account of the microscopic structure of tissues and organs, a section on embryology, and a detailed description of the bones, is necessarily a work of considerable size and weight, and too cumbersome to be conveniently carried to and fro by the student, as is required with a dissecting-room manual. On the whole, therefore, we prefer the old and well-accustomed lines on which text-books have for so long been written, to Prof. Macalister's modified plan.

But whilst expressing our inability to regard the method which has been followed in the descriptive anatomy of the soft parts as an improvement on the customary arrangement of systematic text-books, we recognize with pleasure the clearness of the descriptions and the many suggestive hints, both morphological and practical, which the book contains. The volume is profusely illustrated with upwards of eight hundred wood-cuts, about one half of which are original figures.

OUR BOOK SHELF.

A Treatise on Ordinary and Partial Differential Equations. By W. W. Johnson. (London: Macmillan, 1889.)

WE have read Prof. Woolsey Johnson's work with some interest: his style is clear, and the worked-out examples well adapted to elucidate the points the writer wishes to bring out. He appears to recognize Boole, but, so far as the text is concerned, does not acknowledge the existence of Mr. Forsyth's fine work. We do not say that he was under any obligation to do so, but nowadays we are so accustomed to see a list of authors upon whom a writer has drawn that we missed it here. "An amount of space somewhat greater than usual has been devoted to the geometrical illustrations which arise when the variables are regarded as the rectangular co-ordinates of a point. This has been done in the belief that the conceptions peculiar to the subject are more readily grasped when embodied in their geometric representations. In this connection the subject of singular solutions of ordinary differential equations, and the conception of the characteristic in partial differential equations may be particularly mentioned." This is certainly the most prominent feature of the early chapters, and it is, to our mind, clearly put before the student. Reference is duly made to Prof. Cayley's work in the *Messenger of Mathematics* (vol. ii.), which initiated the present mode of treatment of the subject, but not to Dr. Glaisher's "Illustrative Examples" (vol. xii.), nor to Prof. M. J. M. Hill's paper (London Math. Soc. Proc., vol. xix.), in which the theorems *stated* by Prof. Cayley are proved. This paper, though read before the Society, June 14, 1888, may not have reached the author before his work was in the printer's hands: we do not say that a perusal of it would have called for any further notice than a reference. Symbolic methods come in for their due meed of recognition and employment. The author satisfies himself with referring the student to the table of contents for the topics included and the order pursued in treating them. The work consists of twelve chapters divided up into twenty-four sections: i. (1) discusses the nature and meaning of a differential equation between two variables; ii. (2, 3, 4,) equations of the first order and degree; iii. equations of the first order, but not of the first degree, (5) singular solutions (discriminant, cusp-, tac-, and node-loci), (6) Clairaut's equation, (7) geometrical applications, orthogonal trajectories; iv. (8) equations of the second order; v. (9, 10) linear equations with constant coefficients, in (10) symbolic methods are employed; vi. (11–13) linear equations with variable coefficients; vii. (14, 15) solutions in series; viii. (16) the hypergeometric series; ix. (17) special forms of differential equations, as Riccati's equation (due reference is made to Dr. Glaisher's classical paper in the Phil. Trans. for 1881), Bessel's equation, and Legendre's equation (reference is made to text-books and memoirs); x. (18–20) equations involving more than two variables; xi. (21, 22) partial differential equations of the first order; xii. (23, 24) partial differential equations of higher order. Examples for practice are added at the end of each section. Though Prof. Johnson cannot lay claim to have made here any additions to our knowledge of the subject, he has produced an excellent introductory hand-book for students, and this, we expect, was the object he proposed to himself in its compilation. We have omitted to state that all use of the complex variable is eschewed.

The Land of an African Sultan: Travels in Morocco, 1887, 1888, *and* 1889. By Walter B. Harris, F.R.G.S. (London: Sampson Low and Co., 1889.)

A GOOD deal has been written about Morocco lately, and Mr. Harris's volume is an interesting, although not a very important, contribution to the literature of the subject. He describes first a journey through northern Morocco, then a journey with H.B.M. Special Mission to the court of the Sultan at Morocco city, next a visit to Wazan and a ride to Sheshuan; and in a final chapter he sums up the impressions produced upon him by the Moors and their country. In the chapter on his ride to Sheshuan, he describes a place which had been "only once before looked upon by Christian eyes." Mr. Harris does not pretend to have produced an exhaustive work on Morocco; but he presents clearly what he himself has had opportunities of observing.

Wayside Sketches. By F. Edward Hulme, F.L.S., F.S.A. (London: Society for Promoting Christian Knowledge, 1889.)

THIS is a pleasantly conversational book on all sorts of subjects more or less connected with natural history or country life: birds, caterpillars, flowers, snow-crystals, and the forms of clouds, all come in for a share of attention. Without having any scientific pretensions of its own, the book may well serve to rouse a first interest in many branches of science. The numerous illustrations are very good indeed.

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.*]

Influenza.

THE following paragraph, taken from Sir David Brewster's "Life of Sir Isaac Newton," is not uninteresting at the present time:—

"Some light has been recently thrown on the illness of Newton by Dr. Dowson, of Whitby, who, at a meeting of the Philosophical Society there on the 3rd of January, 1856, read a paper 'On the Supposed Insanity of Sir Isaac Newton,' in which he has shown that the malady with which he was afflicted in September 1693 was probably influenza or epidemic catarrhal fever, which prevailed in England, Ireland, France, Holland, and Flanders in the four last months of 1693. This distemper, which lasted from eight or ten days to a month, was so general, that 'few or none escaped from it'; and it is therefore probable, as Dr. Dowson believes, that Newton's mental disorder was merely the delirium which frequently accompanies a severe attack of influenza. See Dr. Theophilus Thomson's 'Annals of Influenza or Epidemic Catarrh in Great Britain,' published in 1852 by the Sydenham Society. See also the Philosophical Transactions for 1694, vol. xviii. pp. 105–115." W. GREATHEED.

ABOUT forty-five years ago I paid a visit with a friend to the laboratory of the celebrated chemist Prof. Schonbein, the discoverer of ozone in the atmosphere and the cause of influenza. Just prior to our visit the Professor had obtained some ozone, and had inhaled it for the purpose, as he said, of giving himself influenza, in order to ascertain how it would affect him. We both distinctly observed most of the ordinary symptoms of the malady. AUGUSTUS HARVEY.

12 Landridge Road, Fulham, January 17.

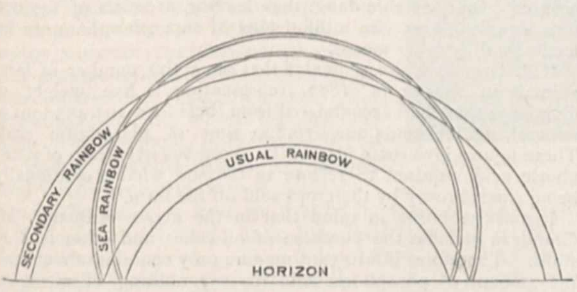
Rainbow due to Sunlight reflected from the Sea.

I HAVE never heard of a rainbow, due to the image of the sun in water, having been seen; and I think the following letter, from an old student of mine of sixteen years ago, may interest your readers. WILLIAM THOMSON.

The University, Glasgow, January 7.

ON September 18, 1889, I saw a rainbow, caused, not by the direct rays of the sun, but by their reflection from the sea.

We were at the height of 900 feet; the sky was all clouded except along the western horizon; the sun, an hour before setting, was hidden; but its rays were reflected from the sea. A drizzle was falling, and my companion was remarking how strong the light from the sea was, when it occurred to me that it might give a bow. And there it was behind us—not the usual recumbent bow, less than a semicircle, but an overhanging one, greater than a semicircle. The clouds were drifting from the west, so that the sun came into view; and the usual rainbow became visible with its secondary bow; *so that three rainbows were seen at once.* The sea-bow and the usual bow were identical at the horizon. The angle between them was greater than the sun's



angular height, but not double. It seemed as if the complementary segment of the rim had been folded up from beneath into view, but that the colours were not reversed. The sea-bow was just as bright as the secondary bow, which it intersected.

From the fact that the three were seen together, for over 3 minutes, at least in part, I would argue that it is no unusual sight, and that in Scotland, where bows are so frequent, and plenty of comparatively smooth water available, this sea-bow may be looked for and seen.

I may mention, also, that I saw a fourth bow that evening. After the sun had set, a bow of one colour, an orange-pink, took the place of the usual bow. The source of light, I thought, was a cloud just over the place where the sun had set.

WILLIAM SCOULLER.

86 Calle de la Independencia, Valparaiso, November 9, 1889.

Osteolepidæ.

YOUR reviewer R. L. is mistaken in condemning so absolutely the above form. The word "Osteolepus" would be a legitimate adjective expressing the same idea as the substantive Osteolepis; and the patronymic of the "Osteolepi" would be simply "Osteolepidæ," and not "Osteolepididæ."

It may be useful for R. L. and some others to apprehend this principle in word-building—viz. that compound Greek adjectives do *not* take the lengthened genitive as root; thus the correct Latin equivalent for the corresponding Greek adjective is *not* "echinodermatus" but "echinodermus," not "distomatus" but "distomus." Hence, the correct form for the neuter plural of the former is "Echinoderma;" and for the neuter singular of the latter is Distomum. And it would be wrong to write "Distomatidæ" as the family name, and correct to write "Distomidæ." Hence Osteolepidæ and the like are admissible, since they may be considered as formed from adjectives, and not from the substantive (of questionable form itself) in -is.

R. L. + E.

Exact Thermometry.

SINCE the publication of my letter in NATURE (December 19, 1889, p. 152) on the cause of the rise of the zero-point of a thermometer when exposed for a considerable time to a high temperature, two letters on the same subject have appeared, one from Mr. Herbert Tomlinson (January 2, p. 198), the other from Prof. E. J. Mills (January 9, p. 227), who replies to my objections to the plastic theory.

Mr. Tomlinson considers that my experiments seem to leave no doubt that compression, due to the plasticity of the glass, is not the main cause of the rise of the zero-point, but he considers that it is not merely the prolonged heating, but also the change of temperature (heating or cooling), that is effective in bringing about the change. I have not yet had time to make any special experiments to test this point, but I may perhaps mention that such data as I possess seem rather to point to the conclusion that long-continued steady heating is more effective than alternate heating or cooling. As the following experiment, made about a year ago, seems to bear on the point, I give the results:—

									Total rise of zero
Approximate time in hours.	6	3	6	6	6	31	6	6	
Rise of zero-point	1°·6	0°·15	0°·85	0°·5	0°·1	1°·2	0°	0°	4°·4

Two other thermometers, heated each day for about six hours, showed after nine days rises of zero-point of 3°·8 and 4°·1 respectively, but in these cases the change was apparently not quite complete. The temperature was in each case 280°, and all these thermometers belonged to the same batch as those employed in my experiments already described in NATURE.

Prof. Mills does not regard the experiments as conclusive, but criticizes my results in the following words: "The zero movement, however, only ranged from 1° to 1°·2—small readings which might very possibly have been obtained, or not, on either of the thermometers at other times." This criticism, in striking contrast to the rest of the letter, appears to be rather unkind either to me or to my thermometers, I hardly know which. I sincerely hope that none of my thermometers are capable of such erratic behaviour as to show changes of zero-point of 1° (or even twice this amount if the plastic theory is correct) without extraordinary treatment, or that my readings of temperature are reliable only to within 1° or so. But to make the matter more certain, I will continue the heating of the two thermometers, A and C, under the same conditions as before, and will also heat two more thermometers under similar conditions to about 360°.

Prof. Mills mentions the very curious behaviour of lead-glass thermometers at different temperatures, but his objection on that score to the temperature 280° does not seem to apply, as my thermometers are all made of soft German soda-glass. It may, however, be useful to heat two more thermometers to a temperature of about 220° in order to compare the total rise with that at 280° and 360°.

With regard to the statement that the final state of a thermometer kept at the ordinary temperature for an infinite time would differ from that of the same thermometer after being subjected to prolonged heating at a high temperature, I am not prepared to give a decided opinion either one way or the other, but it does appear to me to be rather a daring procedure to make observations of the minute changes of zero-point over a few years, and to extrapolate from a decade or so to eternity.

I am also quite willing to admit that there may be other causes tending to raise the zero-point besides the equalization of tension, such, for instance, as the chemical changes alluded to by Prof. Mills; but I should like to ask, as I am ignorant on the point, whether there is any experimental evidence of their nature or existence. SYDNEY YOUNG.

University College, Bristol, January 11.

Foreign Substances attached to Crabs.

IN your issue of December 26, and also in exhibiting his collection of crabs before the Linnean Society, Mr. Pascoe cast some doubt on the function of the two pairs of modified legs of *Dromia vulgaris*, which are usually supposed to be adapted to the retention of the sponge with which it covers its carapace.

That these legs were really used for this purpose I was enabled to observe, during my stay at the zoological station in Naples last winter. I had in my tank several specimens, in some of which the sponge had also extended on to the ventral surface, over the edge of the carapace, thus securing a firm hold apart from the action of the legs. In all specimens, however, there are seen, when the sponge is removed, which requires considerable force, two oblique depressions into which the legs fit, giving them thus a distinct hold on the sponge.

If the latter be, however, removed from the animal but left in the tank, the crab soon sets to work to regain possession of its covering, and can be seen to use its modified hinder pairs of legs most effectually for this purpose. It would seem therefore beyond doubt that these modified legs serve not only for holding on the sponge, but also for getting hold of a new sponge, should the old one get injured or die, as must happen not unfrequently.

F. ERNEST WEISS.

The Zoological Laboratory, University College, January 6.

Galls.

I AM sorry if I unintentionally misrepresented the opinions of Prof. Romanes and Dr. St. George Mivart in suggesting that they wished to assail the theory of natural selection in their recent communications to NATURE on this subject. They must, however, pardon me for saying that I still think the extract to which I alluded in my note admits this interpretation. As my views of the relations of gall-formation to the theory of natural selection are clearly at variance with those of your correspondents, perhaps you will allow me space to give briefly the grounds upon which I base my conclusions.

There are in England about ninety well-known varieties of galls, and of this number fully a third are found in the oak. About half the oak-galls are formed on growing leaves. In nearly one-third of the total number the grub is hatched, and the gall is fashioned in a developing bud. We can readily imagine, in the case of a tree with deciduous leaves, that the presence of a few galls upon its foliage would not greatly affect its chances of survival, if its fitness was in other respects complete. It is otherwise when a gall occupies the position of a developing bud, especially when the bud is a terminal one. In this case there occurs coincidently with, and as a result probably of, the adventitious formation, an arrest of normal development and growth. Indeed, I believe "the gnarled and twisted oak" owes many of its gnarls and most of the twists to the common oak-apple and other bud-galls. If a tree endowed with less developmental vigour and with fewer supplementary buds than the oak had been exposed to the repeated attacks of the insects for many generations in a struggle for existence, it would doubtless have long ago succumbed, and it would have done so by a process of natural selection operating in the ordinary manner, and not "at the end of a long lever of the wrong kind," whatever that may mean. This selective process in the case of gall-bearing trees has left possible traces of its action to-day, for I am unaware that any other English tree than the oak is attacked by terminal bud-galls. The terminal leaf-galls of certain Salices and Conifers can scarcely affect their growth and development to the same extent as the bud-galls.

