THURSDAY, JULY 5, 1894.

A LABORATORY FOR PHYSICAL AND CHEMICAL RESEARCH.

IT is now about twenty years since the Duke of Devonshire's Commission pointed out that the needs of chemical and physical investigators, upon whose work our national industries so largely depend, were entirely neglected by the Government. Money has been freely lavished that artists may have all they require; biology and archæology have been well equipped, and students of literature have been provided with the finest library in the world; but such is the chaos and disorganisation of our scientific system that many industries are languishing, and some have already left the country because those who are able to foster them by making new discoveries find absolutely no help, and have neither places to work in nor instruments to use, although the sum which the Government has not hesitated to give for one picture would have been more than is needed to correct a condition which is really disastrous from the national point of view.

We rejoice to learn that this state of things, so little to the credit of successive ministries, is now to be partially corrected by the munificence of an individual, Dr. Ludwig Mond, one who, though not an Englishman by birth, has already aided English science by large endowments in other directions.

We learn from a communication which we have received from the Royal Institution, that Mr. Mond last year bought the large freehold house, No. 20 Albemarle Street, contiguous to the Royal Institution, and formerly the residence of the Earl of Albemarle, and has resolved to convey it in fee simple to the Royal Institution. He further proposes to defray the whole expense of converting it from its present uses into a laboratory of chemical and physical research, to be called the Davy-Faraday Research Laboratory, and of equipping it with everything needful for the conducting of scientific research upon a large scale. In addition to this, he proposes to endow the new laboratory first with an income sufficient to defray all local expenses; and, secondly, with a further and of course much larger income, sufficient to pay the salaries and incidental expenses of a trained scientific staff.

Mr. Mond thus realises an idea which engaged the attention of Faraday and Brande and the managers of the Royal Institution half a century ago. In the year 1843 a proposal was made to establish at the Royal Institution a school of practical chemistry, which was not only to give practical and systematic instruction to students, *but was also to provide a place where original researches could be conducted by individuals skilled in manipulation, and where the professors could work out their problems by the aid of many qualified hands.*

In a letter addressed to the managers of the Royal Institution, Mr. Mond writes:—

"I have felt that the need for such a laboratory has become greater and greater since the work of the scientific investigator has become more and more subtle and exact, and, in consequence, requires instruments of precision and a variety of facilities which a private laboratory can only very rarely command; and surely this need exists nowhere to a greater extent than in England, and nowhere can such a laboratory be expected to bear more abundant fruit than in this country, which possesses such an unrivalled record of great scientific researches, which have emanated from private laboratories not connected with teaching institutions, and amongst which the laboratory of the Royal Institution stands foremost, and has kept up its reputation for nearly a hundred years.

"It has been my desire for many years to found a public laboratory which is to give to the devotees of pure science, anxious and willing to follow in the footsteps of the illustrious men who have built up the proud edifice of modern science, the facilities necessary for research in chemistry, and more particularly in that branch of the science called physical chemistry.

"I have come to the same conclusion as the promoters of the scheme of 1843, viz. that such laboratory would still have the greatest prospect of success under the ægis of the Royal Institution, that in fact it would be the consummation of the work which this great Institution has been fostering in its own laboratory, with such remarkable results, by the aid of the eminent men whose services it has always been fortunate enough to procure.

"As only want of space prevented the Royal Institution undertaking this task fifty years ago, I took the opportunity which offered itself last year of acquiring the premises, No. 20 Albemarle Street, adjoining the Institution. This property I found very suitable for the purposes of such a laboratory, and large enough to afford, besides, facilities to the Royal Institution for a much needed enlargement of its present laboratory and its libraries and reception rooms, which I should with great pleasure put at the disposal of the Institution.

"Being convinced that the managers of the Royal Institution will give all the encouragement and aid in their power in the foundation and working of such a research laboratory, I hereby offer to convey to the Royal Institution the freehold of No. 20 Albemarle Street, and also the lease I hold from the Institution of premises contiguous thereto, to be held by them for the purpose of a laboratory, to be named 'The Davy-Faraday Research Laboratory of the Royal Institution,' and also for the purpose of providing increased accommodation for the general purposes of the Royal Institution, as far as the available space will allow, after providing for the requirements of the research laboratory.

"I also offer to make, at my own expense, all structural alterations necessary to fit the premises for these purposes, and to equip the Davy-Faraday Research Laboratory with the necessary apparatus, appliances, &c., and to make such further adequate provision as will hold the Royal Institution free from all expense in connection with the premises and the working of the said laboratory. . . . .

"I am aware that my offer will not provide for the third object of the scheme of 1843, viz. to enable the professors to work out their problems by the aid of many qualified hands; but I trust that if the laboratory which I offer to found proves successful, others will come forward who will supply the means for attaining this end, by the foundation of scholarships and bursaries to qualified persons willing to devote themselves to scientific work and not in a position to do so without assistance."

It is almost impossible to overrate the importance of the results which may be expected to naturally follow this noble endowment. The new Institute will not fill the gap to which we have previously referred, but it will emphasize its existence. It will not fill it because we suppose that when it is in full work it will not hold as many workers as are to be found in some of the research

laboratories which form an integral part of many industrial establishments on the continent.

Further, here at last we have from one who is both a practical man of affairs and a successful student of science, a distinct endowment of research such as was advocated now many years ago to deaf ears.

We believe that Dr. Mond's noble endowment, for which all true lovers of science must thank him, will have far-reaching effects.

THE HISTOLOGICAL INVESTIGATION OF DISEASE.

Methods of Pathological Histology. By C. von Kahlden. Translated and edited by H. Morley Fletcher, M.D. With an introduction by G. Sims Woodhead, M.D. (London: Macmillan, 1894.)

HISTOLOGICAL methods have become so perfected during recent years that we are apt to forget that there was an age of discovery when microtomes, special dyes, celloidin and paraffin were unknown. In the days of Max Schultze, of Schwann and Virchow, tissues were cut free-hand with an ordinary razor; for the purpose of embedding, pieces of carrot and liver were used, and stains were not dreamt of. Solutions of salt, acetic and mineral acids and iodine were the only reagents employed, and gradually carmine came in use. Yet that age turned out its heroes in such men as von Bäer, Remak, Schwann, Max Schultze, Johannes Müller and Virchow, who with tools and media which we are unable to use now, observed appearances and processes which have remained the corner-stones of normal and morbid histology. We are apt to forget their deeds as being antiquated. Gradually stains were introduced, and these led to fresh discoveries. Dr. Klein's work on histology, begun in Stricker's laboratory, is a permanent testimony of what a practised hand can do without our modern microtomes, embedding methods, and multitude of stains. Hæmatoxyline and carmine were the only dyes used. Since then various kinds of microtomes, simple and complicated, have been designed, and every laboratory possesses apparatus for cutting in paraffin, celloidin or ice, and instead of two simple stains, almost numberless reagents are a necessity for the modern worker.

On reading Dr. Morley Fletcher's edition of von Kahlden's book on "Methods of Pathological Histology," we cannot help being struck with the great strides made in histological *technique*. While fully acknowledging the brilliant work of our predecessors, and even regretting that the simpler methods of examination of unstained tissues have practically been forgotten, we feel that every histologist, however modest, should make himself acquainted with the *ars technica* of microtomy. With simple methods it is possible only to study simple processes, and these often with difficulty. The minute structure of the nervous tissues in health or disease, the pathological changes of the blood or of infective lesions, can only be approached, if the necessary staining methods have been fully mastered. Stains are chemical reagents, and their action must be properly appreciated. There exists in our midst a large number of "histologists" who have accustomed themselves to one stain, and whatever comes into their hands is treated in the same manner, and they even acknowledge their inability of recognising tissues or lesions stained in any other way. Carmine specimens often trouble those who have become the slaves of hæmatoxyline. We cannot sympathise with them; their methods are at fault, and they have not appreciated the value and *raison d'être* of staining. Many great and important discoveries have been made by morbid histologists such as Weigert, Ehrlich, and others, by methods which at first sight appear to be empirical, but are based on sound chemical principles, discoveries which have proved as useful to the physiologist and anatomist as to the pathologist. It is von Kahlden's merit to have collected the most important histological methods, previously scattered and hidden away in archives and journals, and thus to have made them more accessible; and we are indebted to Dr. Morley Fletcher for having given us a readable English translation of a work which rightly enjoys great popularity abroad.

The few critical remarks which we shall make apply chiefly to the German original. The methods of embedding in paraffin and celloidin, and of preparing sections by means of freezing, are well described, and if to some the hints given appear incomplete, it should be remembered that as the work is meant to be a guide for the pathologist, some knowledge of histological methods may reasonably be assumed to exist. The Cambridge rocking microtome was deserving of more than a short reference, at least in an English edition, for with us paraffin is much more *en vogue* for delicate work than celloidin. A few notes might have been added stating for what tissues and stains each embedding method should be used, for the inexperienced have generally difficulties in deciding how to proceed with tissues supplied to them for examination. For the staining of bacteria in tissues, for instance, the paraffin method is the only satisfactory one. The "metal lifter" is a piece of rough apparatus we object to, and recommend a strip of cigarette paper as being the most delicate carrier for transferring sections from water or clearing medium to the slide. Under "double staining" no allusion is made to acid fuchsine, a most selective and beautiful stain. We have little to add to the section on bacterial staining, but venture to offer an important suggestion. When examining for bacteria in albuminous or gelatinous media, it is advisable to remove the ground substance by means of acetic acid. From personal experience we do not agree that Gabbet's method is the best for the detection of tubercle bacilli in sputum. Ziehl's and Van Ketel's methods are far more certain. In the latter the bacteria are previously treated with carbolic acid, which destroys them, so that there is no danger of disseminating infective matter, while at the same time the staining power of the micro-organisms is greatly increased. Carbolic acid should be added to all microbic material, so as to avoid all possible risk of infection. Moreover, treated in this manner any material may be kept indefinitely for histological examination.

The chapter on blood examination is excellent, and must prove extremely useful also to the physician. The systematic study of the blood at the bedside is still too much neglected in this country, though in cases of anæmia it is of the utmost importance, and without a

complete knowledge of the same, a certain diagnosis is often impossible. For this reason we should have liked to see a fuller account of the methods of examining blood for the *plasmodium malariæ*, for we feel certain that the inexperienced would not succeed with the meagre instructions given on page 109. The foot-note on page 115 is not clear, if correct. For purposes of simple diagnosis cover-glass preparations of blood should be stained "with a solution of alcohol-soluble eosine ('5 gramme in 100 cc. of 50 per cent. alcohol)," and not "with a 50 per cent. alcoholic solution of eosine," which would overstain everything. The summary of the methods used for the histological examination of the nervous system is perhaps the best part of the book.

So far our remarks apply to the work of von Kahlden. Dr. Morley Fletcher as translator and editor has done his share creditably. The editorial notes on the whole will be found useful, and in future editions we would suggest to raise them from their position at the foot of the page, and incorporate them with the text, at the same time adding others, so as to render the book entirely in keeping with English histological teaching. The idea of a book for the pathologist is so good that it should stimulate the editor to perfect it, all the more as there is no other work in the English language which serves the same purpose. Dr. Sims Woodhead's well-known manual will always remain a favourite book with the ordinary student, but as a compendium of descriptive morbid histology rather than a laboratory guide.

A. A. KANTHACK.

NATAL ASTROLOGY.

A Treatise of Natal Astrology. By G. Wilde and J. Dodson. To which is appended "The Soul and the Stars." By A. G. Trench. (Halifax, Yorks: The Occult Book Company, 1892.)

THREE authors have therefore combined to produce this work; and to accept a brief, either on behalf of, or in opposition to, a work exhibiting so much erudition, is to undertake a heavy responsibility. The peculiarity of your astrologer is that he is so heartily in earnest. He, with a faith that no disaster can overturn or contradiction disturb, believes his results are as certain and as unquestionable as the astronomy on which he relies for his calculations and configurations. He, worthy man, asks to be taken seriously, and society as a rule declines to accept his deductions and explanations otherwise than as literary curiosities. But his day of triumph and reward may be approaching, for in the preface it is distinctly asserted that the production (and presumably the sale) of this kind of literature is on the increase. This is curious, if it be true. What have the promoters of primary education and the machinery of the School Board to say to the assertion that "the literature of astrology is to-day more perused than that of any other natural science"? The authors cannot be angry with anyone for saying that such an assertion is as true as that the positions of the planets and luminaries decide the health of a person (p. 86).

It is only honest to confess our inability to do justice to the aims and ambitions of those who read the future in the skies. We need an exponent on whom the mantle of the late Prof. De Morgan has fallen. Of men who have enjoyed a reputation for sound mathematical knowledge, he is the only one, that occurs to us at the present moment, who has found leisure or inducement to make a serious study of the peculiar tenets of the astrologer. And after an examination, which was no doubt thorough and exhaustive, it is believed that he decided that there was no ground for the conclusions drawn by the students of horoscopes, a decision to the truth of which many will subscribe, who have not the same means and the same knowledge to guide them. But we have been told, and let us hasten to add the fact for the satisfaction of the votaries to this "science," that he did not pronounce this sentence till after three months' study. If three months were necessary to convince a De Morgan of the uselessness of further prosecution of this occult inquiry, it need be no wonder that a much longer period, embracing possibly a whole life-time, is in some cases necessary before a less cultivated and less gifted man can escape from the ensnaring meshes of a fascinating delusion. The authors of this book have not yet issued from the realms of darkness and recognised the inquiry as a curious, it may be an absorbing, but certainly a misleading study. Nor are they likely to gain enlightenment, for their methods of inquiry and examination are imperfect and deceptive. Their process seems to consist in the examination of many cases, and the exhibition of those which favour, or seem to favour, the conclusions drawn from the horoscope. The story of Dryden's sons is served up for our edification, and a tale is told of a gentleman who married at the age of fifty and went to Italy, which it is thought by the authors ought to carry conviction to the unconverted. How many men in a year do marry at fifty and go to Italy for a honeymoon? But averages or coincidences are alike disregarded by the student of horoscopes. "The successes of a science," say they, "establish it, while the failures cannot disprove it. The practice of medicine is recognised because of its successes, and not rejected because of its failures." This is a very curious remark, and apparently an oversight by the authors. What success or what failure can there be for medical science when men's health and condition are regulated by the position of the stars and planets?

But apart from the question of the usefulness or the worth of astrology, about which the authors wax eloquent, and with whom of course it is absolutely useless to argue, they have produced a book not without interest. Astrology is a study which has occupied men's minds for many ages, much time and ingenuity have been devoted to it, and the student of science or of human nature might very well like to know what were the methods by which these men worked, what was the character or the measure of the success that supported them in their labours, and urged them on, in days when planetary ephemerides did not exist and astronomical calculation must have been difficult. Kepler is perfectly frank about his horoscopes—he worked them for his daily bread, and despised himself for doing it; but others certainly looked for success, undaunted by disappointment and failure. "Horoscopes," and "cusps," and "houses," and "malefics," and what not, constitute a jargon that many an one might like to have explained

and to know something about, without pledging himself to the accuracy of the conclusions which the experts draw. In this book he will find the definitions and the grammar of the subject lucidly explained, and if he be at all familiar with the use of planetary tables and understand that much ridiculed but nevertheless valuable science "the use of the globes," he will be able to construct, or rather to erect, a horoscope with certainty, and perhaps edification. Naturally, I have experimented in my own case, but I cannot say that the result has thrown a great deal of light, either on my character, my circumstances, or my future condition, on all points of which I expected information. But I have learnt one caution, that it is not desirable to operate on anyone, in whom we may be interested, indiscriminately, because the result may not be flattering, but is apt to be even disagreeable. A cynic might suggest that since there are more failures than successes in the world, it is necessary to connect a preponderance of gloom and disappointment with planetary configuration. It seems especially that Uranus is responsible for much that could easily be dispensed with, and one cannot help congratulating those who lived before his presence and influence were discovered. But if this is our flippant view, the authors, on the other hand, regret that the older astrologers were without the guidance that a knowledge of the motions of Uranus and Neptune could have afforded, and recognise the possible existence of yet unknown planets, that not only shape our destinies but also disturb the accuracy of astrological prediction. There is, however, no hint that the theoretical determination of horoscopes compared with the observed facts of individual life will in time lead to the assignment of the position of a hypothetical planet, as the perturbations of Uranus revealed Neptune.