When we compare pathological tumours in the higher animals with these vegetable excrescences, we must make due allowances for the different conditions under which each lives. I cannot then see that the "morphological specialization" of galls, which, for the most part, are composed of hypertrophied reproductions of the simpler vegetable tissues, is greater than that exhibited by man himself, when, for instance, he becomes the involuntary host of Dr. Lewis's *Filariæ*, and his leg the seat of *Elephantiasis lymphangiectodes*, accompanied by hypertrophy of many integumentary structures of the limb. Oak-spangles, on the other hand, are to my mind comparable to the circular nests of ringworm, or to the sprouting epithelium of a *Verruca necrogenetica*. Such comparisons may be of little scientific value, yet I take it they are as useful in their place as attempts to gauge the amount of "disinterestedness" shown by a cabbage when it becomes the unwilling host of the gall-producing *Ceuthorhynchus sulcicollis*. W. AINSLIE HOLLIS.

Brighton, December 30, 1889.

The Evolution of Sex.

THE interesting note of Mr. M. S. Pembrey in your issue of January 2 (p. 199), induces me to draw the attention of your correspondent to a short paper of mine just published (or in course of publication) in the *Ibis*, where I communicated the experiences of a friend, who had hatched a series of parrot eggs, belonging to the genus *Eclectus*, in which the young males are green, the young females red. It is remarkable that by far the larger number of the birds hatched were males. In each case only two eggs were laid, and the breeder himself, without being able to tell why, is of opinion that nearly all his hatches consisted of male birds. As there are still many embryos of those *Eclectus* in my hands, the sex of which is not yet determined, I hope to be able to make known the result of my investigation later, whether the pairs are always males, or always females, or consist of a male and a female bird, at least sometimes. Meanwhile, I should be glad to hear if anything more is known about the sexes of birds which lay only two eggs at a time.

A. B. MEYER.

Royal Zoological Museum, Dresden, January 5.

"Manures and their Uses."

ALLOW me to thank the well-known writer "W." for his review of the above-mentioned book. "W." does not hold with the view that "farmyard manure is erroneously supposed to contain *all* the necessary plant-foods required for the growth of plants." I believe, with M. Ville and others, that "the farmer who uses nothing but farmyard manure exhausts his land." "W." speaks of this as an "obvious fallacy." If the statement is wrong, would "W." kindly answer the quotation given on p. 76 of the book in question. The quotation "runs" as follows:—

"M. Grandeau (the French agricultural authority) recently estimated that one year's crop in France represents 298,200 tons of phosphoric acid, of which only 151,200 tons were recovered from the stable dung, thus leaving a deficit of 147,000 tons, equal to over one million tons of superphosphate, to be made good by other means.

"M. Grandeau also estimated that the entire number of farm animals in France in 1882, representing a live weight of 6,240,430 tons, had accumulated from their food 193,453 tons of mineral matter containing 76,820 tons of phosphoric acid. These figures give some idea of the enormous quantities of phosphoric acid required to restore to the soil what is continually being carried away by the crops sold off the farm."

It must be borne in mind that in the above estimates, M. Grandeau includes the purchase of oil-cakes and other feeding stuffs. Therefore, if farmyard manure only contains about half the amount of phosphoric acid (to say nothing of nitrogen, potash, &c.) required to retain the land in a fertile condition, how can I have attached "too much prominence to chemical manures, and too little importance to stock-feeding as a manurial agency"? A. B. GRIFFITHS.

[DR. GRIFFITHS assumes that because, as asserted by M. Grandeau, the balance of fertilizing matter in France is against the land, "the farmer who uses nothing but farmyard manure exhausts his land." This is arguing from general principles to special cases, and there is no sequence in his reasoning. A nation may be rushing to ruin, but that does not prevent an individual from growing rich. Phosphates and nitrates may be diminishing, but that does not prevent them from accumulating on any particular farm. We traverse Dr. Griffiths's statement without qualification, that the farmer who uses nothing else but farmyard manure exhausts his land. We believe he improves his land.—THE REVIEWER.]

MAGNETISM.[1]

II.

WHEN one considers that the magnetic property is peculiar to three substances—that it is easily destroyed by the admixture of some foreign body, as manganese—one would naturally expect that its existence would depend also on the temperature of the body. This is found to be the case. It has long been known that iron remains magnetic to a red heat, and that then it somewhat suddenly ceases to be magnetic, and remains at a higher temperature non-magnetic. It has long been known that the same thing happens with cobalt, the temperature of change, however, being higher; and with nickel, the temperature being lower. The magnetic characteristics of iron at a high temperature are interesting. Let us return to our ring, and let us suppose that the coils are insulated with a refractory material, such as asbestos paper, and that the ring is made of the best soft iron. We are now in a position to heat the ring to a high temperature, and to experiment upon it at high temperatures in exactly the same way as before. The temperature can be approximately determined by the resistance of one of the copper coils. Suppose, first, that the current in the primary circuit which we use for magnetizing the ring is small; that from time to time, as the ring is heated and the temperature rises, an experiment is made by reversing the current in the primary circuit, and observing the deflection of the galvanometer needle. At the ordinary temperature of the air the deflection is comparatively small; as the temperature increases the deflection also increases, but slowly at first; when the temperature, however, reaches something like 600° C., the galvanometer deflection begins very rapidly to increase, until, with a temperature of 770° C., it attains a value of no less than 11,000 times as great as the deflection would be if the ring had been made of glass or copper, and the same exciting current had been used. Of course, a direct comparison of 11,000 to 1 cannot be made: to make it, we must introduce resistance into the secondary circuit when the iron is used; and we must, in fact, make use of larger currents when copper is used. However, the ratio of the induction in the case of iron to that in the case of copper, at 770° C., for small forces is no less than 11,000 to 1. Now mark what happens. The temperature rises another 15° C.: the deflection of the needle suddenly drops to a value which we must regard as infinitesimal in comparison to that which it had at a temperature of 770° C.; in fact, at the higher temperature of 785° C. the deflection of the galvanometer with iron is to that with copper in a ratio not exceeding that of 1·14 to 1. Here, then, we have a most remarkable fact: at a temperature of 770° C. the magnetization of iron 11,000 times as great as that of a non-magnetic substance; at a temperature of 785° C. iron practically non-magnetic. These changes are shown in Fig. 8. Suppose now that the current in the primary circuit which serves to magnetize the iron had been great instead of very small. In this case we find a very different order of phenomena. As the temperature rises, the deflection on the galvanometer diminishes very slowly till a high temperature is attained; then the rate of decrease is accelerated until, as the temperature at which the sudden change occurred for small forces is reached, the rate of diminution becomes very rapid indeed, until, finally, the magnetism of the iron disappears at the same time as for small forces. Instead of following the magnetization with constant forces for varying temperatures, we may trace the curve of magnetization for varying forces with any temperature we please. Such curves are given in Diagrams 9 and 10. In the one diagram, for the purpose of bringing out different points in the curve, the scale of abscissæ is 20 times as great as in the other. You will observe that the effect of rise of temperature is to diminish the maximum magnetization of which the body is capable, slowly at first, and rapidly at the end. It is also very greatly to diminish the coercive force, and to increase the facility with which the body is magnetized. To give an idea of the magnetizing forces in question, the force for Fig. 8 was 0·3; and as you see from Figs. 9 and 10, the force ranges as high as 60. Now the earth's force in these latitudes is 0·43, and the horizontal component of the earth's force is 0·18. In the field of a dynamo machine the force is often more than 7000. In addition to the general characteristics of the curve of magnetization, a very interesting, and, as I take it, a very important, fact comes out. I have already stated that if the ring be submitted to a great current in one direction, which current is afterwards gradually reduced to zero, the ring is not in its non-magnetic condition, but that it is, in fact, strongly magnetized. Suppose now we heat the ring, whilst under the influence of a strong magnetizing current, beyond the critical temperature at which it ceases to have any magnetic properties, and that then we reduce the current to

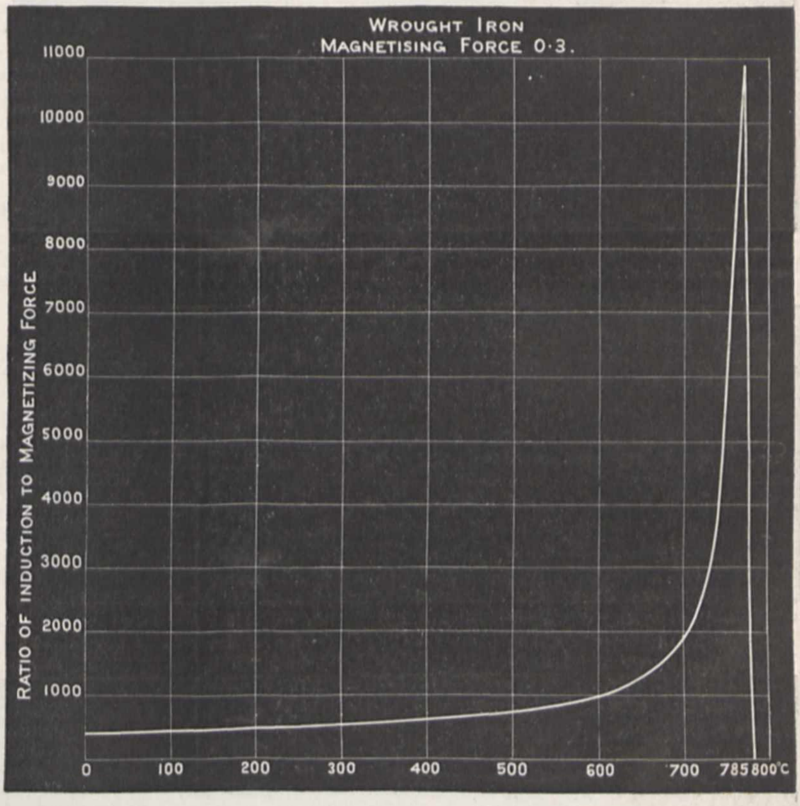


Fig. 8.

[1] Inaugural Address delivered before the Institution of Electrical Engineers, on Thursday, January 9, by J. Hopkinson, M.A., D.Sc., F.R.S., President. Continued from p. 254.

zero, we may in this state try any experiment we please. Reversing the current on the ring, we shall find that it is in all cases non-magnetic. Suppose next that we allow the ring to cool without any current in the primary, when cold we find that the ring is magnetized; in fact, it has a distinct recollection of what had been done to it before it was heated to the temperature at which it ceased to be magnetic. When steel is tried in the same way with varying temperatures, a similar sequence of phenomena

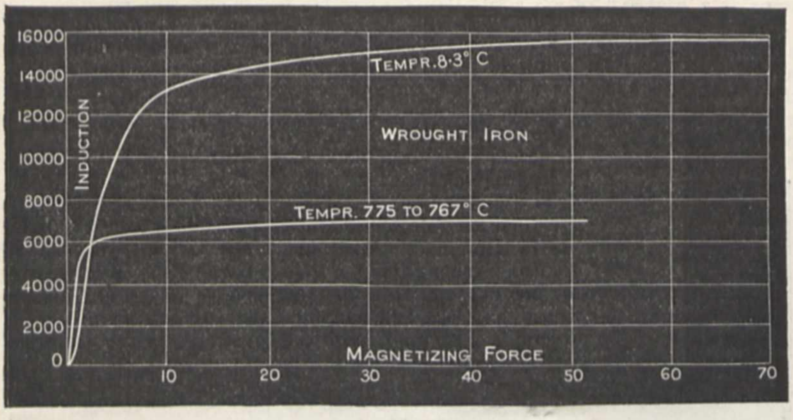


Fig. 9.

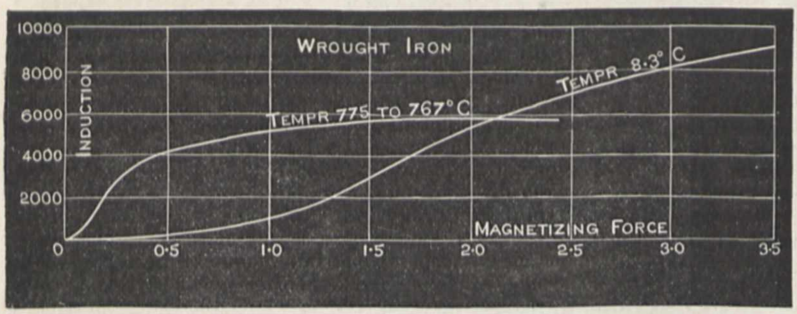


Fig. 10.

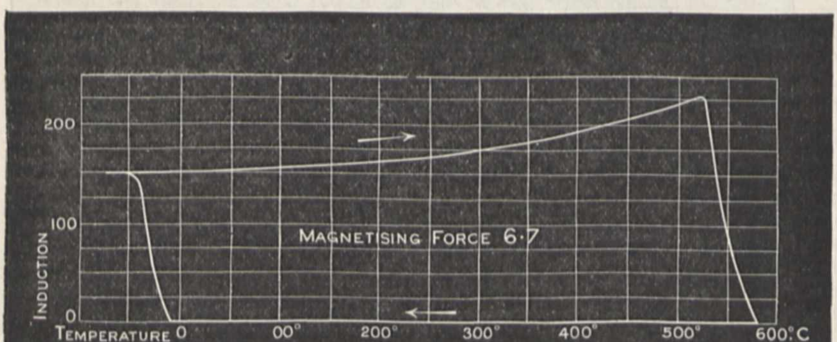


Fig. 11.

is observed; but for small forces the permeability rises to a lower maximum, and its rise is less rapid. The critical temperature at which magnetism disappears changes rapidly with the composition of the steel. For very soft charcoal iron wire the critical temperature is as high as 880° C.; for hard Whitworth steel it is 690° C.

The properties of an alloy of manganese and iron are curious. More curious are those of an alloy of nickel and iron. The alloy of nickel and iron containing 25 per cent. of nickel is non-magnetic as it is sure to come from the manufacturer; that is to say, a substance compounded of two magnetic bodies is non-magnetic. Cool it, however, a little below freezing, and its properties change: it becomes very decidedly magnetic. This is perhaps not so very remarkable: the nickel steel has a low critical temperature—lower than we have observed in any other magnetizable body. But if now the cooled material be allowed to return to the ordinary temperature it is magnetic; if it be heated it is still magnetic, and remains magnetic till a temperature of 580° C. is attained, when it very rapidly becomes non-magnetic, exactly as other magnetic bodies do when they pass their critical temperature. Now cool the alloy: it is non-magnetic, and remains non-magnetic till the temperature has fallen to below freezing. The history of the material is shown in Fig. 11, from which it will be seen that from −20° C. to 580° C. this alloy may exist in either of two states, both quite stable—a magnetic and a non-magnetic—and that the state is determined by whether the alloy has been last cooled to −20° C. or heated to 580° C.