Not a small portion of the book is taken up with the description of the horoscopes of distinguished men. How far they support the contention of the authors, and can be quoted as successes in astrological inquiry, must be left to a closer student of them and of history than I can claim to be. Mr. Gladstone, it seems, was so indiscreet as to admit that he was born about breakfast time. That might seem a sufficiently vague indication in these days, but, nevertheless, his horoscope appears in this gallery; but whether his admirers or his opponents will best agree with the estimate of character drawn, is a matter of doubt. We are sure only a few will see that the fact that the tail of Capricorn, said to bring danger from beasts, conjoined with Mars, affords an explanation of the "historic attack upon Mr. Gladstone by a cow." The incident of the ginger-bread-nut is apparently still unexplained.

The book concludes with a reprint from the *University Magazine* of 1880, of Mr. Trent's paper on "The Soul and the Stars." We are told in the introduction that the original grew out of a controversy on the topic of reincarnation, forsooth, and further that it is commended to the reader's indulgence as an honest attempt to elucidate a subject which ninety-nine out of a hundred understand just sufficiently to misunderstand. Having no claims to be the hundredth man, we must leave this honest attempt with a simple reference for the benefit of those who are interested in the subject. W. E. P.

NAVAL ENGINEERING.

Elementary Lessons in Steam Machinery and the Marine Steam Engine. By Staff-Engineer J. Langmaid, R.N., and Engineer H. Gaisford, R.N. (London: Macmillan and Co., 1893.)

THIS work consists of a series of elementary lessons in steam machinery, and a short description of the construction of a battle-ship, intended for the use of junior students, and especially for the naval cadets in H.M.S. *Britannia*. The syllabus of subjects is based on the plan adopted by the Science and Art Department.

The first lesson relates to exact measurements, by the use of standard rules and gauges; the meaning of strain, stress and strength, factor of safety, &c.; the second and third upon the metals used in machinery and ship construction; the fourth and fifth upon rivets and rivetted joints, and various kinds of screws; the sixth, seventh, and eighth upon shafting, shaft-bearings, and toothed gearing; the ninth upon friction; the tenth, eleventh, and twelfth upon stuffing-boxes, packing, pipe-joints, valves, cocks, and pumps; the thirteenth to the eighteenth upon boilers and boiler mountings; and the nineteenth to the twenty-fourth upon the principal component parts of the marine engine, the indicator and indicator diagrams, and screw propellers. The last one contains a short description of the construction of a battle-ship.

These lessons appear well adapted for imparting to junior students a simple course of instruction, as a preliminary to a thorough study of marine engineering, which is the object the authors had in view. They are illustrated by well-executed and instructive sectional drawings of boilers and marine engines, and with sketches of many of the principal details of boiler and engine work. These include a very useful sketch, for a young student, of a section of cylinder, with movable piston and slide valve. There are also two very clear views of the triple-expansion engines fitted to H.M.S. *Sappho* and *Scylla*, which are representative of a large number of engines in the Navy, these ships being two out of a class of twenty-nine that have been recently built under the Naval Defence Act of 1889.

The terms strain and stress might be dealt with more accurately than is done on pages 8 and 9. Strain is defined as change of form due to load, and stress as the force or forces producing the strain. Tensile strain is then described as "a *stress* that tends to stretch the body acted upon"; and we find the various kinds of stress described as follows: Tensile *strain*, compressive *stress*, torsional or twisting *force*, bending *force*, and shearing *force*. The want of exactness in the use of these terms might easily be corrected. We observe that the thicknesses of the shell-plates of large marine boilers are stated to be 1 in. to 1¼ ins. In the largest marine boilers, however, the shell-plating exceeds 1½ ins.

The description of the construction of a battle-ship is very brief and general, but it serves at least to call attention to a very useful "Text-book of Naval Architecture" by Mr. J. J. Welch, formerly instructor at the Royal Naval College. In speaking of the division of a battle-ship into water-tight compartments, it is stated that "the total number of water-tight compartments is considerably over one hundred; several of them might fill without

affecting the safety of the ship, provided they were not so situated as to cause the ends to be submerged, or the ship to capsize." It is surely, however, the object of the naval constructor to obtain such a relation between water-tight subdivision and the stability of a ship, both transverse and longitudinal, as would prevent capsizing, or going down head or stern first, if a few small compartments were filled wherever these might be situated. With regard to bilge keels, also, it is stated that they are generally fitted for about two-thirds of the length of a ship. The usual length is, however, from one-third to one-half.

It might appear hypercritical to call attention to such points as the above when dealing with a work that is so well adapted for the elementary purposes which the authors designed it to serve; especially as these do not affect the principal lessons that deal with those mechanical details and elements of construction that junior students require to be instructed upon. We can recommend the book to the diligent attention of those for whom it has been prepared.

OUR BOOK SHELF.

The Yoruba-speaking Peoples of the Slave Coast of West Africa; their Religion, Manners, Customs, Laws, Language, &c. With an appendix containing a comparison of the Tshi, Ga, Ewe, and Yoruba Languages. By A. B. Ellis. (London: Chapman and Hall, 1894.)

THE late Colonel Ellis, whose death was almost simultaneous with the publication of this book, had devoted long and earnest attention to the study of the West African tribes, amongst which his military duties led him. This volume completes and brings into focus his life-work. Like the previous volumes on the Tshi- and the Ewe-speaking peoples, it is a contribution to anthropology of the very highest order, combining the enthusiasm of a student and the literary power of a cultured scholar with the simple and unobtrusive directness of the soldier. Colonel Ellis touches no controversy, and records, with no more commentary than is necessary to do justice to the narrative, the facts of his own observation. The book begins with an excellent geographical and historical summary of the Yoruba country and people, goes on to consider their deities, priests and superstitions, and the laws and customs which prevail, and concludes with the citation of 250 Yoruba proverbs, many of them worthy mates of those of Solomon, and a series of folk-lore tales, in which we see the origin of many of "Uncle Remus's" best stories.

As the Tshi tribes represented the lowest stage of primitive culture, the Yoruba represent the highest, having fairly emerged from animism into polytheism. The similarities in their mythology to that of the Greeks, and in their customs to those of the early Hebrews, are in many instances remarkably close. In municipal government they show considerable enlightenment, having a female functionary, the "Mistress of the Streets," to deal with all disputes between women, only those which she is unable to settle being passed on to the *Bale* or civil governor. They are observant of the phenomena of nature, calling Sirius the canoe star, as it is believed to be a guide to canoe-men. The Milky Way is called "the group of chickens," the clearer stars being the hens; while Venus, according to the position in which it appears, is known as the morning or evening star, or when near the moon as "the moon's dog." The Yoruba calendar is based on the lunar month, and it is interesting to note that while the Tshi- and Ga-speaking people divide this period into four weeks of seven days with some odd hours, the Yorubas count six weeks of five days minus a few hours. All the tribes commence the reckoning of the day with the evening, the first day of each month being reckoned from the appearance of the new moon. The first day of each group of five is held as a day of rest, and looked upon as generally unlucky; but the follower of each of the recognised gods must observe another day of rest also, on which those not worshipping the same deity are at liberty to work.

The appendix to the book is an elaborate philological treatise in the form of a comparison of the grammar and vocabularies of all those West African languages which Colonel Ellis had minutely studied.

A Handbook to the Study of Natural History, for the use of Beginners. By various authors. (London: George Philip and Son, 1894.)

STUDENTS of science are usually inspired with the desire to create in others an enthusiasm for the pursuit of natural knowledge. This fact probably explains why so many books of mediocre quality are foisted upon the public. Lady Isabel Margesson, who has edited the book under review, had the laudable ambition of "putting before the Beginner a clue to the many paths of the somewhat bewildering labyrinth called Natural Science." To carry out her idea, she procured persons to write short descriptions which could be used as finger-posts pointing the way to the acquisition of knowledge concerning all manner of living things, of minerals, &c., and, to the whole, Sir Mountstuart Grant Duff has contributed an introduction, in which he expatiates upon the book's inception and the qualifications of the authors of the various parts. Lady Isabel's plan may appear excellent in the abstract, but its realisation is not deserving of much praise. We venture to say that there is scarcely a section in the book exactly meeting the requirements of beginners. Scientific names are frequently given without any explanation, and the beginner is led into the maze of botanical nomenclature before he is told how to disguish the parts of plants. One or two of the authors have confined themselves to describing the spirit in which their branches of natural science should be wooed in order to be won; others give descriptive lists of books suitable for sequential reading; while a third section devote their space to methods of work. When fourteen writers assist in making a book, inequality may be confidently expected. Thus it is that Lady Isabel's idea has not crystallised into a very symmetrical form.

Surveying and Surveying Instruments. (The Specialists Series). By G. A. T. Middleton. (London: Whittaker and Co., 1894).

THE contents of this book have already appeared in a series of articles in the *Building News*, but there is no doubt that in book form they will be found more serviceable to readers in general. The articles in question deal in a practical way with the methods of procedure adopted in surveying, and with the descriptions of the different instruments employed. The first chapter treats of surveys with chains only; here the author gives some very sound advice, and concludes it with a description of a worked-out survey, showing also the method of entering measurements in the field-book. In case of obstructions such as rivers, sheets of water, bog land, &c., modifications in the chain line methods have to be adopted, and these are discussed in chapter ii.; the reader is also brought in contact with right-angle instruments, such as the now comparatively little used cross-staff, the optical square, and Weldon's right-angle prism. Next is described the uses of that very important instrument the level, and the different methods of "levelling" are each dealt with. The numerous worked-out "levellings" with figures, should bring the subject home to the

reader. The numerous forms of levels require the author to devote chapter iv. to a discussion of their qualities and of their different means of adjustment. This latter point is of the greatest importance to the surveyor, for on this depends to a great extent the accuracy and rapidity with which observations may be made. The chief levels discussed are the so-called "dumpy" and "Y" types, but other hand-levels are referred to, such as Stanley's builder's level, Watson's clinometer level, and Stanley's Abney and Stanley's improved Abney level. Short reference is made to the barometer as a measurer of differences of level.

Chapter v. is devoted to the uses of angle-measuring instruments, such as are employed in the determination of either the main points upon an extensive survey or of inaccessible points. By means of extracts from the field-book and illustrative diagrams, the method of procedure is carefully explained, and many practical hints are in addition interpolated. The following two and last chapters contain detailed accounts of the theodolite, other angle-measuring instruments, and instruments for ascertaining distances; among the last-mentioned being Stanley's tacheometric theodolite, Steward's omni-telemeter, and the Labbez Telemeter.

As a handbook for those employed in the practical work of surveying, the volume should be of great use; its value is greatly enhanced by the very excellent drawings of the numerous instruments which are inserted in the text.

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.*]

The Photography of the Splash of a Drop.

PROF. WORTHINGTON tells me that in his lecture on the splash of a drop, at the Royal Institution, on May 18, he was not able, through want of time, to explain how the photographs were taken, and has suggested to me that a short account of this, which was our joint work, may be of interest.

In our first attempts we employed the spark used by Prof. Worthington many years ago for viewing and making drawings of the phenomenon (*see Proc. Roy. Soc.* No. 222, 1882). This spark was produced by breaking at the surface of mercury a current of high self-induction; but we found that when this was made powerful enough for photographic purposes, it became of too great duration (from 4 to 6 thousandths of a second), so that the drop had time to move appreciably while under illumination. We therefore had recourse to the Leyden jar spark as employed by Lord Rayleigh (NATURE, vol. xliv. p. 249). This is so exceedingly convenient a method of producing a suitably timed spark *at any place* without the necessity of insulating the leading wires, that, for the sake of making it more generally known, I venture to repeat with a simplified diagram the description of the arrangement, though really identical with Lord Rayleigh's.

Prof. Worthington's timing sphere had been of ivory; it was only necessary to substitute a brass ball, and the original timing apparatus was suited to the new conditions. (Fig. 1.)

[1] A is a Wimshurst machine, whose + and − terminals are connected to the inner coats of two large Leyden jars, B and C, the capacity of each being roughly equivalent to that of a glass plate condenser, the area of each surface being 4380 square cm, and the thickness 2 mm. These inner coatings were also connected by insulated wires to two insulated knobs, D and E, between which the timing sphere, F, falls. The jars stand on the same imperfectly-conducting table, and from their outer coatings are led stout uninsulated wires through the partition wall of the dark room, where they terminate in a spark gap, H, between two stout magnesium wires. Here the spark is produced which illuminates the drop. K is a rough electrometer, consisting of a brass sphere, L, carried on a pivoted wire, on which slides a suitable counterpoise; L is connected with the inner coating of one jar, and is attracted towards the oppositely charged sphere, M, connected with the inner coating of the other jar. When the spheres D and E are sufficiently charged for the timing sphere to cause a discharge when it falls between them, L is lifted by the attraction of M and strikes a glass plate which separates them; this is the signal for letting off the drop and timing sphere F. The timing sphere F has been held on a ring carried by a horizontal wooden rod or lever about six inches long, and pivoted about a horizontal axis.

A smart upward fillip throws up the other end of this lever, and leaves the sphere in mid-air free to fall, and simultaneously breaks contact with crossed platinum wires beneath the lever, and breaks the current of the electromagnet, N, in the dark room, thus allowing an india-rubber catapult to toss up, in precisely the same way, one end of a similar lever, whose other end carries a smoked watch-glass, O, on which the drop has been lying without adhesion. Thus drop and sphere are liberated simultaneously,

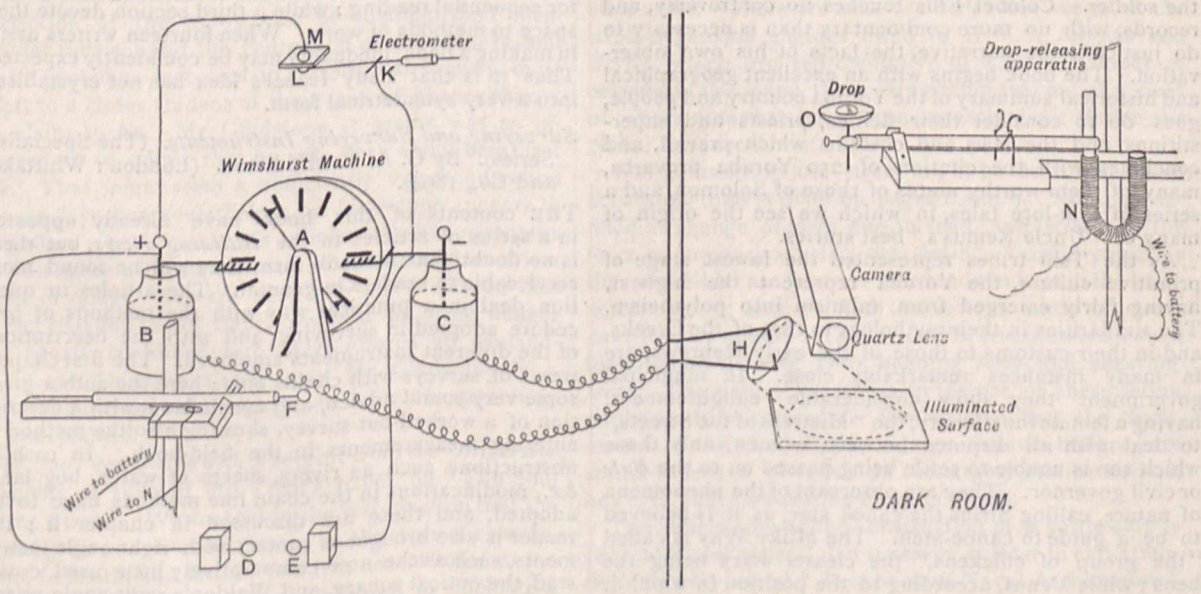

FIG. 1.—Apparatus for photographing a splash.