Sudden changes occur in other properties of iron at this very critical temperature at which its magnetism disappears. For example, take its electrical resistance. On the curve, Fig. 12, is shown the electrical resistance of iron at various temperatures, and also, in blue, the electrical resistance of copper or other pure metal. Observe the difference. If the iron is heated, its resistance increases with an accelerating velocity, until, when near the critical temperature, the rate of increase is five times as much as the copper; at the critical temperature the rate suddenly changes, and it assumes a value which, as far as experiments have gone, cannot be said to differ very materially from a pure metal. The resistance of manganese steel shows no such change; its temperature coefficient constantly has the value of 0·0012, which it has at the ordinary temperature of the air. The electrical resistance of nickel varies with temperature in an exactly similar manner. Again, Prof. Tait has shown that the thermo-electric properties of iron are very anomalous—that there is a sudden change at or about the temperature at which the metal becomes non-magnetic, and that before this temperature is reached the variations of thermo-electric property are quite different from a non-magnetic metal.

Prof. Tomlinson has investigated how many other properties of iron depend upon the temperature. But the most significant phenomenon is that indicated by the property of recalescence. Prof. Barrett, of Dublin, observed that if a wire of hard steel is heated to a very bright redness, and is then allowed to cool, the wire will cool down till it hardly emits any light at all, and that then it suddenly glows out quite bright again, and afterwards finally cools. This phenomenon is observed with great difficulty in the case of soft iron, and is not observed at all in the case of manganese steel. A fairly approximate numerical measurement may be made in this way: Take a block of iron or steel o: which a groove is cut, and in this groove wind a coil of copper wire insulated with asbestos; cover the coil with many layers of asbestos; and finally cover the whole lump of iron or steel with asbestos again. We have now a body which will heat and cool comparatively slowly, and which will lose its heat at a rate very approximately proportional to the difference of temperature between it and the surrounding air. Heat the block to a bright redness, and take it out of the fire and observe the resistance of the copper coil as the temperature falls, due to the cooling of the block. Plot a curve in which the abscissæ are the times, and the ordinates the logarithms, of the increase of resistance of the copper coil above its resistance at the temperature of the room. If the specific heat of the iron were constant, this curve would be a straight line; if at any particular temperature latent heat were liberated, the curve would be horizontal so long as the heat was being liberated. If now a block be made of manganese steel, it is found that the curve is very nearly a straight line, showing that there is no liberation of latent heat at any temperature. If it is made of nickel steel with 25 per cent. of nickel, in its non-magnetic state, the result is the same—no sign of liberation of heat. If now the block be made of hard steel, the temperature diminishes at first; then the curve (Fig. 13) which represents the temperature bends round: the temperature actually rises many degrees whilst the body is losing heat. The liberation of heat being completed, the curve finally descends as a straight line. From inspection of this curve it is apparent why hard steel exhibits a sudden accession of brightness as it yields up its heat. In the case of soft iron the temperature does not actually rise as the body loses heat, but the curve remains horizontal, or nearly horizontal, for a considerable time. This, again, shows why, although a considerable amount of heat is liberated at a temperature corresponding to the horizontal part of the curve, no marked recalescence can be obtained. From curves such as these it is easy to calculate the amount of heat which becomes latent. As the iron passes the critical point it is found to be about 200 times as much heat as is required to raise the temperature of the iron 1 degree Centigrade. From this we get a very good idea of the importance of the phenomenon. When ice is melted and becomes water, the heat absorbed is 80 times the heat required to raise the temperature of the water 1 degree Centigrade, and 160 times the heat required to raise the temperature of the ice by the same amount. The temperature of recalescence has been abundantly identified with the critical temperature of

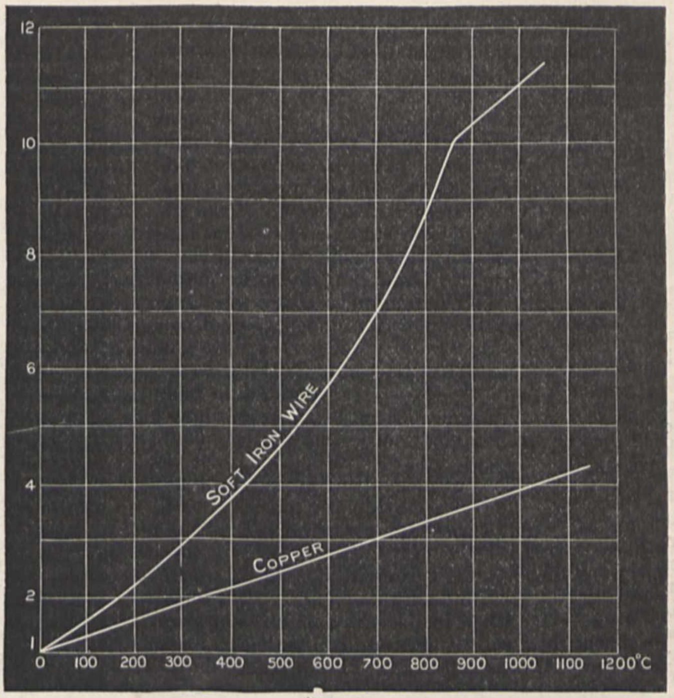


FIG. 12.

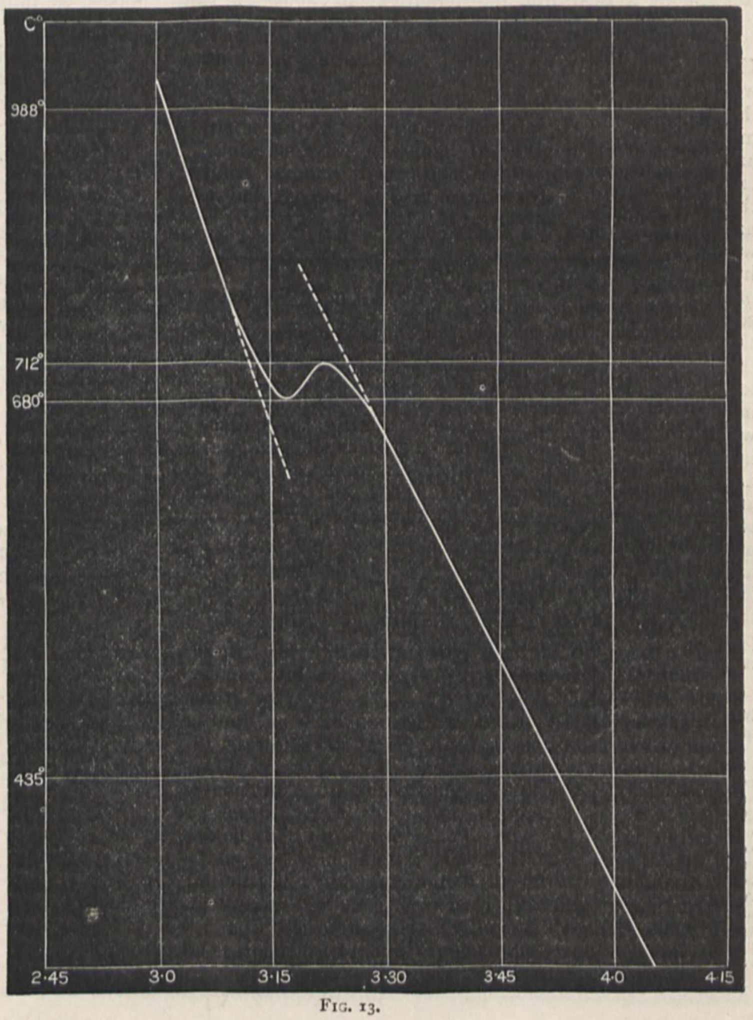


FIG. 13.

magnetism.[1] I am not aware that anything corresponding with recalescence has been observed in the case of nickel Experiments have been tried, and gave a negative result, but the sample was impure; and the result may, I think, be distrusted as an indication of what it would be in the case of pure nickel. The most probable explanation in the case of iron, at all events, appears to be that when iron passes from the magnetic to the non-magnetic state it experiences a change of state of comparable importance with the change from the solid to the liquid state, and that a large quantity of heat is absorbed in the change. There is, then, no need to suppose chemical change; the great physical fact accompanying the absorption of heat is the disappearance of the capacity for magnetization.

What explanations have been offered of the phenomena of magnetism? That the explanation must be molecular was early apparent. Poisson's hypothesis was that each molecule of a magnet contained two magnetic fluids, which were separated from each other under the influence of magnetic force. His theory explained the fact of magnetism induced by proximity to magnets, but beyond this it could not go. It gave no hint that there was a limit to the magnetization of iron—a point of saturation; none of hysteresis; no hint of any connection between the magnetism of iron and any other property of the substance; no hint why magnetism disappears at a high temperature. It does, however, give more than a hint that the permeability of iron could not exceed a limit much less than its actual value, and that it should be constant for the material, and independent of the force applied. Poisson gave his theory a beautiful mathematical development, still useful in magnetism and in electrostatics.

Weber's theory is a very distinct advance on Poisson's. He supposed that each molecule of iron was a magnet with axes arranged at random in the body; that under the influence of magnetizing force the axes of the little magnets were directed to parallelism in a greater degree as the force was greater. Weber's theory thoroughly explains the limiting value of magnetization, since nothing more can be done than to direct all the molecular axes in the same direction. As modified by Maxwell, or with some similar modification, it gives an account of hysteresis, and of the general form of the ascending curve of magnetization. It is also very convenient for stating some of the facts. For example, what we know regarding the effect of temperature may be expressed by saying that the magnetic moment of the molecule diminishes as the temperature rises, hence that the limiting moment of a magnet will also diminish; but that the facility with which the molecules follow the magnetizing force is also increased, hence the great increase of μ for small forces, and its almost instantaneous extinction as the temperature rises. Again, in terms of Weber's theory, we can state that rise of temperature enough to render iron non-magnetic will not clear it of residual magnetism. The axes of the molecules are brought to parallelism by the force which is impressed before and during the time that the magnetic property is disappearing; they remain parallel when the force ceases, though, being now non-magnetic, their effect is nil. When, the temperature falling, they become again magnetic, the effect of the direction of their axes is apparent. But Weber's theory does not touch the root of the matter by connecting the magnetic property with any other property of iron, nor does it give any hint as to why the moment of the molecule disappears so rapidly at a certain temperature.

Ampère's theory may be said to be a development of Weber's: it purports to state in what the magnetism of the molecule consists. Associated with each molecule is a closed electric current in a circuit of no resistance; each such molecule, with its current, constitutes Weber's magnetic molecule, and all that it can do they can do. But the great merit of the theory—and a very great one it is—is that it brings magnetism in as a branch of electricity; it explains why a current makes a magnetizable body magnetic. It also gives, as extended by Weber, an explanation of diamagnetism. It, however, gives no hint of connecting the magnetic proporties of iron with any other property. Another difficulty is this: When iron ceases to be magnetizable, we must assume that the molecular currents cease. These currents represent energy. We should therefore expect that, when iron ceased to be magnetic by rise of temperature, heat would be liberated; the reverse is the fact.

So far as I know, nothing that has ever been proposed even attempts to explain the fundamental anomaly. Why do iron, nickel, and cobalt possess a property which we have found nowhere else in nature? It may be that at lower temperatures other metals would be magnetic, but of this we have at present no indication. It may be that, as has been found to be the case with the permanent gases, we only require a greater degree of cold to extend the rule to cover the exception. For the present, the magnetic properties of iron, nickel, and cobalt stand as exceptional as a breach of that continuity which we are in the habit of regarding as a well proved law of Nature.

[1] I have only recently become acquainted with the admirable work of M. Osmond on recalescence. He has examined a great variety of samples of steel, and determined the temperatures at which they give off an exceptional amount of heat. Some of his results are apparent on my own curves, though I had assumed them to be mere errors of observation. For example, referring to my Royal Society paper, there is, in Fig. 38, a hint of a second small anomalous point a little below the larger one. And, comparing Figs. 38 and 38A, we see that the higher the heating, the lower is the point of recalescence; both features are brought out by M. Osmond The double recalescence observed by M. Osmond in steel with a moderate quantity of carbon I would explain provisionally by supposing this steel to be a mixture of two kinds which have different critical temperatures. Although M. Osmond's method is admirable for determining the temperature of recalescence, and whether it is a single point or multiple, it is not adapted to determine the quantity of heat liberated, as the small sample used is inclosed in a tube of considerable mass, which cools down at the same time as the sample experimented upon.

NOTES ON A RECENT VOLCANIC ISLAND IN THE PACIFIC.

IN 1867, H.M.S. *Falcon* reported a shoal in a position in about 20° 20′ S., and 175° 20′ W., or 30 miles west of Namuka Island of the Friendly or Tonga Group.

In 1877 smoke was reported by H.M.S. *Sappho* to be rising from the sea at this spot.

In 1885 a volcanic island rose from the sea during a submarine eruption on October 14, which was first reported by the *Janet Nichol*, a passing steamer, to be 2 miles long and about 250 feet high.

The U.S.S. *Mohican* passed it in 1886, and from calculation founded on observations in passing, gave its length as $1\frac{4}{10}$ miles, height 165 feet. The crater was on the eastern end, and dense columns of smoke were rising from it.

In 1887 the French man-of-war *Decres* reported its height to be 290 feet.

In the same year an English yacht, the *Sybil*, passed it, and a sketch was made by the owner, H. Tufnell, Esq., which is here produced.

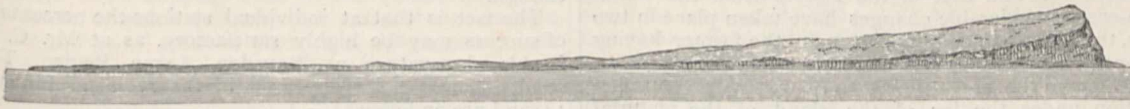
The island has now been thoroughly examined and mapped, and the surrounding sea sounded by H.M. surveying-ship *Egeria*, Commander Oldham.

It is now $1\frac{1}{10}$ mile long, and $\frac{9}{10}$ of a mile wide, of the shape given in the accompanying plan. The southern portion is high, and faced by cliffs on the south, the summit of which is 153 feet above the sea. A long flat stretches to the north from the foot of the hill.

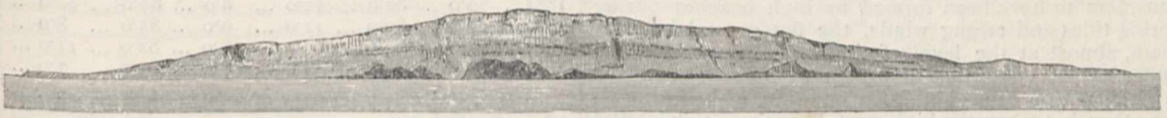
The island is apparently entirely formed of ashes and cinders, with a few blocks and volcanic bombs here and there, especially on the verge of the hill.

Under the action of the waves, raised by the almost constant south-east winds, this loose material is being rapidly removed; continual landslips take place, and Commander Oldham is of opinion that the original

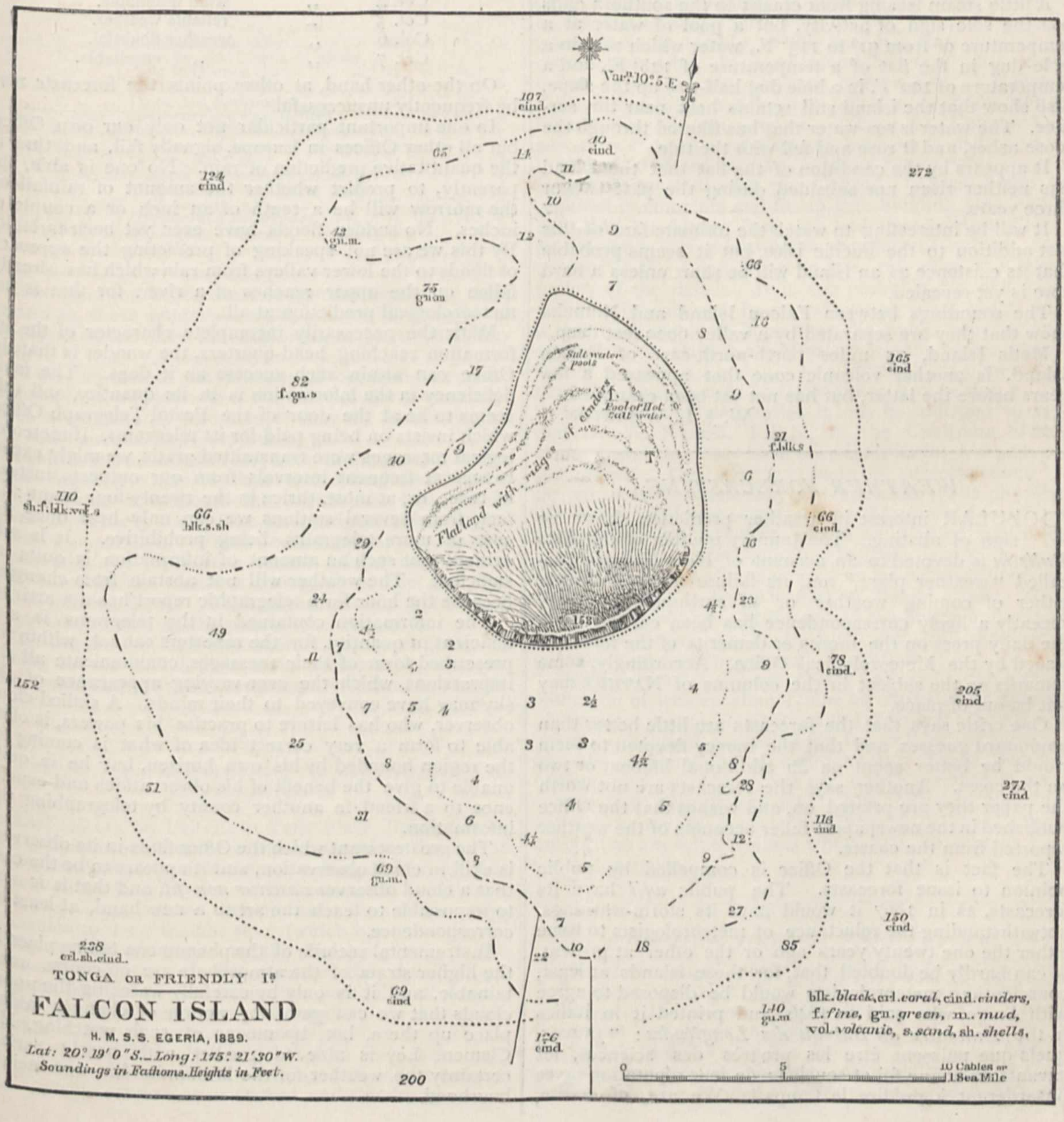
By H. Tufnell, Esq., 1887, bearing S.E. about 2 miles.



By "Egeria," 1889, bearing E. 1½ mile.



By "Egeria," 1889, bearing N.N.W. ½ W. 1 mile.



summit was some 200 or 300 yards southward of the present highest cliff, and that the shallow bank stretching to the south represents the original extension of the island.

As far as can be judged from Mr. Tufnell's sketch from the north-west and that of the *Egeria* from the south-south-east, considerable changes have taken place in two years, the different summits shown in the former having disappeared as the sea has eaten away the cliffs.

The flat to the north seems to be partly due to redistribution under the lee of the island of the material removed from the southern face. It is crossed by curved ridges from 3 to 12 feet high, which Commander Oldham considers to have been formed as high beaches during spring tides and strong winds, the flat ground between them, almost at the level of the water, being deposited under normal conditions of weather.

The island is thus gaining on one side, while losing on the other, but when the high part has gone, this partial recovery will probably cease.

A little steam issuing from cracks in the southern cliffs was the sole sign of activity, but a pool of water at a temperature of from 91° to 113° F., water which rose in a hole dug in the flat of a temperature of 128° F., and a temperature of 100° F. in a hole dug half-way up the slope, also show that the island still retains heat near the surface. The water is sea-water that has filtered through the loose ashes, and it rose and fell with the tide.

It appears by the condition of the flat that the island has neither risen nor subsided during the past two or three years.

It will be interesting to watch the ultimate fate of this last addition to the Pacific isles, but it seems probable that its existence as an island will be short unless a hard core is yet revealed.

The soundings between Falcon Island and Namuka show that they are separated by a valley 6000 feet deep.

Metis Island, 73 miles north-north-east of Falcon Island, is another volcanic cone that appeared a few years before the latter, but has not yet been examined.

W. J. L. WHARTON.

WEATHER FORECASTING.

POPULAR interest in weather prediction shows no sign of abating. The January number of the *Kew Bulletin* is devoted to an account of Herr Nowack's so-called "weather plant," and its failure as an indicator either of coming weather or of earthquakes. Very recently a lively correspondence has been carried on in the daily press on the merits or demerits of the forecasts issued by the Meteorological Office. Accordingly, some remarks on the subject in the columns of NATURE may not be out of place.

One critic says that the forecasts are little better than haphazard guesses, and that the money devoted to them would be better spent on an additional lifeboat or two on the coast. Another says the forecasts are not worth the paper they are printed on, and wishes that the Office published in the newspapers fuller accounts of the weather reported from the coasts.

The fact is that the Office is compelled by public opinion to issue forecasts. The public *will* have its forecasts, as in 1867 it would have its storm-warnings, notwithstanding the reluctance of meteorologists to issue either the one twenty years ago or the other at present. It can hardly be doubted that, for these islands at least, conscientious meteorologists would be disposed to agree with Arago, who said in 1846, and printed it in italics in the *Annuaire du Bureau des Longitudes*: "Jamais, quels que puissent être les progrès des sciences, les savants de bonne foi et soucieux de leur réputation ne se hasarderont à prédire le temps." We are, of course, speaking of forecasts based on telegraphic reports, and emanating from a central office. In every country, without exception, where forecasts for distant counties or provinces are issued from headquarters, the complaints from outlying stations, of occasional failure, are frequent enough.

The fact is that at individual stations the percentage of success may be highly satisfactory, as at Mr. C. E. Peek's observatory at Rousdon, Lyme Regis. The results for this point appeared in the *Times* of January 14, and are as follows:—

	1	2	3	4	5	6	7
1884	58·7	69·0	20·0	11·0	73·4	16·9	9·7
1885	70·0	80·0	12·0	8·0	80·0	12·0	8·0
1886	73·0	80·0	11·0	9·0	85·0	8·0	7·0
1887	75·0	83·0	9·0	8·0	82·0	11·0	7·0
1888	81·0	89·0	5·0	6·0	89·0	7·0	4·0

In this, Col. 1 is percentage of reliable wind and weather.
Col. 2 „ „ wind only.
Col. 3 „ wind doubtful.
Col. 4 „ wind unreliable.
Col. 5 „ reliable weather.
Col. 6 „ weather doubtful.
Col. 7 „ „ unreliable.

On the other hand, at other points the forecasts may be frequently unsuccessful.

In one important particular not only our own Office, but all other Offices in Europe, signally fail, and that is the quantitative prediction of rain. No one is able, apparently, to predict whether the amount of rainfall on the morrow will be a tenth of an inch or a couple of inches. No sudden floods have ever yet been foretold. By this we are not speaking of predicting the approach of floods to the lower valleys from rain which has already fallen on the upper reaches of a river, for that is not meteorological prediction at all.

With the necessarily incomplete character of the information reaching head-quarters, the wonder is that the Office can attain such success as it does. The main deficiency in the information is in its quantity, and this seems to lie at the door of the Postal Telegraph Office, which insists on being paid for its telegrams. If meteorological messages were transmitted gratis, we might expect to hear at frequent intervals from our outposts, instead of twice, or, at most, thrice in the twenty-four hours: in fact, from several stations we can only hear once, the cost of more telegrams being prohibitive. It is self-evident that such an amount of information is quite insufficient. The weather will not abstain from changing because the hour for a telegraphic report has not arrived.

The information contained in the telegrams is also deficient in quantity, for the reporters cannot, within the prescribed form of their messages, communicate all the impressions which the ever-varying appearance of the sky may have conveyed to their minds. A skilled cloud observer, who has leisure to practise his powers, is often able to form a very correct idea of what is coming for the region bounded by his own horizon, but he is quite unable to give the benefit of his observations and experience to a friend in another county by telegraphing the information.

The greatest want which the Office finds in its observers is skill in cloud observation, and it appears to be the case that a cloud observer *nascitur non fit*, and that it is next to impossible to teach the art to a new hand, at least by correspondence.

Instrumental records of the phenomena taking place in the higher strata of the atmosphere are of course unattainable, and it is only by carefully watching the upper clouds that we can gain any notion of changes taking place up there, but, by means of such watching, Mr. Clement Ley is able to predict with nearly perfect certainty the weather for the Midlands—his own neighbourhood.

It must always be remembered that the forecasts are drawn for districts, not for individual stations; and disregarding the amount of correctness claimed by the Office by its own checking of its work, they attain a very creditable amount of success when tested by independent observers. This happens even in the summer-time, the very season at which a recent critic said that the forecasts for one month, if shuffled about, and drawn at random from a bag, would suit just as well for the next! This is proved by the results of the hay harvest forecasts, which are deduced from the reports of the recipients, practical agriculturists.

The following is the table for the season of 1888, the latest for which the figures are available:—

Districts.	Names of stations.	Percentages.			
		Complete success.	Partial success.	Partial failure.	Total failure.
Scotland, N.	Golspie and Munlochy	48	34	17	1
,, E.	North Berwick, Glamis, Aberfeldy, and Rothiemay	43	41	11	5
England, N.E. ...	Chatton and Ulceby	50	27	17	6
,, E.	Thorpe and Rothamsted	48	39	10	3
Midland Counties..	Cirencester and East Retford ...	53	32	9	6
England, S.	Horsham, Maidstone, and Downton	52	40	6	2
Scotland, W.	Dumbarton, Islay, and Stranraer	45	41	8	6
England, N.W. ...	Leyburn and Prescot	57	24	11	8
,, S.W. ...	Bridgend (Glamorgan), Clifton, Glastonbury and Spring Park (Gloucestershire)	46	36	13	5
Ireland, N.	Moynalty and Hollymount	43	38	14	5
,, S.	Moneygall, Kilkenny, Ardfert Abbey	53	31	10	6

Every year the Office hears of farmers expressing their interest in these announcements, and sending daily to the places where they are exhibited, to learn what they contain.

To give an idea of the difficulty of obtaining accurate opinions from outsiders as to the value of storm-warnings, which are a class of forecasts, it may be interesting to give some specimens of reports.

Inquiries were made in 1882, from all the stations where signals are hoisted, as to their correctness and general utility. From Tynemouth the answer was that "these signals have been, and will be, an inestimable boon to our seafaring population." From South Shields, just opposite Tynemouth, the reply to a recent official inquiry was that "the warnings were not a ha'porth of use, and that no one minded them." Each answer merely represented the private opinion of the person who uttered it.

The reader can see that there is some difficulty in picking out the actual truth from such a heap of incongruous statements as the foregoing are certain to furnish.

R. H. S.

THE LABORATORIES OF BEDFORD COLLEGE.

BEDFORD COLLEGE, in York Place, Baker Street, which was one of the earliest institutions devoted to the higher education of women, is taking a leading part in providing facilities for their instruction in science. Founded long before Oxford and Cambridge condescended to the "weaker sex" (which has since proved strong enough to attain to the highest place in the Classical Tripos), it is the result of the work of enthusiasts who would not admit the possibility of defeat. It has had to struggle not only against the inevitable difficulties due to its early foundation, but against the apathy of London. Provincial towns feel that their honour is involved in the success of their institutions. The Colleges for women at Oxford and Cambridge share in the picturesque surroundings of those old homes of learning. They attract attention and interest by their situation amid scenes and traditions of which the whole English-speaking race is proud. Bedford College has had no such advantages. London institutions are regarded as either Imperial or parochial—as too large or too small to interest its citizens as such. Bedford Square compares unfavourably with the "backs," and it is impossible to regard York Place with that gush of emotion which "the High" sets free. Thus it is that, although Bedford College has been at work since 1849, and though one in every four of the whole number of women who have gained degrees of the University of London has been a student in its classes, the work of the College does not yet receive the meed of public appreciation which it has fairly earned. Bedford College is for women what University and King's Colleges are for men. It provides, within easy reach of all Londoners, an education which is tested by the severe standard of the University of London, and bears the hall-mark of success. One-third of its students are aiming at degrees, and their presence in the class-rooms, their work in the examination-hall, guarantees the quality of the teaching they receive to class-mates who do not intend to face the same ordeal. Science has for long been taught in Bedford College, but there has been a pressing need for better laboratories and class-rooms. These the Council has now provided. A new wing has been built, dedicated to the memory of the late Mr. William Shaen, who worked long and devotedly for the College. About £2000 is required to complete and fit up this building free of all debt, and Mr. Henry Tate, who had already given £1000 to the fund, has promised to supplement it by a like amount if the Council on its part can raise the other moiety of the deficit. It is too probable that this sum will only be obtained by an exhausting effort, but surely it is not too much to hope that the public may at last appreciate the importance of promoting the higher education of women in London. In a northern manufacturing town the money would be forthcoming in a week.

As regards the laboratories, it may be sufficient to say that Dr. W. Russell, F.R.S., is the Chairman of the Council, and that they have been built under his general supervision. They appear to be in all respects suited to the purposes for which they are intended. The physical laboratory and lecture-room are on the ground floor. The former has a concrete floor, and is well lighted, partly by windows, partly by a skylight. It looks out upon East Street, and is therefore removed as far as possible from the effects of the heavy traffic in Baker Street. The chemical laboratory is at the top of the house, and opens into a class-room which is fitted with all the usual conveniences for experimental illustration.

It is surely a hopeful sign that a College for the higher education of women should now be regarded as incomplete unless it controls physical and chemical laboratories specially designed and fitted for the delivery of lectures and the performance of experiments. These Bedford College now possesses. We can only hope that it may soon possess them free of debt. The Editor of NATURE will be happy to receive and forward to the College authorities any subscriptions which may be sent to him for that purpose.

STEPHEN JOSEPH PERRY, F.R.S.

ON the evening of January 4 a telegram from Demerara announced that there had been a successful observation of the eclipse of December 22, and that Father Perry had succumbed to dysentery.

Stephen Joseph Perry was born in London on August 26, 1833, and received his early education at Gifford Hall School. Having decided to enter the priesthood, he went to the Catholic Colleges at Douai and Rome. While at Rome, he resolved to enter the Order of Jesuits; and, returning to England, he joined the English province of the Order on November 12, 1853. After two years' noviciate, he went to France for one year. He then returned to Stonyhurst for a course in philosophy. His inclination to mathematics was soon apparent, and his superiors in the Order decided to train him specially for this line of work. In 1858 he occupied the 6th place on the Mathematical Honours list of the London University. After attending lectures by De Morgan, he went to Paris for a year to finish his mathematical studies. On returning to Stonyhurst, he was appointed Professor of Mathematics and Director of the Observatory, succeeding Father Weld, who had for many years occupied the position. During the College year 1862-63, Father Perry taught one of the classes at Stonyhurst. In September 1863 he went to study divinity at St. Bueno's College, North Wales, and in 1866 he was ordained priest. Two years later he returned to Stonyhurst to resume his professorship and the charge of the Observatory. From this time he never left the College save to take part in some scientific expedition.