[1] The arrangement of jars was, I believe, first used by Dr. Lodge.

or if not so, with a very short and practically constant interval between them.

The discharge of the inner coatings of the jars by the timing sphere reaching the gap between them is accompanied by a simultaneous discharge of the outer coatings across the spark-gap in the dark room, and it is this that illuminates the splash, the stage of the splash that is illuminated depending on the height of fall of timing sphere, which can be adjusted at pleasure.

The duration of this discharge, if we may argue from Prof. Boys' experiments, probably did not exceed one-hundredth-thousandth of a second.

Great difficulty was at first experienced in getting enough illumination, and finally the spark-gap was placed in the focus

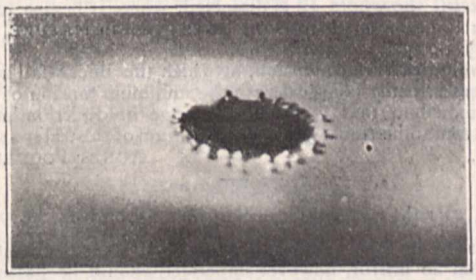

FIG. 2.—Splash of mercury on xylonite.

of a small silvered watch-glass, which enclosed an angle of nearly 180°, and this was placed to illuminate the splash from one side, at an inclination of about 30° to the horizontal at a distance of 6 or 7 cm.; it is to this that most of the detail obtained was due.

The camera was inclined at an angle of about 30° to the horizontal, looking downwards, and was fitted with a single pebble spectacle lens to avoid the loss of the ultra-violet rays which occurs with glass; as the lens was far from achromatic, the proper adjustment of the distances of object and plate had to be found by preliminary experiments. The most rapid plates obtainable (not isochromatic) were used, and were developed for thirty or

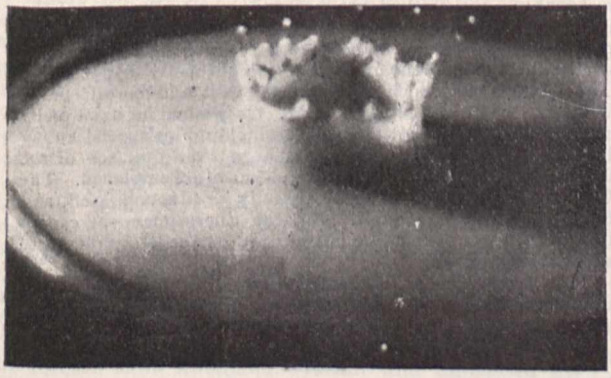

FIG. 3.—Splash of a drop of water into milk, early stage.

forty minutes with eikonogen, the developer being made as strong as possible in eikonogen. To avoid all chance of fogging, the operations were performed in the dark.

The mercury splashes with which we began turned out to be the most difficult to photograph, owing to the halation produced by the very bright reflection at some points, and the comparative darkness of the remainder (Fig. 2) We had to try various surfaces for the drop to fall on to find out how to obtain the best contrast; we finally adopted a piece of polished white xylonite.

Of many liquids tried, the easiest to photograph was milk, and with this there was plenty of detail (Fig. 3 and 4).

These photographs are, as far as we know, the first really detailed objective "views," as opposed to shadows, that have been taken with such a very short illumination.

Besides these we also took a number of shadow photographs, in much the same way as that in which Prof. Boys photographed a rifle bullet, by letting a drop of mercury fall on *the clean side* of the sensitive plate itself, and producing a spark between two

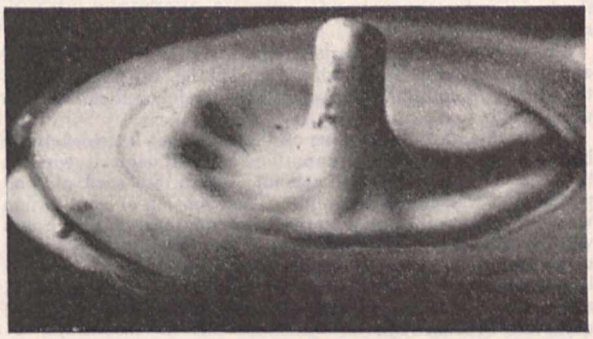

FIG. 4.—Splash of a drop of water into milk, late stage.

magnesium knobs vertically above the splash. No difficulty was found in this case in getting enough exposure.

It will be observed that the method requires that different stages should be photographed from different splashes. We hope, however, to succeed in the more difficult task of photographing many stages of the same individual splash.

R. S. COLE.

On the Spreading of Oil upon Water.

IN a paper entitled "Die Lehre von der Wellenberuhigung," by M. M. Richter (see NATURE, vol. xlix. p. 488), the opinion is expressed that the tendency of oil to spread itself on water is only due to the free oleic acid contained in it, and that if it were possible to completely purify the oil from oleic acid, it would not spread at all.

This I found to be actually the case with olive oil, and though I agree by no means with the theoretical views of the author, I will mention the fact, for I may suppose it to be not yet generally known.

The Provence oil used in my experiment was shaken up twice with pure alcohol, and the rest of the latter being carefully removed, a drop of the oil was placed upon the freshly formed water-surface in a small dish by means of a brass wire previously cleaned by ignition. The oil did not really spread, but after a momentary centrifugal movement, during which several small drops were separated from it, it contracted itself in the middle of the surface, and a second drop deposited on the same vessel remained absolutely motionless.

Of course the surrounding water-surface proved to be in the anomalous state, the tension determined by the method of separating weights being $=0{\cdot}82$ of the normal value. It has been diminished by the "solution-current" of the oil (as I have called the contaminating current, issuing from a body in contact with a clean water-surface), which may be observed if the surface be dusted over with sulphur or lycopodium before placing the oil upon it. The observation of the solution-current, preceding unpurified oil, is more difficult, because the oil itself covers rapidly the whole surface.

As soon as the relative tension 0·82 is attained, the slightest trace of a solution current ceases, whilst ordinary oil still shows solution-currents at much lower tensions. The surface-tension 0·82 is the lowest possible that can be produced on water by pure Provence oil; the surface then may be considered as saturated with oil.

This can be seen most clearly if the drop be deposited upon the adjustable trough filled with water, which was employed in my former experiments (NATURE, March 12, 1891, p. 437). The tension then remains constant on either expansion or contraction of the surface; on considerable contraction, however, one can perceive a slight precipitate of oil, which gives to the surface a turbid appearance.

Evidently the pure oil does not spread over a surface of the minimum tension attainable by its contact with water, because the sum of its surface-tension and the interfacial tension of oil and water, which we may call "tension of equilibrium," is greater than the minimum tension. Therefore upon a clean water surface the oil is repulsed by its own solution current.

On the other hand, a drop of common Provence oil placed upon the saturated surface spreads, while the surrounding surface diminishes its area and grows turbid. From this we see that the tension of equilibrium of the oil containing free sebacic acid is lower than its saturation tension, and this is also the reason why it is not prevented from spreading by its own solution-current.

I have repeated these experiments with various kinds of oil, and in each case found that by shaking up with alcohol the tension of equilibrium rose, and the tendency to spread was diminished.

In the case of ordinary olive oil there was but little difference between the purified and unpurified oil, although it was six times shaken up with fresh alcohol. With rape-seed oil and poppy oil I was more successful. Their tension of equilibrium was still somewhat inferior to the minimum tension, which was with rape-seed oil 0·85, and with poppy oil 0·82, but the spreading on a saturated surface was very slow, and upon a large clean surface the oils covered but a comparatively small area. The best success I had with almond oil, which behaved quite like Provence oil.

On the other hand, the tendency to spread, not only of pure oil, but also of benzol and petroleum, increased when oleic, palmitic, or stearic acid was dissolved in them.

Pure benzol can rest on water but in a rather thick layer. When the thickness is diminished to a certain degree, the layer breaks into drops, for which the following explanation seems to me most probable. The water-surface surrounding benzol, as in the case of oil, never is in the normal condition, the tension being diminished by the vapour streaming over the water. This vapour current ceases at the tension 0·88, which, as it appears, is somewhat lower than the equilibrium tension of benzol. Therefore a thin layer of benzol is broken by the vapour current.

When a floating fluid layer is not very thin, the tension of the surrounding anomalous water-surface, just balanced by it, is no longer equal to the sum of interfacial and surface tension. In the case of benzol it assumes a lower value than the minimum tension of the vapour-current, and therefore a sufficiently thick layer is allowed to spread coherently.

Benzol which is contaminated, for instance, by stearic acid or resin, behaves quite differently. The tension of equilibrium being lowered by those substances, it spreads so far as to show colours of thin plates.

Pure petroleum seems to be the only liquid which does not spread upon a normal surface. The vapour-current going out from petroleum ceases already at a relative contamination < 1, and therefore cannot produce a sensible decrease of tension. Nevertheless it may possibly prevent the floating drop from spreading. When sebacic acid is dissolved in petroleum, the latter shows a much greater tendency to spread.

In order to examine whether the effect of sebacic acids upon the tension of equilibrium be due to a decrease of the cohesion of the solvent, I have compared the surface-tensions of pure and contaminated benzol or petroleum, and those of the purified and unpurified oils. In no case have I found the surface-tension to be diminished by the sebacic acid, hence I came to the conclusion, that it is the interfacial tension which is altered.

Now let us consider the behaviour of common oil. It spreads in a coherent film to a certain thickness, which is different with various sorts of oil. Then small holes appear in the interior of the film, whilst the circumference of the latter is still increasing, and by the gradual increase in size of the holes the layer at last is broken and dissolved in small drops.

Why does the oil thus withdraw from the surface while its circumference is still increasing? The reason is, no doubt, that the oil spreads at the minimum tension of pure oil, but not at that of the free sebacic acid contained in it. The solution-current of the latter drives it back from the surface. Outside the oil-film spreading upon a large water-surface the tension of the latter does not sink below the minimum tension of the pure oil; in the interior of the holes, however, a newly-formed surface would be instantaneously saturated with oil, and here the tension, therefore, can be further diminished by the sebacic acid.

The minimum tension of oleic acid, at which the latter also does not spread, is in relative measure 0·52, and that of palmitic acid about 0·55.

The depression of surface-tension which can be attained by unpurified oil is not so great, but much greater than that produced by pure oil, and depends upon the quantity of oil applied.

If the quantity be such as to cover the whole surface before breaking, the surface afterwards is not contaminated with oil at all, but only with sebacic acid; and the tension is still sinking slowly by the effect of the continued solution-currents of the single drops.

When less oil is employed, the free sebacic acid contained in it is often not sufficient to produce the lowest possible tension. Then one may observe that freshly added drops of oil still give solution-currents, whilst those of the older drops have already ceased.

When a water-surface, on which minute drops of oil which have not yet dissolved are present, is expanded, the tension rises to the minimum value for pure oil, and then remains constant till the whole oil is dissolved, where it begins to rise again in the same manner as the curve given in NATURE, June 15, 1893, p. 152.

The value of surface-tension, at which the linear fall of the curve ceases, being identical with the minimum tension of pure oil, it is evident that the sudden change of direction at the relative contamination 1·3 means saturation of the water-surface with oil.

AGNES POCKELS.

Prof. Ostwald on English Chemists.

"To see ourselves as others see us" is so difficult of attainment, that no mirror, however imperfect, should be passed by without a glance bestowed upon it. The image of us which Prof. Ostwald displayed to the electricians assembled in conclave at the second anniversary meeting of the German electricians on June 7, is the less pleasant by reason of the consciousness that the reflector is a good one. The opening words of the Professor's address were virtually as follows:—

"It is a positive fact that every year there are imported into Germany from England so many thousand centners of benzene, amounting to nearly the whole of the production of this material in the latter country. Now benzene is an intermediate product, destined to be converted into dye-stuffs, medicaments, and other commodities, so that we have the remarkable situation that the country of all the world, in which industry has flourished longest, relegates the most important and profitable part of one of her manufactures to a foreign country. The reason is of the plainest: England *cannot* undertake the conversion of its raw material into the finished product, and why? Because of the insufficient training of the English chemist. The would-be practical Englishman with the intention of entering a dye-factory, studies, not general chemistry, but the chemistry of dye-stuffs. The German studies chemistry, lock, stock and barrel, never wrecking what his calling is to be. Only when he has a really scientific foundation will he begin to build up his special knowledge. By and by there comes a change over the face of the industry in which these competing chemists are employed. The German—he is ready; without difficulty he adapts himself, and follows up the novel course. But the Englishman—he cannot imagine at what position he has arrived; he must begin, so to say, over again."

Thus spoke one of Germany's—nay, the world's—greatest thinkers. Let our manufacturers, who despise the college-bred youth, meditate thereupon.

A. G. BLOXAM.

Goldsmiths' Institute.

"Testacella Haliotidea."

TATE, in his "Molluscs of Great Britain," gives a list of counties in which this mollusc may be found. In this list Worcester is not included. Hence it may be of interest to note that specimens are not infrequently collected in asparagus-beds here, as also are those of the much rarer *T. scutulum*. A good specimen of the latter was recently given by me to Mason College, Birmingham.

Nematus grossularia.—Here the gooseberry plantations are often devastated by the larvæ of this saw-fly, in the extirpation of which pest the insectivorous value of the cuckoo to planters may be appreciated through the following incident. Recently the attention of a resident of Crowle, a village near Worcester, was directed to his gooseberry plantation, close by a window of his house. A cuckoo was in one of the grub-infested bushes, fluttering its wings, and so causing numbers of the pests to fall on the ground, whence they were quickly gathered by the bird.

Daily the bird visited the garden till the bushes were cleared, and so the crop was saved. In Crowle this year these birds are numerous. I have a garden in a place in North Wales where this year there are few of these birds. The grub stripped the bushes of leaves, and the fruit died.

Worcester, June 23. J. LLOYD-BOZWARD.

On the Diselectrification of Metals and other Bodies by Light.

REFERRING to a footnote on page 135 of NATURE, June 7, Messrs. Elster and Geitel have been good enough to call my attention to a great deal of work done by them in the same direction and published in recent numbers of Wiedemann's *Annalen*. The most important statement about it is that they had observed the photoelectric power of fluorescent minerals and the electrical activity of sunlight, and had worked for some time at the influence of these facts on atmospheric electrification; the idea that atmospheric electricity was thus caused (by the discharging action of sunlight) having been already mooted apparently by von Bezold and Arrhenius.

OLIVER J. LODGE.

Absence of Butterflies.

IT may be worth while to put on record what has happened this spring and summer, viz. the total absence of butterfly life. Beyond an occasional white butterfly, there are none to be seen. I have a large garden where there is usually abundance of them, but a coloured butterfly has not been seen this year yet.

Gravesend, July 2. DELTA.

THE SETTLEMENT OF THE EPPING FOREST QUESTION.[1]

BY a happy coincidence the *Essex Naturalist*, containing the full official report of the discussion on the management of Epping Forest, which took place under the auspices of the Essex Field Club on April 28,[2] and the Report of the experts appointed by the Corporation of London, have been published almost simultaneously, the former having been issued a fortnight or so before the latter. As the proceedings of the Conservators had been subjected to a running fire of the most vehement criticism ever since last autumn, the question of the management of the forest may be considered to have excited an amount of popular interest such as had never before been raised since the public dedication by the Queen in 1882. The reason for the popular outburst of indignation on the present occasion is to be found in the circumstance that the thinning operations had been carried on in a district which is well known to contain the finest example of a beech wood that the forest offers, viz. Monk Wood, and the amassed heaps of felled trunks, drawn to the roadside for removal, naturally attracted the attention of every passer-by, and gave rise to a not altogether unnatural feeling of uneasiness as to the fate of the forest's show woodland. A fair and unbiassed examination of Monk Wood, however, soon sufficed to dispel any fears of unnecessary destruction or permanent injury, and those whose judgment in such matters is worthy of the most serious attention, did not hesitate to express their belief that the operations had on the whole been carried out judiciously, and for the future benefit of the forest. This conclusion was arrived at in many cases against the preconceived notions of some of the visitors who attended the meeting on April 28, and some speakers in the discussion with great candour admitted that the result of the visitation and the explanations given on the spot had been to cause them to modify their views. This appears most distinctly from the speeches of such well-known friends of the forest as Sir Frederick Young, Prof. Boulger, and Mr. F. C. Gould, and it is only fair to add that many others who, without any special knowledge of forestal operations, attended the meeting, of which the proceedings are now reported, as lovers of the naturally picturesque, had their judgment materially aided by the opportunity given them for comparing portions of the forest which had been severely thinned in former years with other portions which had not yet been attacked. The arguments for and against the conservatorial doings are fully set forth in the *Essex Naturalist*, and will form an important chapter in the history of the forest management.