The work at Stonyhurst Observatory had been chiefly meteorological and magnetic before Father Perry's assumption of the directorship. In 1866 it was selected as one of the first-class meteorological stations. In 1867 the astronomical department of the Observatory was placed in a much more satisfactory position by the acquisition of an equatorial which originally belonged to Mr. Peters, and a small instrument destined for spectroscopic work. The first of these instruments was an 8-inch by Troughton and Simms, the second a 2¾-inch. The first spectroscope was procured in 1870 from Mr. Browning, and was used for preliminary work on star spectra, pending the construction of a larger instrument ordered from Troughton and Simms. In 1874 a large direct-vision spectroscope was ordered from Browning for use in observing the transit of Venus. Two years later a Maclean spectroscope was added, and in 1879 another by Browning containing 6 prisms of 60°; and more recently a Christie half-prism by Hilger.

With these instruments Father Perry has carried out systematic work of the highest class, his aim being to make Stonyhurst as efficient an observatory for solar physics as the means at his disposal would admit. His first communication to the Royal Astronomical Society indicates the policy he pursued—to undertake no work which was a mere duplication of that done at other places. His solar work during the last ten years formed the subject of a lecture at the Royal Institution on May 24. It may be divided into two classes—drawings and spectroscopic observations. For the drawings an image of the sun 10½ inches in diameter was projected on a sheet of drawing-paper affixed to a sketch-board carried by the telescope, and all markings on the sun traced. The drawing finished, the chromosphere and prominences were examined with the spectroscope. About 250 drawings were made every year from 1880. The results of the observations were published annually in a neat little volume, and also in various publications.

In addition to this work, regular observations of Jupiter's satellites, comets, &c., were made, as also spectroscopic observations of comets, stars, &c.

Father Perry's labours were not confined to the Observatory alone, and in fact the extraneous work which he undertook gave the world the best opportunities for studying his high character, and impressed astronomers with a sense of his great devotion to their science. The first occasion on which he left the Observatory for scientific work was in the autumn of 1868, when, accompanied by Father Sidgreaves, he made a magnetic survey of the west of France. In the following year the vacation was spent in a like work for the east of that country. In 1871, assisted by Mr. Carlisle, he made a similar survey of Belgium.

In 1870, Father Perry took part, for the first time, in an eclipse expedition, being stationed near Cadiz, whither he had taken the two spectroscopes acquired by the Observatory in 1870, and two telescopes—a Cassegrain of 9½ inches and a 4-inch achromatic. In 1874 he volunteered for the Transit of Venus expeditions, and was selected by Sir George Airy as chief of the Kerguelen party. Much tact and energy were required for the success of his party, who encountered several obstacles before arriving at the "Island of Desolation," as he termed Kerguelen. The spirit in which these obstacles were met is shown by his words—"We were determined that no consideration should make us flinch where the astronomical interests of the expedition were at stake." That this was no vain boast is proved by the evidence of those who were his colleagues in any excursions by water. His sufferings from sea-sickness were so fearful that everyone wondered that he cared to venture on even the most promising trip; aad that he should have undertaken the terrible voyage to Kerguelen speaks volumes for his enthusiasm for science. "Four days and nights the mighty waves had been washing over the *Volage*." His patience in suffering on this and other occasions helped to win for him the esteem of the officers with whom he came in contact. Not one word of his discomfort is to be found in any of the journals kept by him. In addition to the work of the expedition, he took magnetic observations at the Cape, Kerguelen, Bombay, Aden, Port Said, Malta, Palermo, Rome, Naples, Florence, and Moncalieri, and lectured on the Transit of Venus at the Cape and Bombay, and, on his return, at the Royal Institution.

In 1882 he went to Madagascar for the Transit of Venus. For the eclipse of August 29, 1886, he went to Carriacou, for that of August 19, 1887, to Russia; and last November he sailed for Salut Isles on his final expedition. It is worthy of remark that the Archbishop of Demerara, who had been a pupil of his, went to Barbadoes in 1886 to see his old master; and on the present occasion the body of the master was taken to Demerara.

When at Stonyhurst, Father Perry, in addition to his Observatory work, carried out to the fullest extent his duties as a professor. He was very popular as a lecturer; and at Liverpool, Wigan, and neighbouring towns, he often delighted audiences, some of which numbered more than 3000 people. Father Perry but rarely occupied the pulpit of recent years, but he was much admired as a preacher. His sermons were marked by the earnestness which formed so distinguished a feature of his character.

To those who came in contact with him in connection with his scientific work, he endeared himself by his genial and retiring manner, retiring on all occasions save when some sacrifice was demanded for the science he loved so well, and for which he laid down his life on December 27.

In 1874, Father Perry was elected a Fellow of the Royal Society, and very shortly before his last voyage he was placed on its Council. He was a Fellow and Member of Council of the Royal Astronomical Society, and a Fellow of the Royal Meteorological Society, the Physical Society of London, and the Liverpool Astronomical Society. Of the last-named Society he was President at the time of his death. In 1886 he received the honorary degree of D.Sc. from the Royal University of Ireland, and at various dates he was elected by the Accademia dei Nuovo Lincei, the Société Scientifique de Bruxelles, and the Société Géographique d'Anvers. For several years preceding his death, he served on the Committee of Solar Physics, appointed by the Lords of the Committee of Council on Education, and also on the Committee for Comparing and Reducing Magnetic Observations, appointed by the British Association for the Advancement of Science. In April 1887 he took part in the International Astrophotography Congress held at Paris.

MR. DANIEL ADAMSON.

As a mechanical engineer and a metallurgist, Mr. Daniel Adamson must always maintain a foremost place, for he was in the van in the industrial progress of the century. He was born at Shildon, in the county of Durham, in 1818, and apprenticed to Mr. T. Hackworth, locomotive superintendent of the Stockton and Darlington Railway, with whom he remained from 1835 to 1841. He then held various stations in the same railway until 1850, and in 1851 he began business on his own account as an iron-founder, engineer, and boiler-maker.

From this time forward until quite recently Mr. Adamson has brought out many highly successful inventions in connection with the manufacture of boilers and the application of steam. The first of these was a flange seam for high-pressure boilers, patented by him in 1852, and well known as Adamson's flange seam. In 1856, Mr., now Sir Henry, Bessemer, read a paper before the British Association at Cheltenham describing his steel process, and one of the first to apply it was Mr. Adamson. Having satisfied himself by experimental trials of the quality of steel, he determined to use it for the manufacture of boilers; and Sir Henry Bessemer, when on May 9, 1888, he presented the Bessemer Medal to Mr. Adamson on behalf of the Council of the Iron and Steel Institute, referred with satisfaction to this circumstance, as being the turning-point in his own career, and as having given a start to the use of steel for general engineering purposes. Later on, when open-hearth steel was introduced by the late Sir William Siemens, Mr. Adamson made trial of it for boiler use, and was for years an upholder of the merits of steel. He wrote a comprehensive paper "On the Mechanical and other Properties of Iron and Mild Steel," which was brought before the Paris meeting of the Iron and Steel Institute in 1878, when it gave rise to a most interesting discussion. This paper is looked upon as a standard one on the subject of steel.

Mr. Adamson's inventions appear to have been all intimately connected with his business. In 1858 he applied hydraulic power for the riveting of steel structures, and in 1862 he brought out an invention for building steam boilers, the rivet holes being drilled through the plates when these were in position. He was entirely opposed to the punching of steel plates; he described it as a barbarous mode of treatment, as it tore the fibre of the material; and he would never allow it to be used in his own works. The important feature in all Mr. Adamson's work was its thoroughness; all the material used was subjected to chemical and mechanical tests, so that he obtained a reputation throughout the world for the soundness of everything he turned out.

Mr. Adamson was one of the first to show the superiority of compound engines. This class of engine had already been introduced by Mr. John Elder, of Glasgow, but to Mr. Adamson is greatly due the credit of the employment of triple and quadruple expansion engines. In 1874 he read a paper at Manchester, in which he maintained that pressures of 150 pounds on the square inch could be as safely applied as pressures of 50 pounds by a careful extension of the compound system. As far back as 1861 he patented and brought out a triple-expansion engine, and in 1873 a quadruple engine. In the paper to which we have just referred Mr. Adamson gave expression to the opinion that the consumption of coal per horse-power per hour should not exceed from 1 to 1½ pounds of coal, whilst at that time 2½ pounds per horse-power per hour was considered a very good result.

Besides these inventions, Mr. Adamson took out patents in connection with the manufacture of steel by the Bessemer process, with machinery for compressing steel, and for testing machines, as also improvements in guns and armour.

No account of his work would be complete without a reference to his connection with the Manchester Ship Canal. He was of an enthusiastic temperament, and this was made specially evident in connection with this great undertaking. A Manchester man, and thoroughly convinced of the benefit which would accrue to the surrounding manufacturing towns, Mr. Adamson set to work to effect what others had proposed. It is more than 65 years ago since it was proposed that Manchester should be connected with the sea by a ship canal, but it was Mr. Adamson's invitation to various persons to meet at his house on June 27, 1882, that really started the project. The proceedings then initiated resulted in the incorporation of the Manchester Ship Canal Company in 1885. Mr. Adamson's work in connection with international progress, and his labours to make Manchester an ocean steam port, will not readily be forgotten.

In September and October last he was engaged on an examination of the iron mines of the island of Elba, and he embodied the results in a report to the Italian Government. About two months ago he caught a cold on his Flintshire estate of Wepre Hall. He returned to his home at Didsbury, and died there on Monday, the 13th inst.

Quite recently Mr. Adamson was elected President of the Iron and Steel Institute. He was a member of the Institution of Civil Engineers, of the Institution of Mechanical Engineers, and of the Iron and Steel Institute, and to the proceedings of these Societies he presented many papers containing the results of his inquiries as to the properties and treatment of metals, especially iron and steel.

NOTES.

At a meeting of a Committee appointed by the Council of the Royal Society to set on foot a memorial to the late James Prescott Joule, held on November 30 last, at Burlington House, it was unanimously resolved that a fund should be raised for a memorial of an international character commemorative of the life-work of Joule. This memorial will have for its object the encouragement of research in physical science. It is proposed also that a tablet or bust shall be erected to his memory in London, a Manchester Memorial Committee having already taken steps to ensure a suitable monument in his native city. Joule's discoveries were of such commanding importance that there can be no doubt as to the success of this movement. The Committee feel confident not only that men of science will gladly contribute towards a fund to do honour to Joule's memory, and to assist others to follow in his footsteps, but that those who devote themselves to the practical application of scientific principles will also be anxious to aid in the promotion of a fitting memorial of one whose work has exerted so great an influence on industry.

We regret to announce the death of Gustave-Adolphe Hirn, the eminent physicist. He died at Colmar on January 14, in his seventy-fifth year.

Mr. Rooney, who accompanied the late Father Perry on the solar eclipse expedition to the Salut Isles, has arrived in England, bringing with him the plates successfully exposed during the totality of the eclipse by Father Perry and himself. Mr. Rooney has put himself in communication with the Astronomer Royal, and the plates will be handed over to the Royal Astronomical Society to be developed.

The Forth Bridge was tested by the engineers on Tuesday as a preliminary to the passage of the first train over it on Friday. The following is the official report:—" Sir John Fowler and Mr.

Baker, engineers of the Forth Bridge, have to-day tested the two 1700-feet spans by placing on the centres two trains, each made up of 50 loaded coal waggons and three of the heaviest engines and tenders, the total load thus massed upon the spans being the enormous weight of 1800 tons, which is more than double what the bridge will ever be called upon in practice to sustain. The observed deflections were in exact accordance with the calculations of the engineers, and the bridge exhibited exceptional stiffness in all directions." Every part of the bridge will be in perfect order for the visit of the Prince of Wales on March 4.

AT the meeting of the Convocation of London University, on Tuesday, there was some discussion as to the question of the re-constitution of the University. Dr. F. J. Wood, who presided, said he was not in a position to help Convocation very much. As they were well aware, the Senate had drawn up a scheme which was intended to follow on the lines of the recommendations of the Royal Commission. That scheme had been submitted to the consideration of University College and King's College, and up to now those Colleges had arrived at no decision upon it, but requested a conference. That conference was about to take place, and, of course, until it was held it was impossible for any of them to say what shape the scheme would ultimately assume. Mr. T. Tyler moved a resolution declaring that "The proposal of the University for London Commission that, under a new charter for this University, special powers and privileges should be conferred on certain institutions in or near London is incompatible with the fair and just treatment of the provincial Colleges, and that the acceptance of this proposal would be detrimental alike to the interests of the provincial Colleges and to those of the University itself." This motion was unanimously adopted.

ON Friday, January 24, at 4.30 p.m., Mr. Holland Crompton will begin a course of ten lectures at the Central Institution, Exhibition Road, on the theory of electrolysis and the nature of chemical change in solution. In this course an historical account will be given of the recent development of the Clausius dissociation hypothesis by Arrhenius, Ostwald, and others; of van't Hoff's extension of Avogadro's theorem to dilute solutions; and of the Raoult methods of determining the molecular weights of dissolved substances. On Monday, January 27, at 4.30 p.m., Prof. Armstrong, F.R.S., will begin a special course of ten lectures on methods of analysis as applied to the determination of the structure of carbon compounds. The object of this course will be to explain and experimentally demonstrate the methods adopted in determining the structure of the more important and typical compounds, including alkaloids, carbohydrates, and oils and fats.

THE annual meeting of the Association for the Improvement of Geometrical Teaching was held last Friday morning in one of the theatres of University College, London, under the presidency of Prof. Minchin. While observing with pleasure that the Universities of Oxford and Cambridge had embodied in the printed regulations for various examinations some requests of the Association with regard to elementary geometry, the Council in their report expressed regret that the Euclid papers set for responsions at Oxford still consist exclusively of "book work." The response of the University of Dublin to the Society's petition is that they are not prepared to decide on such important questions without much consideration. At the afternoon meeting papers were read by the Master of St. John's College, Cambridge, on a new treatment of the hyperbole; by Mr. G. Heppel, on the teaching of trigonometry; by Mr. E. M. Langley, on some geometrical theorems; by Prof. Minchin, on statics and geometry; and by Mr. R. Tucker, on isoscelian hexagrams.

FEARS having been expressed as to a possible connection between influenza and cholera epidemics, Dr. Smolenski publishes, in the Russian *Official Messenger*, an elaborate report upon the subject. He points out that the suspicion is not new, and that in 1837 it was discussed by Gluge ("Die Influenza"), and refuted. In fact, influenza or *grippe* epidemics have been known in Europe since 1173—that is, for more than seven hundred years; whilst the first cholera epidemic appeared in Europe in 1823, but did not spread, that time, further than Astrakhan. Six years later it broke out in Orenburg; next year in Caucasia and Astrakhan again, whence it spread over Russia, and, in 1831, reached Western Europe. As a rule, influenza spreads very rapidly, and in 1782, at St. Petersburg, no fewer than 40,000 persons fell ill of it on the same day (January 14). In 1833 its progress was also very rapid, and within a few days it appeared at places so far apart as Moscow, Odessa, Alexandria, and Paris, while cholera epidemics are usually slow in their migrations from one place to another. Moreover, influenza is chiefly a winter epidemic, while cholera prefers the spring and the summer. Dr. Smolenski has further tabulated all influenza and cholera epidemics which have broken out in the course of our century in Europe, and he comes to the following results:—Influenza broke out in 1816, in Iceland; 1827, in Russia and Siberia; 1830–33, in Europe generally; 1836–37, in Europe; 1838, in Iceland; 1841–48 and 1850–51, in Europe; 1853, in the Faroe Islands; 1854–55 and 1857–58, in Europe; 1856, in Iceland and the Faroe Islands; 1862, Holland and Spain; 1863–64, France and Switzerland; 1866, France and Great Britain; 1867, France, Germany, and Belgium; 1868, Turkey; and 1874–75, Western Europe. As to the cholera epidemics during the same period they were: 1823, Astrakhan and Caucasia (from Persia); 1829, Orenburg (from Turkestan); 1830, Russia (from Persia); 1831–37, various parts of Europe; the next epidemic appeared in 1846 in Transcaucasia (coming from Persia); in 1847 it spread over Siberia and Russia, and in 1848 it was in Europe; in 1849–52 it was followed by feeble outbreaks all over Europe. The third cholera epidemic came from Persia again in 1852, and it resulted in a severe outbreak during the years 1853–55 in Europe, followed by feebler outbreaks till 1861. The fourth cholera epidemic came through the Mediterranean ports in 1865, and lasted in Europe till 1868, with feebler epidemics in 1869–74. The latest invasion of cholera was in 1884, when it came again through the Mediterranean ports. As to the cholera epidemic which now begins to die out in Persia and Mesopotamia, it certainly is a danger—the more so as, out of the five epidemics of cholera which have visited Europe, three have come from Persia.

ATTENTION has lately been called to the fact that anchovies are found off Torquay and other south coast fishing centres. Prof. Ewart, of Edinburgh, has written to the *Times* that during the present winter they have made their appearance in the Moray Firth. At the end of December they were abundant off Troup Head, where considerable numbers were captured in the herring nets by the Buckie fishermen. Prof. Ewart thinks that further inquiries may perhaps show that the northward migration of the anchovies is in some way related to the mildness of the winter. He points out that it is most desirable to ascertain whether they have reached the Moray Firth with the warm Atlantic water that during western winds rushes through the Pentland Firth, or by travelling along the east coast through the cold Arctic water that wells up from the bottom in the vicinity of the Dogger Bank.

THE programme of the Royal Horticultural Society for the present year includes a daffodil exhibition and conference, to be held at Chiswick on four days of April; the great show in the Temple Gardens in May; an exhibition of tea roses, by the National Rose Society, in June; in July an exhibition of and conferences upon carnations, ferns, and selaginellas; and in September, at Chiswick, exhibitions of and conferences upon dahlias and grapes. The drill-hall meetings began with one on the subject of winter gardening, introduced by the Rev. W. Wilks; and, after the annual meeting in February, there are to be papers and discussions upon hippeastrums (amaryllis), saladings, spring flower gardening, spring flowering shrubs and trees, herbaceous pæonies, lilies, fruit-drying, hollyhocks, crinums, trees and shrubs for large towns, and Chinese primulas. The accommodation at the drill-hall is not adequate to the wants of the Society, and the Council is considering whether it would not be possible to erect a suitable building on the Thames Embankment.

THE International Horticultural Exhibition to be held in Berlin under Royal and Imperial auspices, from April 25 to May 5, will be characterized by two special features—an exhibition of horticultural architecture, and one of horticultural models, apparatus, &c. It is requested that all exhibits or announcements of such should be promptly sent to the General Secretary of the Society for the Promotion of Horticulture, Prof. Dr. L. Wittmack, Invalidenstrasse 42, Berlin N., from whom all further information may be obtained. The Exhibition will be held in the Royal Agricultural Exhibition building, on the Lehrt Railway. The general organizer of the scientific department is Prof. Dr. Pringsheim; and the following gentlemen have undertaken the management of special branches:—For the geography of plants, Prof. Dr. Ascherson; for physiology, Prof. Dr. Frank; for seeds, Herr P. Hennings; for morphology, anatomy, and the history of development, Prof. Dr. Kny; for fungi, Prof. Dr. Magnus; for soils, Prof. Dr. Orth; for history, literature, and miscellaneous, Dr. Schumann; for officinal and technical objects, Dr. Tschirch. The Minister for Agriculture, Dr. Freiherr v. Lucius-Balhausen, will be the Honorary President of the Exhibition. The city of Berlin has granted the sum of 15,000 marks towards its expenses; and a guarantee fund of 80,000 marks has been raised.

THE Calcutta Herbarium contains a rich collection of Malayan plants, and Dr. King, the superintendent of the Calcutta Royal Botanic Garden, proposes to publish from time to time a systematic account of as many of them as are indigenous to British provinces, or to provinces under British influence. In addition to the States on the mainland of the Malayan penninsula, these provinces include the islands of Singapore and Penang, and the Nicobar and Andaman groups. The classification which Dr. King intends to follow is that of the late Mr. Bentham and Sir Joseph Hooker. The current number of the Journal of the Asiatic Society of Bengal contains the first of this proposed series of papers.

THE January number of the *Kew Bulletin* contains an able and most interesting report, by Dr. Francis Oliver, on the so-called weather plant. This plant is *Abrus precatorius*, Linn., a well-known tropical weed. Mr. Joseph F. Nowack claims to have discovered that its leaves have "the peculiar property of indicating by their position various changes in nature about forty-eight hours before the said changes occur." Numerous observations with hundreds of such plants have convinced him that "any given position of the leaves corresponds always to a certain condition of the weather forty-eight hours afterwards." Some time ago he devised an apparatus for the purpose of putting his supposed discovery to practical use. It consists of a "transparent vessel containing the weather plant, closed on all sides, protected against injurious external influences, and adapted to be internally ventilated and maintained at a temperature of at least 18° Reaumur, these being the conditions under which, in temperate climates, Nowack's weather plant answers the purpose of a weather indicator." Last year Mr. Nowack was anxious that his apparatus should be scientifically tested at Kew, but it would not have been easy for any member of the staff of the Royal Gardens to find time for the necessary observations. The task was undertaken by Dr. Francis Oliver, who now presents the results of his investigation. The following is a summary of the conclusions at which he has arrived:—"I contend that all the movements exhibited by the leaves of *Abrus precatorius* depend on causes not so far to seek as those suggested by Mr. Nowack. The ordinary movements of the leaflets, of rising and falling, are called forth in the main by changes in the intensity of the light. In a humid atmosphere they are more sluggish than in a relatively dry one. In other words, when the conditions are favourable for transpiration the movements are most active. The position for snow and hail is connected intimately, in the cases that have come under my observation, with a spotting or biting (by insects) of the leaflets, and is not due to any other external factor. The position for fog and mist, and for electricity in the air, is probably due to the disturbance caused by varying light, the rhythmical movements of the leaflets being temporarily overthrown. The position indicating thunder and lightning I take to be pathological from its tendency to recur on the same leaves. Daily movements of the rachis constitute a periodic function in this as in many other plants with pinnate leaves. The regularity of these oscillations is considerably influenced by both light and temperature."

ON Tuesday an Archæological Congress began its proceedings at Moscow. The sitting was attended by delegates from German, Austrian, and French Archæological Societies. The section of the Russian Imperial Historical Museum in Moscow allotted to the Moscow Archæological Society was formally opened on January 8, by Prince von Dolgoroukoff, the Governor-General. The collection consists of a variety of antiquities from the Caucasus, stone and glass ornaments, beautiful enamel work from various parts of Russia, ancient holy images, and antique garments and china. A correspondent of the *Times*, who gives an account of the exhibits, calls attention especially to a number of ancient gold ornaments from the Caucasus (described as Merovingian), contributed by the Countess Ouvarova, the President of the Society. He also refers to certain Osetinian copper pins, 18 inches long, found near some human skulls, and supposed to have been used for dressing the hair. A helmet of Assyrian form has attracted much notice.

IN one of the lectures he is delivering at Aberdeen, under the Gifford Bequest, Dr. E. B. Tylor offered a most interesting suggestion the other day as to the meaning of a well-known but puzzling Assyrian sculptured group. This group consists of two four-winged figures, with bodies of men and heads of eagles, standing opposite a tree-like formation, which is easily recognized as a collection of date-palms, or a conventionalized representation of a palm-grove. Each of the two figures carries in the left hand a bucket or basket, in the right a body which each seems to be presenting to the palm-tree. What is this body? It is usually described as a fir-cone, but some have regarded it as a bunch of grapes, others as a pine-apple. Dr. Tylor suggests that it should be connected with the most obvious point of interest for which the date-palm has been famous among naturalists since antiquity—namely, its need of artificial fertilization in order to produce a crop of edible dates. This process in its simplest form consists in shaking the pollen from the inflorescence of the male date-palm over the inflorescence of the female. The practice is mentioned by Theophrastus and Pliny, and in modern times in such works as Shaw's "Travels in Barbary." Dr. Tylor exhibited a drawing of the male palm inflorescence, and said it was hardly necessary to point out the resemblance to the object in the hand of the winged figure of the Assyrian sculpture. As the cultivator of the palm-tree has to ascend the tree in order to perform the process of fertilization, he of course takes with him a supply of fresh flowers in a basket. Dr. Tylor's theory, therefore, is that the objects carried by the winged genii of the Assyrians are the male inflorescence of the date-palm in one hand, the basket with a fresh supply of inflorescence in the other, and that the function the genii are depicted in the sculptures as discharging is that of fertilizing the palm-groves of the country—a function which must have been held to denote their great beneficence, since it showed them fulfilling the great duty of providing the Assyrians with bread.

THE current quarterly statement of the Palestine Exploration Fund contains a brief review of the work done in connection with the Fund during 1889. It is stated that excavations on property belonging to a French gentlemen on the eastern slope of Zion have revealed a number of rock-hewn chambers, which appear to have been used in ancient times partly as dwellings and partly as storehouses. In describing them Herr Schick remarks that nearly all the ground covered by the city of Jerusalem is found on examination to be honeycombed with these rock-hewn chambers. It is not improbable that the Jebusites were to some extent troglodytes. In the Apocryphal Acts of the Apostles mention is made of a cave at Cyprus "where the race of the Jebusites formerly dwelt."

SEVERAL violent shocks of earthquake occurred in Carinthia on January 14, at 9.30 p.m., their direction being from south-east to north-west. In the theatre at Klagenfurt, which was densely packed, the seismic disturbance caused a panic, which was heightened by a false alarm of fire. The audience, however, soon became reassured, and there was no accident to life or limb.

THE Pilot Chart of the North Atlantic Ocean for the month of January states that December was notable for the severe storms that prevailed along the Transatlantic routes. A number of the depressions followed each other in rapid succession; the most notable of these was one on the 16th, in about lat. 51° N., long. 37° W. Gales of hurricane force, with mountainous seas, accompanied this disturbance, as it moved to the north-eastward, to the serious embarrassment of west-bound steamers. Two storms occurred to the eastward of Bermuda during the first week of the month. The first of these disturbances was central on the 4th, in about lat. 36° N., long. 55° W. After 16 hours the wind hauled to south-east and moderated. The south-east wind experienced after the passage of the storm was probably due to the approach of the second cyclone, which was central on the 5th in about lat. 31° N., long. 63° W., and was accompanied by severe hailstorms and heavy seas. Very little fog was reported. A dense fog along the coast of the United States on the 19th, 20th, and 21st, extended some distance inland; navigation in New York harbour was practically suspended on the 20th. Ocean ice was reported in the neighbourhood of lat. 48° N., long. 47° W.

WE referred lately to a new kind of butter which is now being made in Germany from cocoanut milk. The Calcutta Correspondent of the *Times* says that the cocoanuts required for this industry are imported in large numbers from India, chiefly Bombay, and that the trade seems likely to attain still greater importance.

ACCORDING to the *Perseveranza* of Milan, quoted in the current number of the *Board of Trade Journal*, important sponge-banks have lately been discovered close to the island of Lampedusa, on the southern coast of Sicily. These deposits of sponges extend for over a surface of from 15 to 18 marine leagues, and are situated about an equal distance from the south-eastern extremity of the island. The smallest depth above these banks is 20 ells; the greatest depth is from 30 to 31 ells. At the lesser depths rock is met with, on which the sponge grows; at greater depths a sandy soil is found. All varieties of sponge are discovered here, including those which are in the greatest commercial request, and they are easy to obtain. Greek and Italian vessels have already proceeded to Lampedusa to take advantage of this discovery.

AT the meeting of the Linnean Society of New South Wales, on November 27, Mr. K. H. Bennett read a paper on the breeding of the glossy ibis (*Ibis falcinellus*, Linn.). The unprecedented rainfall of the year on the Lower Lachlan induced several species of birds to breed in the district, contrary to the author's experience of previous years. Among these was the glossy ibis, two nests of which with eggs of a beautiful greenish-blue colour somewhat resembling those of *Ardea novæ-hollandiæ*, but much brighter, were found in October and November. At the same meeting Mr. J. H. Maiden communicated preliminary notes, by Dr. T. L. Bancroft, on the pharmacology of some new poisonous plants. Mr. T. P. Lucas read a paper on Queensland Macro-Lepidoptera, with localities and descriptions of new species. Forty-one species belonging to various families were proposed as new, and new localities were given for about ninety-five other species.

THE new number of "The Year Book of Pharmacy" (J. and A. Churchill) has been issued. It comprises abstracts of papers relating to pharmacy, materia medica, and chemistry, contributed by British and foreign journals from July 1, 1888, to June 30, 1889. It presents also the Transactions of the British Pharmaceutical Conference at the twenty-sixth annual meeting, held at Newcastle-on-Tyne, September 1889.

MESSRS. E. AND F. N. SPON have issued a third edition of "A Guide for the Electric Testing of Telegraph Cables," by Colonel V. Hoskiær, of the Royal Danish Engineers. The first edition appeared in 1873. The Congress of Electricians in 1881 made some alterations necessary, and the author explains that he has added a few methods of testing, in the hope of making the book more useful.

THE Society for Promoting Christian Knowledge has issued, in the series entitled "Chief Ancient Philosophies," a third edition of the Rev. I. Gregory Smith's "Aristotelianism," in which an attempt is made to tabulate from the "Ethics" the opinions of Aristotle on questions relating to what has been called "the scientific basis of morality." In the same volume is printed a treatise, by the Rev. W. Grundy, Head Master of Malvern College, on the more important of Aristotle's other works.