But the Essex Field Club has of course no official connection with the Epping Forest Committee, and although, as everybody knows, the chief executive verderer is Mr. Edward North Buxton, this gentleman gave his services as a conductor of the meeting because of his special knowledge on the one hand, and on the other as an officer of the Field Club. The decision at which the meeting arrived, as already reported in these columns, is in no sense an official utterance of the Club as a body corporate, but is simply to be regarded as an expression of individual opinions consequent upon a personal visitation and a discussion raised thereby. It seems desirable to make this statement in order to avoid future misunderstanding.

The Corporation of London, as the official Conservators of the forest, on April 12 appointed a special Committee of experts, in their own words, "to view the forest, and advise us forthwith as to the effect of the thinning, and our future policy with regard to the management of the forest." The names suggested were Viscount Powerscourt, Dr. Schlich (the Professor of Forestry at Cooper's Hill), Mr. James Anderson of Manchester, and Mr. William Robinson, the editor of the *Garden*. Sir Joseph Hooker was also asked to nominate two other members, and he suggested the names of Earl Ducie, Mr. A. B. Freeman-Mitford, M.P. (formerly Secretary to H.M. Commissioners of Works), and Mr. Angus D. Webster, formerly forester to the Duke of Bedford. Lords Ducie and Powerscourt were unable to join the Committee, but the five signatures attached to the Report may be considered as strongly representative of the art and science of forestry as the names of any committee of experts that has ever been or possibly could be brought together in this country.

Taking the Report as a whole, it will be seen that the Committee practically give their sanction to the policy which has been, and is being, pursued by the Conservators, and endorse the decision arrived at by the majority of those who took part in the meeting and discussion on April 28. Surely after this most weighty verdict there need be no further alarm as to the future of the forest. A detailed analysis of the Report would occupy too much space in these columns, but some of the most important recommendations may be considered. And first of all, with respect to the opening out of views and the making of clearings, there is no uncertainty about their statement:—

"As there is much beautiful landscape in and around the forest, the opening up of which would add much to its charms, we think that the best views should be carefully opened up by making judicious clearings. Such views would be in every way a gain. . . . . The rides and drives are beautiful features of the forest, and those made in recent years are well designed. They should receive constant attention, lest the encroachments of vegetation should mar their picturesque effect. In this connection we would call attention to the beauty of the glades which already exist. These should be increased in number, where it can be done without sacrificing the finer trees, or interfering with the massive groups of the forest."

[1] "*The Essex Naturalist*, being the Journal of the Essex Field Club," edited by William Cole, Hon. Sec. Nos. 1–5, vol. viii., published June 1894. "Epping Forest, Report of Experts as to Management, &c. Report, Epping Forest Committee," presented June 14, 1894.

[2] A brief report of the meeting appeared in NATURE, May 3, p. 12.

With respect to the thinning out of superfluous trees, the Commissioners touch upon a point of considerable importance:—

"A vast proportion of the area of the forest is covered by pollard hornbeams. In parts they are an interesting feature; but the practice of pollarding having been discontinued, the trees are now so dense that neither light nor air can penetrate. We consider that, with a view to encouraging the growth of better trees and varying the monotony of the forest, the best course will be, not generally to thin the trees, but to make bold clearances among them. The finer pollard oaks throughout the forest should be carefully preserved."

The importance of this recommendation lies in the circumstance that such a large area of the forest is covered by pollard hornbeams, often most unsightly through overcrowding, while pollard oaks, and especially such as could fairly be called "fine," are comparatively scarce. There are very few naturally-grown hornbeams throughout the forest area, and it is to be noted with satisfaction that the policy adopted by the Conservators, and further enforced by this recommendation of the experts, will give an opportunity for developing the natural growth of a tree which is an almost unique feature of the forest. The writer is not acquainted with any woodland in this country where the hornbeam forms such a prominent feature.

The Committee lay stress upon the importance of preserving the "massive character of the forest," and this also is a point on which it appears necessary to make some observations. Where the trees admit of being "massed," as the beeches in Monk's Wood, or the oaks in Hawk Wood, this policy would naturally find favour. But discretion has been, and no doubt will be, shown in this direction. A large number of trees might advantageously be removed from such an area as Hawk Wood without destroying its massiveness; and yet, when the Conservators come to deal with this part of the forest, there will no doubt be another outcry. With respect to this area the Committee state:—

"Hawk Wood is in the main an oak wood, and the trees are not such as would be improved by wholesale thinning. It would be, in our opinion, wise to take out no trees except such as are obviously dying, and a few scrubby stunted trees which are injuring the others. Where, here and there, a single specimen of more than usual beauty can be encouraged into noble growth, it should be protected from overcrowding."

This is precisely what the Conservators proposed to do with Hawk Wood before the present agitation, and a very good suggestion has been made that the chairman of the Committee of experts should be invited to go over this wood and mark the trees which he would recommend to be removed. The Conservators have already marked the trees which they proposed to remove. A comparison of the results would be a most practical lesson in forestry, and, so far as the writer is acquainted with Hawk Wood (which is very thoroughly), it may be safely affirmed that there would be no very serious division of opinion between the chairman and the verderers.

In connection with the question of encouraging the growth of underwood the Committee "do not think that in all parts sacrifices should be made for the purpose of encouraging it where the trees do not allow of its healthy growth, as under beeches." This observation no doubt applies more especially to Monk Wood, and so far may be claimed as a ratification of the work done there. The thinning cannot in this district be fairly considered to have led to any serious sacrifices of good trees, and a ramble through that woodland will convince the lover of the picturesque that the massiveness has not been interfered with. In view of the circumstance that the public attention was first drawn to the recent thinnings by the operations in this district, it is to be regretted that the experts have not expressed themselves more fully on this point. They express no disapproval of what has been done, but they consider that the thinnings will be sufficient "for many years to come," an observation which will no doubt be fully concurred in by the Conservators. There was never any intention expressed of thinning further in this woodland for the present.

The Committee recommend also that the trees in High Beech should not be interfered with, that the hollies in Walthamstow Wood should be allowed to develop by removing the dead or dying trees or the pollards which are interfering with them, and that the "healthy oaks, even where crowded, should be left standing. The beauty of tall oak stems, often lichen-covered, when growing in close woods, should be considered." In connection with this last remark it may be interesting to add that for some reason or another lichens refuse to flourish on the trees in Epping Forest—certainly in the lower forest, and the hoary trunks which are such delightful features of the Kentish and Surrey woods are unknown in the southern portions of the forest. In Theydon High Wood "moderate and periodic thinning" is recommended. In Lord's Bushes it is recommended that the young trees should be allowed to take the lead, and only the "finer and more picturesque pollards" preserved. All these recommendations are, it will be seen, substantially in accord with the line of action pursued by the Conservators.

The following suggestion with respect to drainage will give extreme satisfaction to naturalists:—

"We consider that there should be as little artificial drainage as possible, though in the case of rides or drives it is sometimes necessary. The natural drainage is in most places sufficient, and the streamlets should be allowed to make their own courses."

Another recommendation, which we endorse most heartily, is that "it may be necessary for a time to protect certain spaces against the inroads of cattle, horses, and deer."

The experts are opposed to artificial planting in general, and are in favour of letting nature do her own planting, excepting in cases where tree growth is insufficient, when they recommend that the seed of indigenous trees should be introduced. Four of the Commissioners are even opposed to having a nursery, but Dr. Schlich does not agree with this. In view of the fact that a large area of forest land was formerly under cultivation, and has only been thrown open in recent years, we are disposed to agree with Dr. Schlich. None of us will ever live to see these tracts restored to anything like a natural condition unless planting is resorted to.

Taking the Report in its entirety, it may be said that the question of the management of Epping Forest is now settled beyond cavil, and settled in a manner calculated to give strength to the hands of the Conservators and to reassure the public. The ridiculous exaggeration of seekers after cheap notoriety may in future be allowed to pass by unheeded. As Sir John Lubbock said in his late address to the Selborne Society:—"A great debt of gratitude was due to the conservators and verderers of the forest"; and again in the *Times* of June 11:—"We are greatly indebted to the Corporation of London, to Mr. Buxton and his colleagues, and . . . Epping Forest will be even more beautiful fifty years hence than it is now." The Report of the experts concludes with the very pregnant paragraph:—

"In conclusion, we may say that we are not prepared to endorse the strictures which have been passed upon the work carried out in Epping Forest. We are of opinion that much has been done judiciously and well. In some instances we should not, perhaps, unanimously approve of the whole of the action of the authorities. In others, we may consider that more might have been done. But of one thing we are certain, that whatever

has been done has been animated by earnest desire to preserve the finest features of the forest, and through intimate knowledge of its necessities and peculiar conditions."

R. MELDOLA.

NOTES.

THE meeting held on Saturday last at the Royal College of Physicians, and reported in the *Times*, was a very satisfactory one. It was attended by delegates from nearly all the institutions which it was proposed, in the report of the late Royal Commission on the Gresham University, should form constituent colleges of the reorganised University of London. Dr. Russell Reynolds, F.R.S., occupied the chair. Since Sir Albert Rollit gave notice in the House of Commons of a motion asking that some action be taken to carry into effect the report of the Royal Commission, there has been ample time for the various institutions involved in the scheme for a Teaching University to deliberate and deliver their opinions on the recommendations. Practically all the constituent schools and colleges have availed themselves of the opportunity, and have, in the main, expressed approval of the proposals. The time has arrived, therefore, at which to set the machinery in action which would lead the Government to appoint a Statutory Commission to frame a scheme on the lines of the report of the late Commission. The necessary motive power is contained in the following resolutions put before Saturday's meeting. It was moved by Prof. Erichsen, the president of University College, and seconded by the Rev. Mr. Whitehouse—"That this meeting of delegates from institutions mentioned in the report of the Royal Commission on the Gresham University desires to express generally its approval of the proposals contained in the report of the Royal Commission, and would urge on the Government that a Statutory Commission be appointed at an early date with power to frame statutes and ordinances in general conformity with the report of the Royal Commission." This resolution was put to the meeting and was carried, the only dissentients being the representatives of King's College. It was also agreed, on the motion of Dr. Norman Moore, "That a copy of this resolution be forwarded to the Lord Chancellor, the Lord President of the Privy Council, the Home Secretary, and the Vice-President of the Council, to be accompanied by a request that they will receive a deputation on the subject, the same to consist of the delegates to this meeting."

PAST and present students of the Mason College, Birmingham, presented Dr. Tilden with a silver bowl and a congratulatory address last week, on his removal to the chair of Chemistry at the Royal College of Science, and as a mark of appreciation of his long and honourable career in connection with the college. The proceedings were of a very enthusiastic character, and Dr. Tilden's students and colleagues vied with each other in expressing their esteem for him as a teacher and an investigator. In the course of his reply, Dr. Tilden remarked that fourteen years ago he went to Birmingham quite a stranger, at a time when there was no science college actually opened. His three colleagues—Profs. Hill, Poynting, and Bridge—were appointed with him as the first four professors of the college, when the building was quite empty. In the first session they had some eighty students between them, and those days were exceedingly happy. Those first professors had unusual privileges and responsibilities. They were naturally given a free hand. They had no traditions to live up to, no standard to go by except that which they themselves set up. They were entrusted with the great duty, the heavy responsibility, of creating their several departments and building up the life of the college, and setting up standards of teaching and conduct which would serve for their successors. Referring to his successor, Dr. Tilden said that, under Prof. Percy Frankland's care, he had no doubt that the work of the college would advance in the right direction.

OUR continental neighbours must often be amused at the forms in which we raise monuments. It will be remembered that a year ago a subscription list was opened for the purpose of erecting a memorial of some kind to Gilbert White. The appeal resulted in £250 being obtained. With this money a hydraulic ram has been fixed at the spring head near the village of Selborne, to force water into a reservoir erected eighty feet above the village. The water runs from the reservoir through pipes laid along the main streets, and tapped at convenient intervals. Selbornites are thus enabled to obtain a supply of water without journeying to the fountain at the spring head, as had previously to be done. This useful and unpretentious memorial is in keeping with Gilbert White's character; nevertheless, it seems to us that the committee having the funds at their disposal should also have taken into consideration the fact that he does not belong to Selborne alone, but to all lovers of nature.

WE learn from the *British Medical Journal* that three further remarkable instances of the success of Prof. Haffkine's system of anticholera inoculation are reported from Calcutta. In the first case, four out of the six members of a family were inoculated last March. The cholera appeared in the neighbourhood lately, and the disease attacked one of the two who had not been inoculated, while the inoculated remained free. In the second case, five members of a family consisting of eleven persons were inoculated in March. The cholera lately attacked one of the six who had not been inoculated. In the third case, six out of a family of nine were inoculated. When the cholera prevailed in the neighbourhood a few days later the disease attacked one of the three not inoculated. It is stated that the Corporation of Madras have passed a resolution inviting Prof. Haffkine to visit that city and introduce his system.

THE Council of the Royal Statistical Society announce that the subject of the essays for the Howard Medal, which will be awarded in 1895 with 20*l.* as heretofore, is as follows:—"Reformatories, and industrial schools of that class, in their relation to the antecedents, crimes, punishments, education after conviction, and training of juvenile offenders: together with the nature and extent of their influence on the diminution or increase of crime generally. These particulars have to be collected and analysed on a statistical basis, both as respects the institutions and agencies, public and private, at home and abroad, for the reclamation of juvenile offenders, and the best means of dealing with them on release. This does not include the industrial and training institutions certified by the Local Government Board under the 25 and 26 Vict. cap. 43." The essays should be sent in on or before June 30, 1895.

THE death is announced of Prof. F. Q. Rodriguez, Professor of Crystallography in the University of Madrid.

DR. JOSEPH COATS has been appointed Professor of Pathology in the University of Glasgow.

MR. L. O. HOWARD has been appointed entomologist to the U.S. Department of Agriculture, in succession to Prof. C. V. Riley.

MR. J. WOLFE BARRY, the engineer of the Tower Bridge, has had the honour of the Companionship of the Bath conferred upon him by the Queen.

PROF. W. ERB, of Heidelberg University, and F. Jolly, of Berlin, representing an influential committee, invite subscriptions for the erection of a monument to the late Dr. Charcot in the Salpêtrière.

THE death is announced of Dr. Louis de Coulon, one of the founders of the Société des Sciences Naturelles de Neuchatel in 1832, and its president for more than half a century from 1836 to 1890, when he became "Président honoraire." Dr. de Coulon was born July 2, 1804, and died June 13, 1894.

A MEDICAL Congress will be held at Calcutta at the end of next December, under the patronage of the Viceroy, and the presidency of Surgeon-Colonel Harvey. The objects of the Congress are "to bring together men from all parts of the Indian Empire, and to discuss medical subjects connected with Indian diseases, and to place on permanent record some of the work which is now lost to science for want of proper publication."

THE seventy-seventh meeting of the Société Helvétique des Sciences Naturelles will take place at Schaffhausen, from July 30 to August 1 inclusive. The Swiss botanical and geological societies will also hold concurrent meetings. Papers intended to be read before the different sections should be in the hands of the Committee before July 15. The President for the year is Prof. J. Meister, and the Secretaries, Dr. J. Nüesch and H. Wanner-Schachenmann.