SOME interesting properties and reactions of the chlorides of selenium are described by M. Chabrié in the current number of the *Bulletin de la Société Chimique de Paris*. Selenium tetrachloride, $SeCl_4$, was obtained by Berzelius by passing a stream of chlorine over selenium at the ordinary temperature, a quantity of the reddish-brown liquid subchloride, Se_2Cl_2, being first formed, and eventually converted to the pale yellow solid tetrachloride. The tetrachloride was subsequently volatilized by heating and obtained in small white opaque crystals. By heating the crystals obtained by this method in one end of a sealed tube to 190°–200° C., M. Chabrié has obtained a sublimate of much larger and better formed crystals, presenting brilliant faces. With these crystals determinations of the vapour density of the tetrachloride were attempted by Victor Meyer's method at 360° in an atmosphere of nitrogen. The resulting numbers show that two molecules of $SeCl_4$ dissociate at 360° into one molecule of Se_2Cl_2 and three molecules of chlorine. The subchloride, Se_2Cl_2, is a very much more stable body, and may be distilled unchanged at 360°. Determinations of the density of its vapour yield values closely approximating to 7·95, the theoretical density of a molecule of the formula Se_2Cl_2. Among the numerous reactions of these compounds which M. Chabrié has studied, the most interesting are those between selenium tetrachloride and benzene. It is curious that when pure benzene is allowed to react upon pure $SeCl_4$, the latter body undergoes precisely the same decomposition as when heated to 360°, the liberated chlorine reacting with the benzene to form several chlorbenzenes and all the selenium remaining in the form of Se_2Cl_2. If, however, the benzene and selenium tetrachloride are brought together in presence of that most useful of intermediate reagents, aluminium chloride, quite a different series of changes occur. On treating the mixture with water, and separating and distilling the oil obtained, three distinct fractions may be collected The first, which passes over at 131°–133°, consists of monochlor benzene, C_6H_5Cl. The second, distilling at 227°–228° under a pressure of only a few millimetres of mercury, consists of phenyl selenide, $(C_6H_5)_2Se$, corresponding to phenyl sulphide, $(C_6H_5)_2S$, and phenyl oxide, $(C_6H_5)_2O$. It is a yellow oil of sp. gr. 1·45 at 19°·6. The third fraction, boiling between 245° and 250° under the same reduced pressure, consists of another new compound of the composition $Se_2(C_6H_5)_3C_6H_4Cl$. This substance is a red oil of sp gr. 1·55 at 19°·6. On allowing this red oil to stand it deposits yellow crystals of a compound of powerful odour, which may be obtained recrystallized from alcohol in long rhombic prisms. On analysis this substance turns out to be seleno-phenol, C_6H_5SeH, analagous to thiophenol and mercaptan, both of evil odour. Like all the hitherto investigated mercaptans, its alcoholic solution readily reacts with salts of mercury and silver. Analysis of the silver salt leads to the formula C_6H_5SeAg. The reactions by which phenyl selenide and seleno-phenol are respectively produced are believed by M. Chabrié to be as follows:—

$$2C_6H_6 + SeCl_4 = (C_6H_5)_2Se + 2HCl + Cl_2,$$
$$C_6H_6 + SeCl_4 = C_6H_5SeH + 2Cl_2.$$

THE additions to the Zoological Society's Gardens during the past week include a Black-headed Gull (*Larus ridibundus*), British, presented by Mr. E. Hart, F.Z.S.; a Chinese Jay Thrush (*Garrulax chinensis*) from China, presented by Sir Harry B. Lumsden, C.B., K.C.S.I., F.Z.S.; a King Parakeet (*Aprosmictus scapulatus* ♂) from Australia, presented by the Rev. A. J. P. Matthews, F.L.S.; a Peregrine Falcon (*Falco peregrinus*) from Scotland, presented by Mr. Geo. W. Landels; a Vulturine Eagle (*Aquila verreauxi*), a Jackal Buzzard (*Buteo jacal*), a White necked Raven (*Corvultur albicollis*) from South Africa, presented by Mr. Marshall; a Pigmy Cormorant (*Phalacrocorax africanus*), a Moorhen (*Gallinula chloropus*), two Shining Weaver Birds (*Hypochera nitens*), four Black-bellied Weaver Birds (*Euplectes afer* 2 ♂ 2 ♀), two Abyssinian Weaver Birds (*Ploceus abyssinicus* ♂ ♂), four Red-beaked Weaver Birds (*Quelea sanguinirostris* 2 ♂ 2 ♀), four Cutthroat Finches (*Amadina fasciata* 2 ♂ 2 ♀), four Orange-cheeked Waxbills (*Estrelda melpoda*), a Paradise Whydah Bird (*Vidua paradisea* ♂) from West Africa, an Indian Silver-Bill (*Munia malabarica*) from India, two Cardinal Grosbeaks (*Cardinalis virginianus* ♂ ♂) an Indigo Bird (*Cyanospiza cyanea* ♂) from North America, purchased.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on January 23 = 6h 12m. 44s.

Name.	Mag	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 1225	—	—	5 36 5	+9 2
(2) LL. 12169	7	Yellowish-red.	6 15 58	−11 46
(3) θ Canis Maj. ...	5	Yellow.	6 48 38	−11 53
(4) γ Geminorum ...	2	White.	6 31 24	+16 30
(5) 74 Schj.	6	Reddish-yellow.	6 19 12	+14 46
(6) U Cancri ...	Var.	Reddish.	8 29 28	+19 16
(7) R Draconis	Var.	Yellowish-red.	16 32 22	+66 59

Remarks.

(1) The General Catalogue description of this nebula is as follows: "Planetary nebula; pretty bright, very small, very little extended." So far as I know, the spectrum has not yet been recorded, but if it is of the same nature as other planetary nebulæ, bright lines may be expected. The character of the chief line, near λ 500, if visible, should be particularly noted.

(2) Dunér classes this with stars of Group II., but states that the type of spectrum is a little uncertain. He notes, however, that the bands 2, 3, and 7 are visible, so there seems to be no reasonable doubt about the type. The probability is that it is either an early or late star of the group, in which case we should not expect to find all the bands fully developed. The star has been provisionally placed in species 2 of the subdivision of the group, but further observations are at once suggested to determine whether this is right or wrong. If right, the bright flutings of carbon should be fairly prominent, as it is probably due to the masking effects of these flutings that some of the dark bands are absent. The carbon flutings near 517 and 474, seen in the spectrum of a bunsen or spirit-lamp flame, should therefore be particularly looked for. It is possible, too, that in the earlier stars of the group the hydrogen lines may appear bright, as the swarms are only a little more condensed than those constituting stars with bright lines, so that the interspacial radiation may more than balance the absorption.

(3) According to the observations of Konkoly, this is a good example of stars of the solar type. The usual observations, as to whether the star belongs to Group III. or to Group V., are required.

(4) A star of Group IV. (Gothard). The main point to be noted in stars of this class is the relative intensities of the lines of hydrogen and those of iron, magnesium, and sodium, for the purpose of arranging them in a line of temperature. If possible, the criterion lines which indicate increasing or decreasing temperature should also be noted, as in the stars which have hitherto been classed as of the solar type.

(5) This is a star of Group VI., showing the usual carbon flutings and the subsidiary bands 4 and 5 (Dunér). In some stars of the group of smaller magnitude, a greater number of secondary bands have been noted, and it seems possible, therefore, that 74 Schj. may not have been observed under the most favourable conditions. Further confirmatory observations are therefore necessary before conclusions as to the specific differences between the different stars of the group can safely be drawn.

(6) The spectrum of this variable has not yet been recorded. The period is 305·7 days, and the range from 8·2–10·6 at maximum to < 13 at minimum (Gore). The maximum occurs on January 23.

(7) This variable star has a period of 244·5 days, and ranges from 7–8·7 at maximum to < 13 at minimum. The spectrum is of the Group II. type, and the range of variability is such that the appearance of bright lines at maximum may be expected, as in R Leonis, &c., observed by Mr. Espin. The maximum occurs on January 25. A. FOWLER.

THE CLUSTER G.C. 1420 AND THE NEBULA N.G.C. 2237.—Dr. Lewis Swift, in the *Sidereal Messenger* for January 1890, calls attention to a wonderful nebulous ring entirely surrounding this cluster. The ring was discovered by Prof. Barnard last year (*Astr. Nach.*, 2918), and its average outer diameter estimated as not less than 40′, so that in comparison the ring nebula in Lyra is a pygmy. Although Dr. Swift discovered, in 1865, a large diffused nebula north-preceding the star-cluster G.C. 1420, his attention was first directed to the ring structure by Prof. Barnard in January 1889.

The nebula N.G.C. 2237 is in the constellation Monoceros; its position is R.A. 6h. 24m. 48s., Decl. + 5° 8′; hence it will soon be favourably situated for observation, and Dr. Swift hopes that Mr. Isaac Roberts will be induced to photograph it, as a change both in brightness and form is suspected.

ON THE SPECTRUM OF ζ URSÆ MAJORIS.—An examination of seventy photographs of the spectrum of this star, taken on as many different nights at Harvard College, and beginning on March 27, 1887, has led Prof. Pickering to conclude that the K line is double at intervals of 52 days, and that, for several days before and after it is seen to be double in the photographs, it presents a hazy appearance. From the period assigned, it was predicted that the line should be double on December 8, 1889, and January 30, 1890, and the duplicity was confirmed on the former of these dates by each of three photographs. Two more stars have been found having a similar periodicity—β Aurigæ and b Ophiuchi. The hydrogen lines of ζ Ursæ Majoris appear to be broader when the K line is double than when it is single. Several other lines are also seen double when the K line is double. Measures of the plates gave a mean separation of 0·246 millionths of a millimetre for a line whose wave-length is 448·1, when the separation of the K line, whose wave-length is 393·7, was 0·199.

The explanation of this phenomenon proposed by Prof. Pickering is that the brighter component of this star is itself a double star having components nearly equal in brightness, but too close to have been separated as yet visually, and some interesting results have been worked out which appear to support this hypothesis.—*American Journal of Science*, January 1890.

SPECTROSCOPIC OBSERVATIONS OF ALGOL.—A note on the motion of this star in line of sight has previously appeared (NATURE, vol. xli. p. 164). The detailed investigation of the six photographs taken at Potsdam is given by Prof. Vogel in *Astronomische Nachrichten*, No. 2947, from which the following is taken. Motion towards the earth is represented by a minus sign, and a motion of recession by a plus sign; both are expressed in geographical miles per second:—

Potsdam mean time. h.		Distance from minimum. h.		Motion in line of sight.
1888, Dec. 4, 6·6	...	11·4 after.	...	−5·0
1889, Jan. 6, 5·7	...	22·4 before.	...	+6·9
,, 9, 5·5	...	19·4 before.	...	+7·5
Nov. 13, 9·3	...	13·3 after.	...	−5·6
,, 23, 9·0	...	22·3 before.	...	+6·2
,, 26, 8·5	...	19·6 before.	...	+6·8

From these results it will be seen that, before minimum, Algol has an average motion of recession of 6·8 geographical miles per second, but after minimum it approaches the earth with an average velocity of 5·3 geographical miles per second. A reduction of the measures by the method of least squares shows the velocities per second to be—

Before the minimum, +5·3 geographical miles,
After the minimum, −6·2 ,,

which give an average motion of recession or approach = 5·7 miles. The entire system is found to be moving towards the earth with a velocity of 0·5 geographical miles per second.

GEOGRAPHICAL NOTES.

AT a meeting of the South Australian branch of the Royal Geographical Society, on November 1, 1889, Mr. Tietkens gave an account of his recent explorations in Central Australia. His expedition was despatched by the Central Australian Exploring and Prospecting Association, and consisted of a party of five persons, including a black tracker and a native boy. At one point of his journey, when the party came within sight of "an imposing range," Mr. Tietkens hoped to find a watercourse flowing from its slopes to Lake Amadeus. He was disappointed. No watercourse worth mentioning was discovered, nor any spring or place where water could collect. Mr. Tietkens discovered several ranges of hills, to which he gave names. One of the pleasantest places found by him he called Gill's Creek, after the hon. treasurer of the South Australian branch of the Royal Geographical Society. Here a stream flows from a range of hills through a gorge or glen of sandstone formation. "This," he says, "was a most beautiful spot, where a few days could be spent profitably, so the camels were unloaded, and Billy and myself went up the creek to explore its wonders. We found that the creek separated into three distinct channels. Following the principal one, we found the creek to be running through a glen with perpendicular cliffs 80 or 100 feet high on each side, and fully three miles in length. We returned to our charmingly situated camp late in the afternoon. . . . The water will not be found to be always running, but in the glen at the head of the creek, and which I have named after my sister Emily, large deep pools will be found, four or five chains long, 10 and 15 feet deep, and so shaded by rocks from the sun that they cannot be looked upon as otherwise than permanent." After the reading of the paper Mr. G. W. Goyder, Surveyor-General, expressing gratitude to Mr. Tietkens, said that although as an effort to increase the extent of Australian mineral and pastoral resources Mr. Tietken's expedition might have been a comparative failure, yet the route which he had travelled might serve as a most useful base for after-comers. His journey showed that no large large river, as had been hoped, flowed into Lake Amadeus, and only gave another proof that the interior of Australia consists of a series of low mountains with shallow basins, which in wet seasons form lakes and in dry seasons evaporate.

MESSRS. GEORGE PHILIP AND SON have issued an excellent map showing all Stanley's explorations in Africa from 1868 to 1889. Each expedition is distinctly marked in colour, and dated on the map; and a condensed account of the explorer's travels and discoveries is provided by Mr. E. G. Ravenstein.

THE SOURCES OF NITROGEN IN SOILS.[1]

THE number of this half-yearly Journal, issued last April, contains nineteen valuable contributions, covering a considerable portion of the large subject of agriculture. Many of them are of purely practical import, such as the report upon the previous year's prize farm competition, on implements exhibited at the Nottingham meeting, and on the Exhibition of thoroughbred stallions of February last. Among the articles of special scientific interest may be named "The History of a Field newly laid down to Permanent Grass," by Sir J. B. Lawes, F.R.S.; "Grass Experiments at Woburn," by W. Carruthers, F.R.S.; "The Composition of Milk on English Dairy Farms," by Dr. Paul Veith, and the Annual Reports of the scientific staff of the Society. The Journal contains 380 closely-printed pages, is well illustrated, and replete with tables and statistics. Among such a mass of information, all of which possesses important economic value, it is by no means easy to make a selection for special notice. The changes within the soil, in the formation of a meadow by Sir John Lawes, are, however, worthy of close attention at a time when grazing and stock-feeding appears to be the most popular remedy for the agricultural depression under which the country has so long suffered. These observations are also important scientifically, as they throw light upon the interesting question as to the sources of nitrogen in all soils. The gradual improvement of grass land, from the period when it is first laid down until it assumes the character of old pasture, is a well-known agricultural fact. The gradual increase in the amount of nitrogen per acre in the meadow selected by Sir John Lawes throws light upon this practical observation, and is recorded as follows:—"There can be no doubt that there has been a considerable accumulation of nitrogen in the surface soil during the formation of the meadow (1856 to 1888), amounting in fact to an average of nearly 52 pounds per acre per annum over the last twenty-three years. The question arises, Whence has this nitrogen been derived?" This is, as is well known, a controverted point. The balance in favour of this acccumulation of nitrogen within the soil is still large, even after every source of nitrogen in fertilizers employed, foods fed upon the land by live stock, rainfall, and from every other possible source is taken into account. Therefore, Sir John comes to the conclusion that the gain of nitrogen in the surface soil must have had its source either in the subsoil, the atmosphere, or both. There is much experimental evidence pointing to the conclusion that at any rate some deep-rooted leguminous plants derive a considerable quantity of nitrogen from the subsoil. Reasoning upon the question as to how far the whole of the accumulated nitrogen in the surface soil has been derived by deeply-searching roots from the subsoil, Sir John says, "On this point we think it may safely be concluded, from the results of the experiments of Boussingault and of those made at Rothamsted, many years ago, that our agricultural plants do not themselves directly assimilate the free nitrogen of the air by their leaves. But in recent years the question has assumed quite a new aspect. It now is, Whether the free nitrogen of the atmosphere is brought into combination within the soil under the influence of micro-organisms, or other low forms, and so serving indirectly as a source of nitrogen to plants of a higher order? Thus Hellreigel and Wilfarth have found, in experiments with various leguminous plants, that if a

[1] "The Journal of the Royal Agricultural Society of England," April 1889. (John Murray, Albemarle Street.)

soil free of nitrogen have added to it a small quantity of soil-extract containing the organisms, the plants will fix much more nitrogen than was otherwise available to them in the combined form. It further seemed probable that the growth and crop residue of certain plants favoured the development and action of special organisms. It is admittedly not yet understood, either in what way the lower organisms affect the combination, or in what way the higher plants avail themselves of the nitrogen thus brought into combination. . . . Should it be firmly established that such an action does take place in the case of certain plants, though not in that of others, it is obvious that part, at any rate, of the gain of nitrogen by the soil supporting the mixed herbage of grass land may be due to the free nitrogen of the air brought into combination under the influence of the action supposed." This must be regarded as an important concession to the view that nitrogen may be derived for the purposes of plant nutrition from the inexhaustible ocean of the atmosphere, and it will probably not be long before the vexed question of the sources of nitrogen in soils will be placed upon a more satisfactory basis.