A NUMBER of papers were read at the meetings of the Museums Association, held in Dublin last week. Mr. F. W. Rudler described the arrangement of a mineral collection, and Mr. G. H. Carpenter read a paper on collections to illustrate the evolution and geographical distribution of animals. Among the subjects dealt with on the concluding day, June 29, were "Classified Cataloguing, as applied to Palæozoic Fossils," by Mr. W. E. Hoyle, and "The Functions of a Botanical Museum," by Prof. T. Johnson.

THE Register for 1893–94 of the Johns Hopkins University of Baltimore has been received. One of the changes we note is that Prof. Newcomb terminated his active duties as Professor of Mathematics and Astronomy at the beginning of this year, the requirements of the Government service having obliged him to do so. The instruction in higher mathematics is now carried on by Profs. Craig and Franklin, and that in astronomy by Drs. Poor and Chessin. In all the departments of the University facilities are afforded for original research. In physics, Prof. Rowland expects all advanced students to devote most of their time to laboratory work and to undertake investigations designed to be of permanent value. Again, the chief instruction in every course of chemistry is that given in the laboratory. Prof. Remsen does not pander to those who merely take up chemistry in order to obtain a degree. "What is desired," he says, "is a certain maturity of mind with reference to the science of chemistry, and an ability to deal with chemical problems intelligently. This condition of mind is reached, if reached at all, by long-continued laboratory training accompanied by careful study of chemical journals and treatises. It may be said that the arrangements of the laboratory are made mainly with reference to those who wish to take up the study of chemistry in a broad way, and that those who want short courses in special branches of chemistry are not advised to come here. It is believed that whatever object the student may have in view, whether he intends to teach or to follow some branch of applied chemistry, the best preparation he can have is a thorough training in the pure science." We have seen few prospectuses in which the aims of study are more clearly defined. It is the same in all the other branches of scientific knowledge fostered at Baltimore; after students have become familiar with the methods of investigation through the study of typical and described material, they are encouraged to undertake original work. No wonder that the Johns Hopkins University is able to keep going journals of mathematics, chemistry, and biology, as well as numerous bulletins, circulars, and memoirs. The training given is just that calculated to produce results worthy of publication.

THE temperature in the shade exceeded 80° in several parts of England and Wales during the three days ending Monday last, and reached 87° at Cambridge on Sunday. Thunderstorms occurred on Sunday night and following days in many parts of Great Britain, accompanied by very heavy rainfall in places. At Jersey 1·1 inch was measured on Monday morning, and 1·7 inch at Stornoway on Tuesday morning. These storms had the effect of cooling the air; the maximum shade temperature in the neighbourhood of London had fallen about 10° on Tuesday compared with that on the previous day.

THE report of the German Meteorological Institute for the year 1893 contains some interesting details of the activity of that office, in addition to the routine work of dealing with observations from nearly 2,000 stations. During the year the important magnetic observatory of Potsdam became affiliated to the central office in Berlin; the very complete observations made there will be included with regular yearly publications. With the co-operation of the Alpine clubs an attempt has been made to reorganise a meteorological station on the Brocken, but hitherto it has not been successful. Fifteen scientific balloon ascents have been made during the year, in which the officials of the Institute have taken part. After the sixth ascent the balloon was exploded by lightning, but this only temporarily interfered with the work, as the Emperor granted funds to continue it. A complete account of the results obtained will be published in a special volume, when the work is discontinued. The introduction of Central European time into Germany has interfered materially with the meteorological work at the stations during the year.

AT the meeting of the Vienna Academy of Sciences on June 14, Dr. J. Hann submitted an investigation on the daily period of wind velocity on the summit of the Sonnblick (3100 metres), based on a careful and laborious calculation and discussion of anemometrical observations for six years, and also on the range on mountain summits generally. The minimum of wind force takes place on the Sonnblick very early, about 8h. or 9h. a.m., and the maximum occurs about 8h. p.m. On the Säntis (2500 metres), the minimum also takes place relatively early, between 10h. and 11h. a.m. But from the accepted theories of the cause of the daily period of wind force on mountain summits, it might be supposed that the minimum would occur in the afternoon. He therefore examined the records for several other stations, and found that in the summer, for altitudes ranging from 1400 to 4300 metres, the mean time of the minimum occurred at noon. He then investigated these facts to see how they fitted in with the assumed causes of the daily range, and as he could not reconcile them, he suggests that the possible explanation of the daily range on mountain peaks may be that the surface of the mountain being much more warmed than free air during the day affects the anemometers. It is assumed, however, that the chief effect is only active for a few hundred metres below the summit, in the morning, and that later it would be interrupted by the wind coming from the valley. If the minimum were due to the great ascending current, it would occur during the afternoon.

AN apparatus for discovering internal flaws in iron and steel is described in *Industries and Iron*. It is electrical, and consists of a small pneumatic tapper worked by the hand, with which the sample of steel or iron is tapped all over. With the tapper is connected a telephone with a microphone interposed in the circuit. One operator is required to apply the tapper, and the other to listen through the telephone to the sounds pro-

duced. Both are in electrical communication, and in separate apartments, so that the direct sounds of the taps may not interrupt the listener, whose duty it is to detect flaws. In applying the system, one operator places the telephone to his ear, and while the sounds produced by the taps are normal he does nothing. Directly a false sound, which is distinguishable from the normal sound, is heard, he signals for the spot to be marked, and by this means is able, not only to detect a flaw, but to fix its locality.

THE current number of the Johns Hopkins University (U.S.A.) *Circular* contains a preliminary note, by Edwin F. Northrup, on a new method of obtaining the specific inductive capacity of solids under either slowly or rapidly changing fields. It is of great importance in connection with Maxwell's electromagnetic theory of light that, since the refractive index for most substances has only been measured for very short waves, the specific inductive capacity be measured under such circumstances that the field of force alternates with such rapidity as to produce waves comparable in length to the waves with which the refractive index is determined. The apparatus employed by the author consists of three heavy brass plates, fastened parallel to each other, and separated by about three inches. Each plate is held in position by four insulating strips of ebonite, through the ends of which pass four iron rods with a screw-thread cut upon their whole length. To the centre of each of the two outside plates, and perpendicular to the plate, is fastened a brass tube. A rod, half of which is of ebonite, moves in this tube and carries at its end a thin plane plate of glass, the surface of which is coated with metal foil. These small movable plates are as nearly as possible parallel to the large plates, and their position is given by a vernier attached to the ebonite rods. The two outside plates are connected by a metal rod which carries a metal ball. Another ball, nearly opposite the first, is fixed by a short metal pin to the middle plate so that the distance between the balls can be adjusted. In employing the apparatus to measure specific inductive capacity with rapidly varying fields, the following arrangement is used. The two outside plates and one terminal of a large induction coil being connected to earth, the other terminal of the coil is connected to the middle plate. When the coil works, sparks pass between the balls, and oscillations are set up. The lines of force, when air only is the dielectric, divide evenly between the plates, and in the region of the small plates the field may be considered as uniform; hence if these plates are at equal distances from the centre plate, they will always remain at the same potential. If, however, a plate of some other dielectric is placed between the centre plate and one of the movable plates, in order that the two small plates may remain at the same potential, they will have to be placed at unequal distances from the centre plate, and from their relative positions the specific inductive capacity can be deduced. In order to "weed" out the effects of the slow changes of potential due to the charge and discharge of the coil, the two small plates are connected to the primary of a small transformer, the secondary of which contains a spark-gap. In this way the effects due to the slow changes are eliminated, since the rate of variation of the induction in the transformer, due to these slow changes, is not sufficient to raise the potential in the secondary to the 300 volts or more required to break down the dielectric in the spark-gap.

STUDIES of the eastern Yucca Moth (*Pronuba yuccasella*) and its importance in Yucca pollination, have, from time to time, been recorded in reports of the Missouri Botanical Garden. In a recent report, Mr. J. C. Whitten describes observations which complete the knowledge of the life-history of this interesting insect. The observations refer to the time when the larva ceases feeding in the capsule, until it is encased in its underground cocoon, when, the following spring, it is to change to the pupa state. It was found that the larvæ made their escape from the capsules of *Yucca filamentosa*, and entered the soil during rainy weather, when the ground was softened, and consequently easily penetrable. They did this either during the daytime or at night, and not exclusively toward the end of the night, as Prof. Riley had predicted. The larvæ descended to the ground both by use of a thread and by crawling.

A CATALOGUE of works on entomology, being No. 26 of *Bibliotheca Entomologica*, has been issued by Herr Felix L. Dames, Berlin, Koch-Strasse 3.

WE have received from the Revenue and Agricultural Department of the Government of India a copy of the Returns of Agricultural Statistics of British India and the Native State of Mysore for 1892–93.

THE May number of the *Journal* of the Jersey Biological Station (*Jour. of Mar. Zool. and Micros.*, edited by James Hornell, vol. i. No. 3, 1894) contains several original contributions by the editor, in one of which is given an interesting account of the variability of the opercular filaments in *Serpula pectinata*. Elementary and picturesque descriptions are also given of the metamorphoses of the Crustacea *Squilla desmarestii* and *Scyllarus arctus*, and of the structure of anemones. The number is illustrated by several autographic plates and woodcuts, and contains a frontispiece giving a photographic view of the aquarium of the laboratory, which would seem, from the editorial report, to be making well-merited progress.

THE special articles, official reports, notes, communications, and reviews in part ii. of vol. v. of the *Journal* of the Royal Agricultural Society, issued on June 30, make up a number replete with information. The first two meetings of the Society—Oxford 1839 and Cambridge 1840—are described by Mr. Ernest Clarke. Profs. J. McFadyean and G. T. Brown write on the prevalence of anthrax in Great Britain, Mr. Joseph Darby on irrigation and the storage of water for agricultural purposes, and Dr. Fream on some minor rural industries. Among the official reports, we note one by Dr. J. A. Voelcker on aubury, club-root, or finger-and-toe, in turnips. Dr. J. M. H. Munro writes on sewage disposal and river pollution, and Lord Egerton of Tatton describes the Tewfikieh College of Agriculture, Egypt.

THE makers of a very neat little camera, Messrs. R. and J. Beck, have just send us a copy of the "Frena Handbook," in which the inventor says practically all there can be said with regard to the description, method of use, manipulation, &c., connected with this instrument. For the benefit of "some future philologist" who may at some time be in doubt as to the derivation of the word "Frena," an etymological note informs us that it is derived from "faro" and "crena," the former being the name of the well-known game of cards, and the latter meaning a notch; the instrument automatically discharging one film after another like a *faro-box*, and doing this by means of notches. In this camera notched films are used, being thin and stiff sheets of transparent cellulose film, and as many as forty can be carried in the holder at the same time. With regard to some of the technical data of the No. 2, quarter-plate, size, the lens is an "autograph" rapid rectilinear of focal length $5\frac{1}{2}$ inches, normal aperture F – 11, and covers a $3 \times 4\frac{1}{4}$ inch film; the dimensions of the case are $11\frac{1}{4} \times 5\frac{1}{2} \times 4\frac{1}{2}$ inches, and when filled with forty films the apparatus weighs four pounds. Among many of the advantages of this camera may be mentioned the arrangement by which the films may be tilted, thus providing a neat and easily worked form of swing-back. After the introduction, the author of this handbook gives a very brief and concise summary of the outline of operations necessary for the veriest beginner, printing them in red ink. This, however,

is supplemented with fuller details by a series of extensive notes on the use of the "Frena," occupying nearly eight times as many pages as the "outlines" above mentioned. These notes contain some sound advice, of which the novice could not do better than take advantage, and they are written in a clear style. The illustrations and figures are exceedingly neat and clear, and the whole get-up of the book is all that can be desired.

SOME new facts concerning the nature of the molecule of calomel are contributed to the current issue of the *Berichte* by Prof. Victor Meyer and Mr. Harris. The determinations of the vapour density of mercurous chloride made by Mitscherlich, Deville and Troost, and Rieth, in each case afforded numbers in close agreement with those demanded by the simple formula HgCl. Odling, however, disputed the possibility of the existence of molecules containing only one atom of each element, involving the assumption of univalency for mercury, and showed that when gold-leaf is immersed in the vapour it becomes amalgamated, indicating the presence of free mercury vapour. Erlenmeyer subsequently showed that this experiment was open to the objection that the amalgamation might be due to a chemical reaction between gold and calomel vapour, and pointed out that the presence of free mercury may be more conclusively shown by immersing a glass tube, cooled by containing a column of quicksilver, in the vapourised calomel, when an abundant condensation of mercury globules is observed. Debray afterwards immersed in the vapour of calomel a bent tube of silver, gilded outside and kept cool by the passage of a current of cold water, and found that both mercury and corrosive sublimate were condensed upon it, but that the greater portion of the sublimate consisted of unchanged calomel. Debray therefore concluded that dissociation into mercury and corrosive sublimate only occurred to an insignificant extent. Prof. Meyer and Mr. Harris now show that if a piece of gold-leaf is immersed for an instant only in the vapour of calomel it is invariably amalgamated, but if it is allowed to remain in the vapour for a few minutes it becomes pure gold again, the mercury being volatilised. They have further carried out a series of vapour density determinations by Prof. Meyer's well-known method, at the temperature of the vapours of boiling sulphur (448°) and phosphorus pentasulphide (518°). The numbers obtained are all in close proximity to that calculated for the molecular condition HgCl, agreeing in this respect with the older determinations above referred to, in which other methods were employed. The calomel was introduced into the apparatus in the form of a compressed pastille, thus obviating the necessity for a containing bulb or tube, and enabling almost instantaneous volatilisation to be achieved. A second series of experiments were then made with a mixture in the proper proportions of free mercury and corrosive sublimate, and the results were almost identical with those obtained from calomel. Of course this does not afford any conclusive evidence, but experiments are next described in which an attempt at identification of the substance or substances present in the vapour was made. It was shown that when the cylindrical bulb of the density apparatus was constructed of porous earthenware, a very large amount of mercury vapour diffused through it, and could be condensed upon an outer enveloping glass cylinder. Further, that when calomel is vapourised in a retort connected with a Sprengel pump, and in which the pressure has been reduced by the latter to about 30 mm., the upper portion of the apparatus becomes covered with a layer of mercury globules, and a proportionate quantity of mercuric chloride is formed. Chemical evidence is also adduced to prove the presence of mercuric chloride vapour in the gaseous product of heated calomel, for it is shown that pieces of caustic potash previously heated to the same temperature become instantly covered with orange-coloured mercuric oxide, just as when plunged into vapour of corrosive sublimate, proving the absence of any large quantities of mercurous chloride, which would have afforded a black deposit of mercurous oxide. Prof. Meyer and Mr. Harris therefore conclude that when calomel is vapourised it dissociates into mercury and corrosive sublimate, $Hg_2Cl_2 = Hg + HgCl_2$, and the necessity for the assumption of monadic valency for mercury is thus avoided.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♂) from India, presented by Mrs. McHugh; three Barbary Turtle Doves (*Turtur risorius*) from North Africa, presented by the Misses E. and P. Mackenzie; a Common Cuckoo (*Cuculus canorus*), British, presented by Mr. W. Keen; two Horned Lizards (*Phrynosoma cornutum*) from Texas, presented by Miss Maitland, an Anomalous Snake (*Coronella anomala*) from South Africa, deposited; an Ostrich (*Struthio camelus*, ♀), from Africa, two Red-headed Merlins (*Hypotriorchis chicquera*) from India, purchased; an Æthiopian Wart Hog (*Phacochœrus æthiopicus*, ♀), from South-East Africa, received in exchange; a Thar (*Capra jemlaica*, ♂), a Burrhel Wild Sheep (*Ovis burrhel*), a Great Kangaroo (*Macropus giganteus*, ♀), born in the Gardens.

PROF. W. R. FISHER requests us to make the following correction in his contribution to our last number:—On p. 193, line 8 from top, for "1·025" read "1·025[45]."

OUR ASTRONOMICAL COLUMN.