JOHN WRIGHTSON.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 5, 1889.—"A New Form of Wedge Photometer." By Edmund J. Spitta.

The author explained that his attention was called to the necessity of devising an arrangement of this nature during a series of experiments upon which he has for some time been engaged to ascertain the cause or causes of the discrepancy previously shown to exist when points of light are photometrically compared with objects of sensible size ("On the Appearances presented by the Satellites of Jupiter during Transit," *Monthly Notices R.A.S.*, vol. 48). This investigation has served to indicate that a portion of the error to which reference has been made arises from the wedge form itself when employed upon a disk of any appreciable area, for it will be remembered that hitherto this instrument has only been employed upon points of light such as is exhibited by the stars. Woodcuts are given to explain how this takes place, but it may be briefly stated, that as the field of view in a single wedge photometer is of necessity variable in intensity of absorption, so the *preceding* limb of a disk is not extinguished at the same part of the wedge, and so not at the same "wedge-reading," as the *following* limb. Hence when comparing two different sized disks it is not difficult to understand that an error in the "wedge-interval," technically so called, must inevitably occur. To meet this difficulty, the error resulting from which will of necessity vary with the size of the area under consideration, the new photometer has been devised.

It essentially consists of two wedges of neutral tinted glass, arranged to pass one another in equal proportions by the turning of a single milled headed screw. A little consideration suffices to show that by this exceedingly simple means, the field of view in the photometer must be absolutely uniform in density throughout its extent, but that its power of absorption can be increased or diminished by the shifting of the wedges in the manner described. Another improvement is submitted by the addition of a wheel of tinted glasses of varying density, which, by revolving in front of the eye-piece, enables the operator to employ the photometer upon objects having a wide range of intensity. The instrument in its complete form, is mounted on the *occulting eye-piece* (*Monthly Notices R.A.S.*, vol. 45) to afford the observer a means of hiding any object or objects not under examination for the time being, which it is needless to point out is a matter of great consideration in all photometric comparisons.

Mathematical Society, January 9.—J. J. Walker, F.R.S., President, in the chair.—The following communications were made:—On the deformation of an elastic shell, by Prof. H. Lamb, F.R.S.—On the relation between the logical theory of classes and the geometrical theory of points, by A. B. Kempe, F.R.S.—On the correlation of two spaces, each of three dimensions, by Dr. Hirst.—On the simultaneous reduction of the ternary quadric and cubic to the forms $Ax^2 + By^2 + Cz^2 + Dw^2$, $ax^3 + by^3 + cz^3 + dw^3$, by the President (Sir J. Cockle, F.R.S., Vice-President, in the chair).

PARIS.

Academy of Sciences, January 13.—M. Hermite in the chair.—On some new fluorescent materials, by M. Lecoq de Boisbaudran. In continuation of his recent communication the author has investigated zircon and $Z\beta$; tin dioxide and samaria; tantalum pentoxide and samaria; tin dioxide and $Z\alpha$; tantalum pentoxide and $Z\alpha$; tin dioxide and $Z\beta$; tantalum pentoxide and $Z\beta$. All these fluorescent substances are fresh examples of the number of spectra obtained from the same active material with different solid solvents. In combination with the agents the solvents must naturally always modify the wave-lengths of the bands as well as their constitution, while still leaving to the various spectra of the agents a family likeness, whereby their common origin may at once be recognized. But if the identity or diversity of two active materials has to be determined *by exact wave-length measurements*, then it becomes essential to operate with absolutely similar solid solvents.—Multiple resonances of M. Hertz's electric undulations, by MM. Edouard Sarasin and Lucien de la Rive. Certain experiments are here described, which tend to throw doubt on Hertz's well-known hypothesis on the undulatory propagation of electric induction. The reading of the paper was followed by some remarks by M. Cornu, who pointed out that it would now be necessary to receive with the greatest reserve the theoretical consequences drawn by M. Hertz from his remarkable researches, more especially as regards the measurement of the velocity with which the induction is propagated in a rectilinear conductor. His experimental method will have to be subjected to much careful study before it can be accepted as a demonstration of the identity of light and electricity.—On the relation between the electric and thermal conductivities of the metals, by M. Alphonse Berget. In a previous paper the author described an easy method for measuring, by means of simple determinations of temperature, the thermal conductivity of the different metals relative to that of mercury, whose absolute value had already been determined. He has now extended these determinations to copper, zinc, iron, tin, lead, and several other metals. The tabulated results show that the order of the conductivities is the same for heat and electricity, but that the relation of the mean coefficients of thermal and electric conductivity is not absolutely constant. Hence the law of their proportionality is only approximately correct, and subject to somewhat the same conditions as Dulong and Petit's law of specific heats.—Heat of formation of platinum tetrachloride, by M. L. Pigeon. A process is described for obtaining this substance in considerable quantities, and the heat of formation of the anhydrous chloride is determined at + 20·5 calories. To complete its thermochemical study M. Pigeon is now endeavouring to determine its heat of solution in water and that of its hydrate.—On the combinations of gaseous phosphoretted hydrogen with boron and silicium fluorides, by M. Besson. The boron compound has the formula $2BF_3.PH_3$, and is decomposed by water with liberation of gaseous phosphoretted hydrogen. The silicon compound was obtained in the form of small and very bright white crystals, their composition corresponding to two volumes of phosphoretted hydrogen gas to three of silicon fluoride or thereabouts. These and some other compounds that remain to be studied render the analogy between phosphoretted hydrogen gas and ammonia still closer.—On the state of equilibrium of a solution of a gas in a liquid, different portions of which are kept at different temperatures, by M. P. Van Berchem. These researches were made with hydrochloric acid and ammonia, their high coefficient of solubility facilitating the detection of slight differences of concentration. The results show that there exists a special state of equilibrium for solutions of gases if the lower part of the solution is cooled, and the upper part heated.—Note on the rotatory power of matezite and matezo-dambose, by M. Aimé Girard. Some numerical errors in the author's former papers on the rotatory power of these bodies (*Comptes rendus*, lxxvii. p. 995) are here rectified, and the author's fresh experiments confirm his previous conclusion that their rotatory power is absolutely identical.—Papers were submitted by M. Emile Picard, on the employment of successive approximations in the study of certain equations with partial derivatives; by MM. Maquenne and Ch. Tanret, on a new inosite ("racemo-inosite"); by M. Edouard Heckel, on the utilization and transformations of some alkaloids present in corn during germination; by M. A. Giard, on the relationship of the annelids and mollusks; by M. Léon Vaillant, on the bichique (*Gobius* and *Sicydium*) fisheries in the island of Réunion; by M. A. Vaissière, on *Prosopistoma variegatum* of Madagascar; and by M. Salomon Reinach, on the volcanic eruptions supposed to have taken place in France during the fifth century A.D.

BERLIN.

Physiological Society, December 27, 1889.—Prof. duBois-Reymond, President, in the chair.—Dr. Augustus Waller, of London, demonstrated the electrical negative variation of the heart which accompanies the pulse. The demonstration was preceded by a short introductory description of the method by which it is possible to detect the negative variation accompanying each beat of the heart both in man and other normal animals. The peculiar position of the heart determines the special position of the equipotential lines for the cardiac muscle, and these then determine the way in which the electrodes must be applied to the outer surface of the body in order to obtain the most marked results. Thus, for instance, when one pole of the capillary-electrometer is applied to the head or right shoulder of a man, while the other pole is connected with his left hand, this arrangement is effective, and the mercurial meniscus in the electrometer can be seen to move synchronously with the pulse. When the poles are applied to the left shoulder and left foot, or left hand and left foot, or right hand and right foot, these arrangements are non-effective. In the horse, dog, and cat, results are obtained by connecting the fore-limbs with the hind-limbs through the electrometer; this is due to the fact that in these animals the heart is placed with its axis from right to left, thus dividing the body symmetrically into a front and hinder half. The demonstrations were made on a man, a horse, and a dog.—Mr. Auschütz exhibited an apparatus ("Schnellseher") for the stroboscopic examination of instantaneous photographs (twelve per second) of moving objects. The reproduction of the movements afforded by the instrument was very perfect.

STOCKHOLM.

Royal Academy of Sciences, January 8.—On our knowledge of the nature of the Antarctic regions, and on the desirableness of researches there as well planned and comprehensive as those which have been conducted by Swedish investigators in the Arctic regions during many years, by Baron Nordenskiöld. If contributions could be obtained from Australia, Baron O. Dickson and Baron Nordenskiöld would fit out a scientific expedition to the Antarctic regions to start from Sweden in 1891.—On remains of birds from the Saltholms Limestone (Upper Cretaceous) at Limhamn, in Scania, by Prof. W. Dames, of Berlin. (The right humerus, scapula, and coracoideum, of probably a wading-bird, being next the Enaliornis of the chalk of Cambridge, in England, the only European find of a Cretaceous bird. It has been named *Scaniornis Lundgreni*, Dam.)—Researches on oiazotiol combinations, by Herr Hector.—On Jurassic woods from Green Harbour, in Spitzbergen, by Prof. Schrenk, of Leipzig.—On the secretions of the digestion in the median intestines, and some phenomena in combination therewith in insects and Myriopoda, by Dr. G. Alderz.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 4.30.—On a Photographic Method for Determining Variability in Stars: Isaac Roberts.—Physical Properties of Nickel Steel: Dr. Hopkinson, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Magnetism: Dr. J. Hopkinson, F.R.S. (Discussion.)

ROYAL INSTITUTION, at 3.—Sculpture in Relation to the Age: Edwin Roscoe Mullins.

FRIDAY, JANUARY 24.

INSTITUTION OF CIVIL ENGINEERS, at 7.30.—The Up-keep of Metalled Roads in Ceylon: Thos. H. Chapman.

ROYAL INSTITUTION, at 9.—The Scientific Work of Joule: Prof. Dewar, F.R.S.

SATURDAY, JANUARY 25.

ROYAL BOTANIC SOCIETY, at 3.45.

ROYAL INSTITUTION, at 3.—The Natural History of the Horse, and of its Extinct and Existing Allies: Prof. Flower, C.B., F.R.S.

SUNDAY, JANUARY 26.

SUNDAY LECTURE SOCIETY, at 4.—John Milton, the Champion of Liberty: Dr. Stanton Coit.

MONDAY, JANUARY 27.

SOCIETY OF ARTS, at 8.—The Electro-magnet; Dr. Silvanus P. Thompson.

TUESDAY, JANUARY 28.

SOCIETY OF ARTS, at 8.—The Relation of the Fine Arts to the Applied Arts: Edward C. Robins.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Anniversary Meeting.—Presidential Address.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Recent Dock Extensions at Liverpool: George Fosbery Lyster. (Discussion.)—Bars at the Mouths of Tidal Estuaries: W. H. Wheeler.

ROYAL INSTITUTION, at 3.—The Post-Darwinian Period: Prof. G. J. Romanes, F.R.S.

WEDNESDAY, JANUARY 29.

SOCIETY OF ARTS, at 8.—The Utilization of Blast-furnace Slag: Gilbert Redgrave.

THURSDAY, JANUARY 30.

ROYAL INSTITUTION, at 3.—Sculpture in Relation to the Age: Edwin Roscoe Mullins.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—Smokeless Explosives: Sir Frederick Abel, C.B., F.R.S.

SATURDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—The Natural History of the Horse, and of its Extinct and Existing Allies: Prof. Flower, C.B., F.R.S.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Atlas of Commercial Geography: J. G. Bartholomew (C. J. Clay).—Electric Light, 3rd edition: J. W. Urquhart (C. Lockwood).—North American Birds, Parts 1 and 2: H. Nehrling (Wesley).—Handbüch der Palæontologie, ii. Abthg., 8 Liefg. (München).—Handbüch der Palæontologie, i. Abthg., iii. Band, 3 Liefg. (München).—Year-book of Photography for 1890 (Piper and Carter).—Livy, Book xxi.: Allcroft and Masom (Clive).—Queensland Meteorological Report for 1887.—Handleiding tot de Kennis der Fl ra van Nederlandisch Indië. Eerste Deel: Dr. J. G. Boerlage (Leiden, Brill).—Die Arten der Gattung Ephedra: Dr. O. Stapf (Wien).—Grasses of the Southern Punjab: W. Coldstream (Thacker).—Prof. Arnold Guyot; J. D. Dana (Washington).—Miscellaneous Papers relating to Anthropology (Washington).—Accounts of the Progress in Anthropology, Zoology, Mineralogy, Chemistry, Physics, Geography and Exploration, Vulcanology and Seismology, North American Geology in 1886 (Washington).—Bibliography of North American Palæontology in 1886 (Washington).—The Advance of Science in the Last Half Century: T. H. Huxley (Washington).—Report of the Smithsonian Exchanges for the Year ending June 30, 1887 (Washington).—Preservation of Museum Specimens from Insects and the Effects of Dampness: W. Hough (Washington).—Ethno-Conchology: R. E. C. Stearns (Washington).—The Human Beast of Burden: O. T. Mason (Washington).—Notes on the Artificial Deformation of Children among Savage and Civilized Peoples: Dr. J. H. Porter (Washington).—Cradles of the American Aborigines: O. T. Mason (Washington).—The Ether Theory of 1839, Part 1: J. Johnstone (Edinburgh, Gemmell).—Third Annual Report on the Puffin Island Biological Station: Dr. W. A. Herdman (Liverpool).—Journal of Anatomy and Physiology, January (Williams and Norgate).—Traité Encyclopédique de Photographie, January 15 (Paris, Gauthier-Villars).—Records of the Geological Survey of India, vol. xxii., Part 4.—Journal of the College of Science, Imperial University, Japan, vol. iii., Part 3 (Tokio).

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