THE FIRST OBSERVATION OF SUN-SPOTS.—A contribution to the history of the rival claims of the various alleged discoverers of sun-spots appears in the *Rendiconti dei Lincei*, from the pen of Prof. E. Millesovich. It is a criticism of Dr. Berthold's pamphlet on "Master Joann Fabricius and the Sun-spots," setting forth the claims of the son of the Frisian astrologer David Fabricius to the name of the true discoverer of the solar phenomenon in question. The other claimants are, of course, Galileo and the Jesuit Scheiner, known under the name of Apelles. The claims of Fabricius are based upon his book *De Maculis in Sole observatis, narratio*, &c., published at Wittenberg in 1611. He had been studying at Leyden University, whence he brought home Lippershey's newly-invented telescope to his father at Osteel. The latter was already well known among astronomers as the discoverer of the variability of Mira Ceti. The method of projecting the solar image on a screen is set forth in detail in the work referred to, as well as the correct conclusion that the sun rotates about an axis. Prof. Millesovich grants that the name of Fabricius was probably known to the Jesuits and suppressed as that of a heretic, but he comes to the conclusion that Galileo was actually the first discoverer, having observed the spots as early as the summer of 1610, whereas Fabricius saw them independently on March 9, 1611, and Scheiner about the same time, without, however, paying much attention to them before the publication of Fabricius's *Narratio*. He then observed them assiduously, and collected a large number of valuable records.

THE PROGRESS OF ASTRONOMICAL PHOTOGRAPHY.—Under this title, Mr. H. C. Russell, C.M.G., F.R.S., the Government Astronomer at Sydney, delivered an address, as President of Section A (Astronomy, Mathematics, and Physics), at the last meeting of the Australasian Association for the Advancement of Science. The address has now been issued, and it is the most complete statement that we have seen of the advance of astronomical photography from the time when Prof. J. W. Draper took daguerreotypes of the moon, in 1840, to June 1893. The references distributed through the address add to its usefulness. Reference is made to eighty-one sources of information in all, and of these, NATURE claims the large proportion of thirty-two. Like many other enthusiastic workers in the realm of celestial photography, Mr. Russell believes that astronomical observations will eventually be automatically made by means of the sensitive plate of the photographer.

MR. TEBBUTT'S OBSERVATORY, NEW SOUTH WALES.—The report of Mr. Tebbutt's Observatory, Windsor, New South Wales, shows that there was no relaxation in the observations carried on during 1893. The work done is quite equal in importance and amount to that of previous years. In addition to constant meridian work, a number of occultations were observed. Interesting phenomena were noted at the disappearance of τ^1 Arietis on January 26, 1893, and Mr. Tebbutt thinks that the star should be examined with a powerful telescope, as it is probably a triple one. The conjunction of Saturn and Virginis in April was observed · also the occultation of Saturn and Titan on May 25. Brooks' Comet (1892 VI.) was followed from November 28, 1892, to June 19, 1893, and the Rordame-Quenisset Comet (1892 II.) from July 29 to August 13, 1893. A series of measures of the binary star α Centauri were also made. When it is remembered that all the astronomical, and nearly all the meteorological, observations are made by Mr. Tebbutt himself, as well as the greater portion of the astronomical reductions, it is impossible not to admire his devotion to astronomical work. The smallness of the number of southern astronomers makes his observations all the more important.

A NEW SPIRAL NEBULA.—At a recent meeting of the Royal Astronomical Society, Dr. Roberts exhibited a photograph of a new spiral nebula in Perseus (*Monthly Notices R.A.S.*, April 1894). The nebula is in R.A. 2h. 29m. 58s. Decl. + 38° 31′·4. It is 3m. 51s. *preceding*, and 5′·4 *south* of the nebula No. 1023 in the New General Catalogue. The accompanying cut, from one of Dr. Roberts' photographs, shows the latter nebula as a

lenticular body a little below the centre, while the new object appears as a faint patch almost directly above it near the top of the figure. The illustration will serve to indicate the position of the nebula, but the spiral character has been lost in the reproduction. Dr. Roberts thinks that the nebula is new to science, for it is not recorded in the New General Catalogue. With regard to its character he says:—"The convolutions of the spirals are very faint, but clearly visible on the negative, and involved in them are four 14-15 mag. stars, and six or seven stars, or star-like condensations, less bright than the 16th mag. The convolutions are symmetrical, and proceed from a very faint star-like nucleus."

TWENTY-FIVE YEARS OF CHEMISTRY IN RUSSIA.

IN November last, the Russian Chemical and Physical Society commemorated the twenty-fifth anniversary of its foundation, and the addresses delivered on this occasion are now published in a separate pamphlet, as an appendix to its journal. The activity of the Russian chemists having been chiefly centred round the Society, the addresses on the progress of physical chemistry, by N. N. Beketoff; of organic chemistry, by N. A. Menshutkin; on researches in the aromatic series, by Th. Beilstein—all in connection with the Russian Chemical Society—may be taken as so many excellent reviews of the progress of these respective branches of chemistry in Russia. The first two addresses are especially full of interest, as there is not one of the great questions which have occupied the attention of chemists during the last five-and-twenty years to which Russian chemists have not contributed some work of importance. The researches in connection with the periodical law, by its discoverer himself, and later on by Bazaroff and Prof. Flavitzky; the work of Prof. Gustavson, on the double substitutions of anhydrides; the researches of Prof. Potylitzin, into the mutual substitutions of haloids, also in the absence of water and at a high temperature, which induced Berthelot to make new researches in order to verify his law; and the discovery, by the same chemist, of the dependency between the limit of substitution of chlorine by bromine and their atomic weights, are passed in review. Next come P. D. Khrushchoff's researches into the heat of solution of mixtures of salts, which gave a further confirmation of the Berthelot, Guldberg, and Waage's law; the well-known exhaustive researches of Prof. Menshutkin into the speeds of reactions; and those of Kajander (prior to those of Arrhenius), into the dependency of these speeds upon the electrical conductibility of the combining bodies; the thermochemical work of Lughinin and Werner, and other works of minor importance. And, finally, the Russian chemists have contributed many and varied researches into the dependencies of physical properties of bodies upon their chemical composition and structure; such, for instance, as Goldstein's, which have led to the discovery of a law expressing the rise of the boiling point of many hydrocarbons as a function of their molecular weights; while the important contributions of Mendeléef, Konovaloff, Alekséeff, and also Scherbacheff, to the theory of solutions, and Prof. Bunge's work in electrolysis, are well known to West European scientists.

The work done in Russia during the same period in organic chemistry is, perhaps, even still more important; but it can hardly be dealt with in a few lines, although, out of more than a thousand papers contributed in this department, Prof. Menshutkin only mentioned those "of which," he said, "the history of chemistry will retain some impression." Many works of importance have been grouped by the reviewer around Butleroff's researches into the tertiary alcohols—a whole school of explorers of the fat series having been created by the well-known Kazan professor; while another series of researches into the aromatic compounds was made under the impulse given to these researches by Zinin and Beilstein. These last are so extremely valuable that they rightly form the subject of another well-filled address, delivered by the present leader of this school, Prof. Beilstein. Th. R. Wreden, in Russia, was one of the first to recognise the importance of those organic compounds which stand between the fat and the aromatic series; and though his work, which went against the then current opinions in science, did not attract the attention it fully deserved, the ulterior researches of Beilstein, Kurbatoff, and Markovnikoff into the compounds entering into the composition of the Baku naphtha have shown that he was on the right track, and fully confirmed his suggestions. The existence of these intermediate forms, which have their rings composed of atoms of carbon only, is now a recognised fact, and their study has already led to many important discoveries, while it promises many more. A short review of the work done in Russia, in connection with stereo-chemistry, and with the relations between the physical properties of organic compounds and their chemical composition and structure, concludes this most interesting address. "Chemistry," Prof. Menshutkin says towards the end of it, "is rapidly approaching the time when it will be no more a descriptive science, but a mechanics of atoms, and the history of the Russian Chemical Society is intimately connected with that part of the history of science."

THE LANDSLIP AT GOHNA, GARHWAL.

SIR E. BUCK has sent to us, through Mr. E. D. Maclagan, Under-Secretary to the Government of India, an advance copy of a report, with maps and plates, by Mr. T. H. Holland,

of the Indian Geological Survey, on the great landslip in the Kumaon Hills. The landslip has been more than once referred to in these columns, but Mr. Holland's report, from which the following extracts have been made, is the first detailed information that has reached us on the occurrence.

Mr. Holland made a journey to Gohna last February, that is, five months after the landslip, and when the lake, formed by the barrier fallen across the Birahi Ganga valley, had risen to within 290 feet of the top of the dam. His investigations lead him to believe that the lake will be full and will overflow the barrier about the middle of August. Means for recording, by instantaneous photographs, the effects of the water on the dam have been arranged by the Government of the North-Western Province.

Gohna in British Garhwal (lat. 30° 22′ 18″ N., and long. 79° 31′ 40″ E.) is a small village in the valley of the Birahi Ganga, a river running westward and joining, at a point 8 miles west of Gohna, the Alaknanda, one of the principal tributaries of the Ganges. The village is about 130 miles north of Naini Tal, and by the road which follows the valley of the Alaknanda, it is 160 miles from Hardwar.

The bed of the Birahi Ganga, sloping at about 2½°, is at Gohna 4600 feet above sea-level, and is the bottom of a narrow gorge with steep, and sometimes precipitous, sides. The gentler slopes are grass-covered, and higher up clothed with evergreen oak, fir, and rhododendron. In the more open parts of the valley, a small amount of cultivation is carried on by the few inhabitants of the small groups of houses dignified by the name of villages. The river basin, which is twenty miles long and nine miles wide, is bounded on the north and east by a snow-clad ridge rising to 21,286 feet. A considerable portion of the water of the river is therefore derived from the melting snows, and it consequently receives its greatest supply during the warmer months. The area of the basin east of Gohna, and consequently the area draining into the lake which has been formed by the landslip, is about ninety square miles.

From the account of the villagers there seem to have been fields along the sloping portion of the gorge near Gohna on both sides of the river, whilst the hill they speak of as Maithána—the one which fell—rose almost vertically above the slope on the north side of the river. Two years ago there was a small slip between Maithána and Gohna village. On the 6th of last September (1893), and towards the close of the rainy season, two falls took place, damming back the river to form a lake. Falling continued for three days with deafening noise and clouds of dust which darkened the neighbourhood and fell for miles around, whitening the ground and tree-branches like snow. Further slips occurred at subsequent intervals after heavy rain ; and at the time of Mr. Holland's visit, a day's rain or fall of snow was always succeeded by falls. Blocks of several tons would bound from ledge to ledge for more than 3000 feet over the broken hill face with a low rumbling noise and the production of clouds of dust. The hill which fell was a spur of over 11,109 feet high ; but except on the edge of the precipice, where pieces could be pushed over with the foot, Mr. Holland found no cracks in the hill. The rocks exposed on the cliff-front are crumbled and faulted in a complicated manner and with varying dip ; but on the west side of the slip the dip is towards the valley at a lower angle than that of the precipice, the average inclination of which is 54°. The mass of broken material which fell stretches for two miles along the river valley, and rests against the cliff of similar rocks on the opposite side a mile away. On the higher mounds, from which the mud has been washed away, large masses, sometimes weighing hundreds of tons, of crumpled dolomitic limestones are seen pitched in obliquely and shot out like a pack of cards. In the first fall, at any rate, the hill must have pitched forward and not have slipped down in the usual fashion of smaller slides. Blocks hurled a mile away against the opposite cliff have knocked down numbers of trees. The second main fall now stands as a heap of irregularly piled blocks weighing from about thirty tons down to ordinary hand-specimens.

The surface of the dam exposed in early March was about 423 acres ; but it was gradually being submerged on the eastern side by the rising lake. The lake in the beginning of March was 2¾ miles long, 1 mile wide at the widest part, and covered 370 acres. It was then rising at the rate of about six inches per day ; but with the melting of the snows in the hot season, the rise must become more rapid. When fall it will, unless a cutting is made, overflow at a point 5850 feet above sea-level ; and the stream, rushing down an incline of 11°, will rapidly cut with increasing head a channel in the mud and loose stones, which cover that portion of the dam, until its speed is checked by the reduction of slope and the exposure of large blocks of dolomite which must occur below at no great depth. Mr. Holland found it impossible from mere inspection to estimate the thickness of the soft mud, but he thinks that if the rapid erosion becomes arrested before 100 feet has been cut, there will be preserved above a lake 3¼ miles long and 1¼ miles wide, the destruction of which by gradual erosion of the dam and silting up of the basin, though a matter of time geologically considered short, will be sufficiently slow for what historically may be called a permanent lake. The lake view from the dam is the crowning charm of scenery typically Himalayan and wild. The steep mountain slopes, partially clad with fir, evergreen oak, and gorgeously-flowered rhododendron, slope steeply down on either side to the blue-green waters of the lake, whilst to the east Tirsúl and two associated peaks, rising over 20,000 feet, with snow-clad slopes and glaciers, form the background of the picture (Fig. 1).

It is pointed out that at several places in the Himalayas, lakes have in the recent past been formed by landslips, filled, and afterwards cut through by their own streams. Mr. Oldham has described the very interesting case of Turag Tal near Gonain in Almora District, which was formed behind a barrier of slipped limestone 250 feet high. The level of the alluvium in the lake is now within 50 feet of top of the barrier, so the age of the lake is measured by the time required to deposit alluvium to a thickness of 200 feet. (*Rec. Geol. Surv. India*, vol. xvi. 1883, p. 164.)

Whilst the steep slopes of the mountains around the lake at Gohna add greatly to the beauty of the view, they are unfortunately a source of danger to the lake itself on account of their liability to follow the example of Maithána and slide down, displacing proportionately large bodies of water. At one spot, a little to the south-east of the dam and half-way to Durmi, where the dolomites dip in the direction of the steep slope towards the lake, the hill side may at any time slide into the lake. In 1869, higher up the same valley, a small lake, Gudyar Tal, having been formed in the same way by a landslip, became suddenly nearly filled with a second slip and displacement of a body of water, which flooded the valley of the Alaknanda and washed away part of Srinagar, 78 miles below. That this, sooner or later, will take place, seems to be certain ; but when, it is impossible to say. The very size of the lake, however, will be a safeguard against high floods. Suppose, for instance, that the permanent lake had an area of 500 acres, and a slip of 12,500,000 cubic feet occurred—the maximum possibility near the south-east corner of the dam—the result would be that the water in the lake would rise about 7 inches. There are, however, one or two steep precipices on the north side of the lake, which Mr. Holland could not examine, and which he thinks might probably give larger slips.

Fears have frequently been expressed concerning the danger of the dam bursting under the hydrostatic pressure of the water accumulating in the lake above. The sections and map accompanying Mr. Holland's report should be sufficiently convincing to any engineer ; but to remove any doubt concerning the security of the barrier, the strength of the dam is conveniently compared by a simple calculation with the actual hydrostatic pressure which it will have to resist before overflow occurs.

The point referred to as 5850 feet above sea-level is approximately in the centre of the dam, and lies in its weakest section. It is shown that this weak section would weigh about 401,922 tons. When the overflow is about to take place, the horizontal hydrostatic pressure against the section will be 13,950 tons.

The weight of the section is thus nearly twenty-nine times the horizontal pressure of the water. But even supposing this section to be free of friction from the sides, and only offers the resistance estimated by its own coefficient on a bed of the same material, it would require about four-fifths of its own weight to move it ; that is to say, a pressure of 321,536 tons. But as the maximum horizontal pressure of the water will only be 13,950 tons, the weakest section of the dam is *at least* twenty-three times the necessary strength. This estimate would, of course, be still higher if the weight of the thousands of tons of dolomitic blocks which rise on either side the weak section and point of overflow were taken into considera-

tion. Finally, the enormous pile of rubbish, weighing quite 800,000,000 tons and lying in a valley nearly one mile wide, would, if shifted, become jammed into a gorge only 500 feet wide.

Mr. Holland traces several causes, which were some time conspiring to the one end of bringing about the catastrophe that has been attended with such serious consequences at Gohna.

Among these the principal, or more correctly, the one which gave facilities for the action of all the others, is the dip of the strata towards the gorge. Over Gohna village, the dip of the dolomites in the south-east direction increases, until in Marthána itself the beds are inclined in the face of the cliff at an angle of about 45°–50°, and consequently large platey surfaces are exposed by the fall. As the dip of the rocks is greater than the angle of repose of dolomite or shale-slabs, sliding would naturally take place when necessary facilities are presented. So long as the slope of the surface does not exceed in angle the dip of the strata there is no danger of a slip; but when, as in this case, the foot of the slope is undermined by the action of a river and by springs, the average slope of the surface is increased, and there is a tendency for the beds lying between the line of slope and the line of dip to slide off.

It is pointed out that the influence of the dip of the strata in fashioning the surface slope is well illustrated in the Cheddar Valley. The river has cut a gorge approximately in the direction of the strike of the carboniferous limestone, which dips on both sides of the river at an angle of 15°-24° south. The south side of the gorge is an almost perpendicular cliff 400 feet high, whilst on the north side the slope is only slightly greater than the dip of the beds, which are constantly, though gradually, slipping down as the river is deepening its valley. Thus, whilst an almost perpendicular cliff is safe on the south side in which direction the rocks dip, there is a perpetual slipping on the north side, and no slope greater than the angle of repose of the loose blocks would be safe.

In the landslip at Gohna not only was the support removed by undermining at the foot of the slope, and loosening of the beds, but the beds were impelled outwards by a series of changes following as a natural consequence of the processes which destroyed the originally compact nature of the strata. These causes combined, taking advantage of the stratigraphical facilities, precipitated the mass of material which now dams back the Birahi Ganga. They are as follows:—

(1) *Those producing a loosening of the strata.*
- (*a*) Dolomitisation.
- (*b*) Solution by atmospheric waters.
- (*c*) Reduction of coefficient of friction by water.

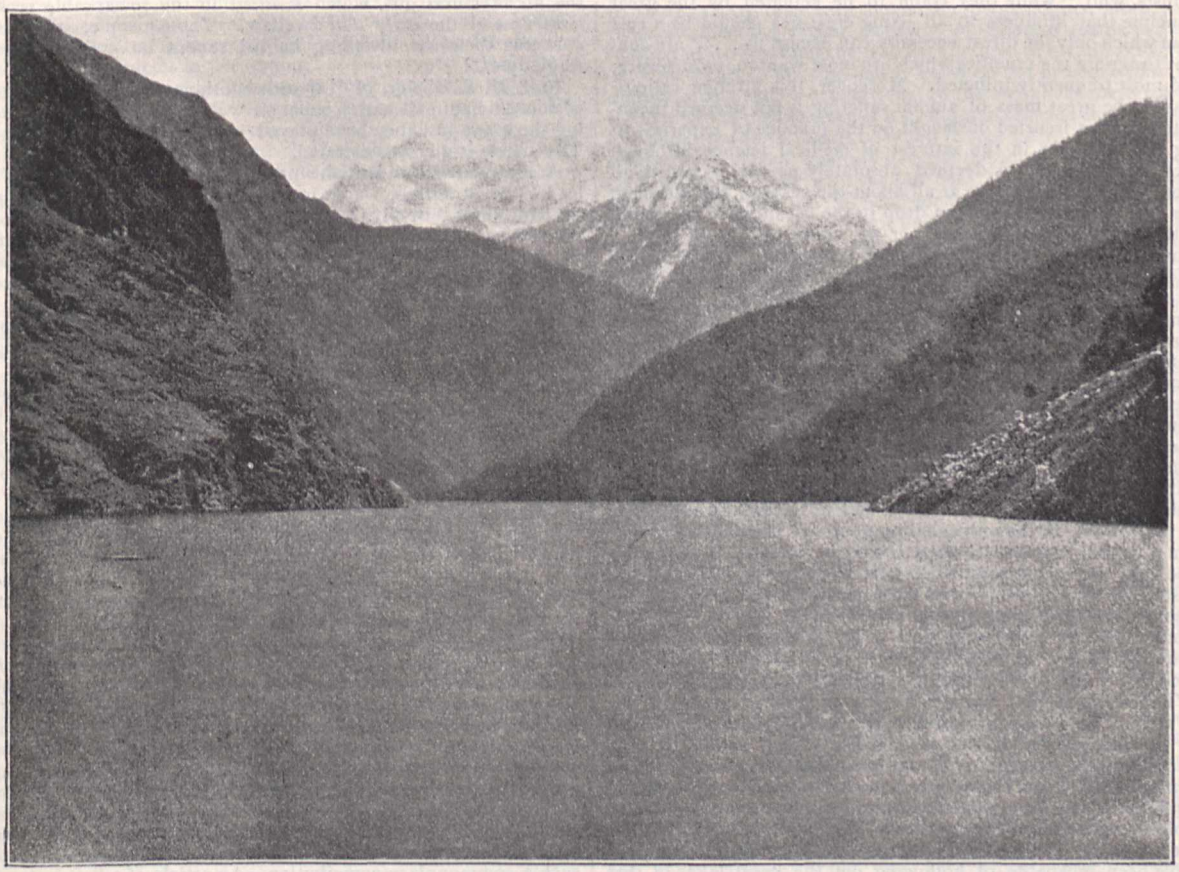

Fig. 1. View of Gohna Tal from the edge of the Dam, 190 feet below overflow point. Tirsúl (23,406 feet) and two associated peaks (over 20,000 feet) form the background

(2) *Subsequent changes impelling strata in the direction of least resistance.*
- (*a*) Expansion of products on oxidation and hydration.
- (*b*) Changes of temperature.
- (*c*) Hydrostatic pressure.

Mr. Holland describes the action of each of these causes, and concludes his report by pointing out that owing to the fact that the folding of the Himalayan range has continued to times geologically recent, if not still in action, there has resulted a condition of strain frequently manifesting and relieving itself by earthquakes, and of steep slopes with rushing torrents, frequently resulting in landslips. When subsequently the inequalities of level have been sufficiently reduced by denudation, the slopes will be more stable, rivers less violent, and the scenery tamer—a condition of affairs exemplified by the more

geologically old-fashioned peninsular portion of India. Water, the great agent of denudation, has, by its chemical and physical action, been the cause of the landslip at Gohna, but the effects of the potential energy accumulating in the lake have to be patienty awaited.

SCIENCE IN THE MAGAZINES.

IN the *Fortnightly* Prof. Karl Pearson heads a forcible article on "Socialism and Natural Selection" with the following quotation from Darwin:—"What a foolish idea seems to prevail . . . on the connection between Socialism and Evolution through Natural Selection." His contribution is a diatribe against the views set forth by Mr. Kidd in "Social Evolution" and the reviewers who have hailed the work as scientific in its construction and conclusions. Dr. Louis Robinson points out the glaring moral inconsistency of the majority of anti-vivisectionists, who "while they claim to be actuated by the great principle that kindness to all living creatures should be a rule from which only the direst necessity can excuse us . . . are content to ignore the cruelties which are most wanton, most severe, and most frequently inflicted. Moreover, this strange callousness to the great mass of animal suffering is not deemed inconsistent with a frenzied onslaught on the practice of experimenting upon animals in the interest of medical science, although such experiments are deemed absolutely needful by nearly all those who know anything at all about the subject, and although the pain so caused is but as a drop in the ocean when compared with that inflicted in sport, or for monetary profit. . . . . Now what would all the good humanitarians say, if some man of science, pursuing knowledge rather than pleasure, were deliberately to smash the leg of an animal, and lacerate its flesh with some blunt instrument, and merely to save himself a little trouble, were to let it crawl about the laboratory, with a compound fracture and wounds unattended to, while he busied himself with something else? What, if he were to commence an operation on a pigeon by wrenching off a wing and gouging out an eye, and then were to stroll off to lunch, and a game of billiards, intending to come back and finish the business when he had leisure? What if he were to tear open the abdominal cavity of a rabbit, and, rather than spend a quarter of an hour in completing the operation he had begun, were callously to let it die in all the unspeakable agonies of peritonitis? What, again, would they say if, when the vicar dropped in to afternoon tea and asked about the result of the experiments, our investigator were to smile and rub his guilty hands as he replied that he had had a most enjoyable morning? And, lastly, what would they say about the vicar if on hearing this shameless avowal he joined in the abominable rejoicings of his host, and accepted a gift of the mangled carcases of the victims?"

The *Contemporary* contains a reply by Prof. Bonney to Dr. Wallace's arguments in favour of the excavation of lake basins by glaciers (*Fortnightly*, Nov. and Dec. 1893). Prof. Bonney winds up by saying: "Notwithstanding Dr. Wallace's ingenious advocacy of the erosive power of glaciers and ice-sheets, I maintain that these can excavate only under the most favourable conditions, and then but to a limited extent, and that they are proved by a close study of the Alpine peaks and valleys to have been incapable of hollowing out the great lakes of that chain."

Dr. Carl Lumholtz has been for the past three years making explorations in the almost unknown regions of the Sierra Madre in Mexico. The first of a series of papers on his discoveries appears in *Scribner's Magazine* under the title, "Among the Tarahumaris." The paper is profusely illustrated from photographs taken by the author. The following extracts are of interest:—

"Cave-dwellers are found among the following tribes, counting from the north: The southern Pimas, the Tarahumaris, and the allied tribe of Huarogios, and the Tepehuanes. All these tribes inhabit the State of Chihuahua and are more or less mountaineers living almost entirely in the great Sierra Madre range. Of these people the Tarahumaris are most attached to caves, the Tepehuanes the least. All are linguistically related. In some of their customs and manners they also greatly resemble each other, while in others, as well as in character, they are strikingly different. Very little that may be called accurate was known of these tribes. The Tarahumaris, the most primitive of them and the least affected by Mexican civilisation, are the most interesting."

As to the relation of these people to the cliff-dwellers of the south-west, Dr. Lumholtz remarks: "Are the cave-dwellers related to the ancient cliff-dwellers of the south-western part of the United States and northern Mexico? Decidedly not. Their very aversion to living more than one family in a cave, and their lack of sociability, marks a strong contrast with the ancient cliff-dwellers who were by nature gregarious. The fact that people live in caves is in itself extremely interesting, but this alone does not prove any connection between them and the ancient cliff-dwellers. Although the Tarahumari is very intelligent, he is backward in the arts and industries. His pottery is exceedingly crude, as compared with the work found in the old cliff-dwellings, and its decoration is infantile as contrasted with the cliff-dwellers' work. The cliff-dwellers brought the art of decoration to a comparatively high state, as shown in the relics found in their dwellings. But the cave-dweller of to-day shows no suggestion of such skill. Moreover, he is utterly devoid of the architectural gift, which resulted in the remarkable rock structures of the early cliff-dwellers. These people, so far as concerns their cave-dwelling habits, cannot be ranked above troglodytes."

Prof. N. S. Shaler, of Harvard, continues his popular studies of domestic animals with a paper on "Beasts of Burden," showing the great part they have played in the civilisation of man. The article is richly illustrated.

A chatty article on British vipers is contributed to *Chambers's* by Dr. A. Stradling. This journal also contains "Wintering on Ben Nevis," by Mr. R. C. Mossman, being a description of meteorological phenomena observed during a winter's exile in the Ben Nevis Observatory. We also note a description of some of the methods adopted by the modern pharmaceutist to make the medicines he dispenses less objectionable than formerly; an article on diamonds, and others on recent developments of photography, "The Sleep of Plants," and "Nest-building Insects."

Sir Henry Roscoe writes on "The New Education" in the *Humanitarian*, and states in his article what is being done in the way of technical instruction. The same journal is the arena of a more or less heated discussion on vivisection. Lady Burton expatiates upon "The Position of Animals in the Scale of Nature," and Dr. E. Berdoe replies to Prof. Victor Horsley's criticisms which appeared in the June number. Lady Burton suggests that criminals sentenced to death should be given the option of being experimented upon or of dying a felon's death. The same idea has been put forward by another writer. In the *Sunday Magazine* we find a concluding article on "The Stuff we are made of," by Dr. J. M. Hobson.

Sir Robert Ball must have a rather poor opinion of the readers of *Cassell's Family Magazine*, or he would not offer them such "an old, old story" as that he tells in "A Talk about the Pleiades." A few remarks on the visibility of stars in the cluster are followed by some trite conclusions upon the gregarious character of the proper motions, a vague statement as to the spectra of the components, and a description of the photography of the group. All this is illustrated by two cuts from one of the author's books and a reproduction of the plate based upon the photograph taken by the Brothers Henry some years ago. Nothing but the author's reputation would have secured the insertion of such a commonplace contribution. An article of a better stamp is his sketch of the life of Sir William Herschel in *Good Words*, being the third of a series on "The Great Astronomers." This series is evidently intended to be published in book form when completed. Misconception will certainly result, however, from the description of the discovery of Uranus. From Sir Robert Ball's account, readers are led to believe that Herschel knew that the object that came within his ken in March 1782 was a planet, as soon as he had found that it was a disc capable of magnification. But it is well known that Herschel thought the object was a comet; in fact, he announced his discovery as cometary, and it was not until some months later that its planetary nature was established by considerations of the orbit it pursued. We would, therefore, suggest to the learned Lowndean professor that he would do well to modify the following statement—"Great then was the astonishment of the scientific world when the Bath organist announced his discovery that the five planets which had been known from all antiquity must now admit the company of a sixth."

The *Century* contains the third part of "Across Asia on a

Bicycle" by Messrs. T. G. Allen and W. L. Sachtleben, an article on "Coasting by Sorrento and Amalfi," and one on "The Highroad from Salerno to Sorrento," all of them being well illustrated.

In addition to the magazines named in the foregoing, we have received *Longman's*, containing "Polar Bear Shooting on the East Coast of Greenland," by Dr. Nansen, and "Chamois Hunting above the Snow Line," by Mr. Hugh E. M. Stutfield.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following are the speeches delivered by the Public Orator, Dr. Sandys, Fellow and Tutor of St. John's, on June 27, in presenting Sir John Bennet Lawes, Bart., F.R.S., Sir Joseph Henry Gilbert, F.R.S., and Prof. Mendeléef, for the honorary degree of Doctor in Science :—

(1) Salutamus tandem par nobile collegarum qui de agrorum cultura, de pecudum alimentis variis, experimentis exquisitis una elaborandis annos quinquaginta, magnum profecto aetatis humanae spatium, dedicarunt. Tot annorum autem labores non modo chartae fideles in perpetuum custodient, sed etiam saxum ingens nomine utroque insculptum inter posteros testabitur. Ab ipso autem "monumentum aere perennius" erit exactum, experimentis tam utilibus, tam fructuosis, munificentia ipsius etiam in posterum continuatis. Auguramur, nec nos fallit augurium, in agri culturae annalibus talium virorum nomina fore immortalia.

Duco ad vos Baronettum insignem, Regiae societatis socium, virum doctoris titulo bis aliunde merito ornatum, IOANNEM BENNET LAWES.

(2) Quos tot annorum labores una coniunxerunt, eos in laudibus nostris hodie divellere vix possumus. Constat tamen labores illos viri huiusce scientiae admirabili et industriae indefessae plurimum debere. Constat eosdem eiusdem scriptis, eiusdem orationibus, non modo in patria nostra sed etiam peregre maximo cum fructu esse patefactos. Cum collega suo summa concordia coniunctus, Plinii verba iure optimo posset usurpare: "nobis erat nullum certamen, nulla contentio, cum uterque pari iugo non pro se, sed pro causa niteretur."

"Felices ter et amplius
quos irrupta tenet copula."

Duco ad vos Regiae societatis socium, virum ab ipsa Regina equitem propter merita nominatum, IOSEPHUM HENRICUM GILBERT.

(3) In scientia chemica investiganda diu inter peritos quaerebatur, quaenam ratio interesset inter atomorum pondera e quibus rerum elementa constarent et vires eas, sive chemicas sive physicas, quae elementis ipsis velut propriae inhaererent. Qua in ratione penitus perscrutanda atque ad certam quandam legem redigenda nemo plura perfecisse existimatur quam vir illustris qui Siberia in remota natus, et undecim abhinc annos a societate Regia Londinensi numismate aureo donatus, hodie nostra corona qualicumque decoratur. Magnum profecto est inter tot elementa rationem certis intervallis velut circuitu quodam recurrentem observasse, eque rerum notarum observatione etiam ignota providisse. Viri huiusce ingenio etiam elementa prius inaudita mentis divinatione singulari praedicta sunt posteaque in ipsa rerum natura reperta. Quae elementa, trium gentium insignium nominibus Gallium, Scandium, Germanium nuncupata, nomen ipsius illustrius reddiderunt et Russorum famam, quantum ad ipsum attinet, feliciter auxerunt. Ergo virum de scientia chemica tam diu tamque praeclare meritum, totque titulis aliunde ornatum, hodie etiam nostrorum

"turba Quiritium
certat tergeminis tollere honoribus."

Newtoni certe in Academia honos ei praesertim debetur, qui etiam in scientia chemica Newtoni in vestigiis tam fideliter insistit, ut alumni nostri "qui genus humanum ingenio superavit" imaginem intuens, Lucreti verba paululum mutata possit usurpare :—

"te sequor, o Grantae magnum decus, inque tuis nunc
ficta pedum pono pressis vestigia signis."

Duco ad vos scientiae chemicae professorem Petroburgensem, DEMETRIUM IVANOVITCH MENDELEEF.

SCIENTIFIC SERIALS.

American Journal of Science, June.—Notes from the Bermudas, by Alexander Agassiz. The story of their present condition is practically that of the Bahamas, with the exception that at the Bermudas we have an epitome, as it were, of the physical changes undergone by the Bahamas. The development of the true reef builders, of the massive corals, is insignificant. Subsidence has brought about the existing outlines of the islands, but there is no evidence to show that the original annular coral reef was formed during subsidence. That reef has disappeared, and nothing is left of it except the remnants of the æolian ledges extending to sixteen or seventeen fathoms outside the reef ledge flats, ledges which owe their existence to the material derived from it: the former æolian hills of the proto-bermudian land.—Discovery of Devonian rocks in California, by J. S. Diller and Charles Schuchert. During the field seasons of 1884 and 1893, the U.S. Geological Survey acquired six lots of Devonian fossils, comprising about thirty species, mostly corals. They demonstrate the undoubted presence of middle Devonian deposits in California, where rocks of this age have long been looked for by geologists, more particularly since the recent discovery of Silurian fossils.—New method of determining the relative affinities of certain acids, by M. Carey Lea. This method is based on the principle that the affinity of any acid is proportional to the amount of base which it can retain in the presence of a strong acid selected as a standard of comparison for all acids. When to free sulphuric acid a salt is added in sufficient quantity to cause the whole of the sulphuric acid to saturate itself with the salt base, it is possible by means of the herapathite test to determine the exact point of such saturation. From this we can deduce the exact nature of the resulting equilibrium. A series of equilibria thus obtained with different salts enables us to determine the comparative strength of the affinities of the acids of these salts. The fact that even small quantities of weak acids added to sulphates will set free a certain quantity of sulphuric acid, can be rendered visible to the eye by a well-marked chemical reaction.—A recent analysis of Pele's Hair and a stalagmite from the lava caves of Kilauea, by A. H. Phillips. The stalagmite is of the kind characteristic of the lava caverns of Kilauea, differing very slightly from Pele's Hair in constitution, but widely from ordinary stalagmites formed by undoubted solution. They are suggestive of fused drops, which falling one on the other are at the time sufficiently plastic to be quite firmly welded together and congealed in a slightly drooping position.

Bulletin of the New York Mathematical Society, vol. iii. No. 8, May 1894. (New York: Macmillan.)—"Utility of quaternions in physics" is an analysis by Prof. A. S. Hathaway of A. McAulay's essay, which is well known to our readers (see NATURE, December 28, 1893, amongst other references). The reviewer considers it to be "of undoubted scientific value, and the work of a man of genuine power and originality," and that it will go far towards accomplishing the author's purpose of arousing serious interest in quaternion analysis.—Prof. Eneström, in a note upon the history of the rules of convergence in the eighteenth century, calls attention to two other mathematicians, in addition to those named in a notice by Prof. Cajori, in vol. ii. pp. 1–10, viz. Maclaurin and Stirling: for the former he claims "a signal place in the history of these rules."—Prof. F. Franklin concisely abstracts Dr. Franz Meyer's "Bericht über den gegenwärtigen Stand der Invariententheorie," a work which gives a remarkably full abstract of researches in the domain of algebraic forms and Invariants.—Cajori's "History of Mathematics" (pp. 190–197) is a work which Prof. D. E. Smith submits to a searching examination, the commencement of which is a severe condemnation of great part of the book, founded on a side by side comparision of Cajori's statements with those of previous writers on the subject, which he is alleged to have copied without giving due credit to the authors cited. He states the book to be weak in bibliography, and carelessly written. Its merits are that it tells the general story of the growth of mathematics in a popular way, is well printed and "altogether an attractive piece of book-making." Not having seen the work we cannot say if this witness is true, but he certainly adduces evidence which it will be hard to rebut.—"Gravitation and absolute units of force" is an abstract of a paper read before the New York Mathematical Society by Prof. W. Woolsey Johnson. Prof. Greenhill's views are

noticed. The "notes" say that in a discussion on the paper, Mr. C. S. Peirce proposed that the term "Galileo" be applied to the unit of acceleration in the C.G.S. system. We also find in them an account of the proceedings at the centenary celebration of the birth of Lobachevsky by the Physico-Mathematical Society of the University of Kazán. Further we learn that Lambert's essay (*cf.* our notice of the *Bulletin* for December 1893) is to be incorporated in a volume entitled "Die Theorie du Parallellinien" (Teübner, of Leipzig), to be edited by Drs. P. Stoeckel and F. Engel. The prime factor will be the "first book of the marvellous work by Saccheri, 'Euclid vindicated from every fleck,'" in which (in 1733) the two hypotheses which, besides Euclid's, are possible are developed, and all the results obtained which have been ascribed to Legendre. There is a list of new publications in higher and applied mathematics.

Wiedemann's Annalen der Physik und Chemie, No. 7.—Further electro-optical experiments, by J. Elster and H. Geitel. The capacity of thin layers of sodium, potassium, and rubidium applied to the walls of vacuum tubes of promoting the passage of a current when illuminated differs for different colours. For long waves, rubidium is the most, and potassium the least sensitive. If the layers are illuminated by polarised light the current intensity is greatest when the plane of polarisation is perpendicular to the plane of incidence. Electric oscillations of small period can be transferred to rarefied gas by illumination in presence of an alkali metal.—A new phenomenon attending the passage of electricity through badly conducting liquids, by O. Lehmann. This is a description of the formation of halos round the electrodes in a solution of pigments in water thickened with gelatine, sugar, or glycerine. Considerable disturbance is produced where the different coloured halos meet, while the rest of the solution remains undisturbed.—Experiments with Tesla currents, by F. Himstedt. The author gives an account of methods by which Tesla's experiments can be repeated with ordinary laboratory apparatus. High potential and rapid oscillations were produced by a Lecher wire combination used for producing Hertz oscillations.—On the demonstration of Hertz's experiments, by P. Drude. The author avoids the necessity of a high tension accumulator, as used by Zehnder, by allowing the sparks of the resonator to discharge an electroscope charged by a dry pile. The point behind the concave mirror is put to earth; also one pole of the dry pile, the other pole being connected with the electroscope and the sphere behind the mirror. When sparks pass, the leaves of the electroscope collapse partly or totally. This may be shown to a large audience by projecting an image of the electroscope on to a screen.—The change of phase of light by reflexion at thin films, by W. Wernicke. Under the name of "optical phase analysis" the author describes a method of detecting exceedingly minute impurities on the surface of polished glass or glass covered with a thin layer of gelatine. The influence of the play of cohesive force upon free molecules as regards their optical properties is investigated for pigments and the metals, with especial reference to silver.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 8.—"Thermoelectric Properties of Salt Solutions." By George Frederick Emery, late Scholar of Trinity College, Cambridge.

In a circuit formed by a metallic wire and a solution an electromotive force is developed proportionately to the difference of temperature between the junctions. The solution to be examined is put in a U-tube with an electrode and thermometer in each limb, round one of which is a hot water-jacket. δ is $\equiv$ E.M.F. per 1° C., unit δ being 10^{-4} volt. Experiments were made with acetate chloride and sulphate of zinc, and sulphate nitrate and acetate of copper. δ varied considerably with concentration. The value for pure water appears to be about 8·6, but cannot be measured directly; for some salts δ increases with concentration, for others it diminishes. In all cases examined the current would go from hot to cold through the solutions. With zinc salts amalgamated zinc electrodes were used; with the copper salts the electrode used was a fine wire projecting from the end of a drawn-out glass tube. Values of δ for mixed salts seemed to show that differences from the water value are qualitatively but not quantitatively additive. Thus δ, starting from about 8·6, tends for moderate concentrations to a nearly constant value for each salt. M. Bouty, with very strong solutions of zinc chloride, found that δ rapidly diminished, whence the entire curve for all concentrations between zinc chloride and pure water would have a point of inflexion. If, keeping the salt a fixed quantity, we use mixtures of two solvents, we get a complete curve for δ. Experiments on 1 per cent. of cadmium bromide gave good results with all solvents used; with mixtures of methyl alcohol and water with alcohol, it gave the following values:—

Methyl alcohol per cent.	δ
100·0	11·3
90·0	11·0
81·3	10·76
70·0	10·4 – 10·5
50·0	10·27
30·0	9·86
18·7	9·64
10·0	8·9
0	8·15

Water per cent.	δ
100·0	7·0
98·9	6·86
90·0	5·83
75·0	5·053
50·0	4·075
25·0	4·123
0	8·15

In the first we have an inflected curve never far from the mean, in the second a small admixture causes a large drop in δ. These two pairs of solvents represent two classes. The alcohols mix quietly without chemical action, while alcohol and water mix with evolution of heat, and change in bulk.

A few experiments, believed to be entirely novel, were made on the E.M.F. in a circuit composed of two kinds of liquid with junctions at different temperatures. Zinc sulphate 4 per cent. and weak zinc chloride gave $E/(t' - t) = 1{\cdot}36 \times 10^{-4}$ V.

Zinc acetate and zinc sulphate gave $E/t' - t = 0{\cdot}8 \times 10^{-4}$ V, $1{\cdot}05 \times 10^{-4}$ V, $1{\cdot}13 \times 10^{-4}$ V, mean value $= 1 \times 10^{-4}$ V.

Lastly, measurements of the Peltier effect at a metal-liquid junction were made with various apparatus with fairly consistent results.

For 15 per cent. copper sulphate and copper, different measurements gave the heat evolved per unit $\equiv$ H = 0·1992, 0·1927, 0·1956, 0·2078, 0·2091, 0·1952.

The last and best gives $H/T = 6{\cdot}83 \times 10^{-4} = \delta$ for the solution. Cupric nitrate with $\delta = 6{\cdot}14$ gave H = 0·1764, H/T = 6·1. Thus these thermoelectric effects are of a reversible nature.

May 10.—"The total eclipse of April 16–17, 1893. Report of results obtained with the slit spectroscopes." By Captain E. H. Hills, R.E.

This paper deals with the results obtained from the photographs of the spectrum of the eclipsed sun taken in Brazil and Africa at the total eclipse of April 1893. The instruments employed, of which there were four, were slit spectroscopes of the ordinary type, and were each arranged to take one photograph during totality. Of the four resulting photographs two were partially unsuccessful and were not measured. The two others each show a strong prominence spectrum, and on both sides of this a continuous coronal spectrum, in which latter are seen a number of very faint lines. The wave-lengths of these lines were determined by using the known lines in the prominence spectrum as reference points, and from these constructing an interpolation curve. The coronal lines, whose wave-lengths were thus fixed, were, in almost all cases, apparently identical with lines which had been observed at previous eclipses, instruments of a similar type having been employed at the eclipses of 1882, 1883, and 1886.

The prominence spectrum, as shown on the photographs, extends from w.l. 3667 to w.l. 5316. It is chiefly remarkable for the extended hydrogen series, there being eight lines beyond the one at w.l. 3699, the wave-lengths of which are given as 3692·5, 3687, 3682, 3678, 3675, 3672, 3669·5, 3667.

"Researches on Modern Explosives" (preliminary communication). By William Macnab and E. Ristori.

A series of experiments with explosive compounds has been undertaken by the authors for the purpose of studying chemical reactions at high temperatures and pressures, and of elucidating certain thermal constants relating chiefly to the specific heat of gases under such conditions. Nitroglycerin, nitrocellulose, and several combinations of these two bodies, which are used as smokeless powders, have been chiefly employed in these experiments. The results given in this communication relate princi-

pally to the amounts of heat evolved by explosion in a closed vessel, and the quantity and composition of the gases produced. The following table contains the results of some of the experiments :—

Table Indicating the Quantity of Heat, also the Volume and Analysis of the Gas developed per gram with Nitro-glycerin, Nitro-cellulose, and with several different Combinations of these two Explosives made at Ardeer Factory.

Composition of explosive.	Calories per gram.	Permanent gas.	Aqueous vapour.	Total volume of gas calculated at 0° and 760 mm.	Per cent. composition of permanent gases.						Coefficient of potential energy.
					CO_2	CO	CH_4	O	H	N	
		c.c. per gram.	c.c. per gram.	c.c. per gram.							
A. Nitro-glycerin	1652	464	257	741	63·0	—	—	4·0	—	33·0	1224
B. Nitro-cellulose (nitrogen = 13·30 per cent.)	1061	673	203	876	22·3	45·5	0·5	—	14·9	16·9	929
C. 50 per cent. nitro-cellulose (N = 12·24 per cent.) + 50 per cent. nitro-glycerin	1349	568	249	817	36·5	32·5	0·2	—	8·4	22·4	1102
D. 50 per cent. nitro-cellulose (N = 13·3 per cent.) + 50 per cent. nitro-glycerin	1410	550	247	797	41·8	27·5	0·0	—	6·0	24·7	1124
E. 80 per cent. nitro-cellulose (N = 12·24 per cent.) + 20 per cent. nitro-glycerin	1062	675	226	901	21·7	45·4	0·1	—	15·7	17·1	957
F. 80 per cent. nitro-cellulose (N = 13·30 per cent.) + 20 per cent. nitro-glycerin	1159	637	227	864	26·6	40·8	0·1	—	12·0	20·5	1001
G. 35 per cent. nitro-cellulose (N = 13·30 per cent.) + 5 per cent. vaseline + 60 ,, ,, nitro-glycerin	1280	627	236	863	26·7	39·8	0·5	—	12·8	20·2	1105

Results are also given when several recognised smokeless powders were fired under various conditions.

The authors are continuing their investigations, and are especially endeavouring to measure the actual temperature of explosion, in which direction considerable success has been attained.

June 7.—"Contributions to the Life-History of the Foraminifera." By J. J. Lister, St. John's College, Cambridge.

In this paper it is shown from an examination of a large number of specimens of *Polystomella crispa* (*Linn*), that the individuals of this species fall into two sets, corresponding with the forms A and B (of Munier-Chalmas and Schlumberger), which have been shown to exist in species of *Nummulitidæ*, *Miliotidæ*, and other families of Foraminifera. The two forms may be distinguished as *megalospheric* and *microspheric*, being characterised by a marked difference in the size of the chamber occupying the centre of the shell.

Associated with this difference in structure there is a marked difference in the nuclei of the two forms.

Individuals of the microspheric form, whose central chamber is about 10 μ in diameter, have many small nuclei distributed through the inner chambers. Evidence is brought forward to show that in this form the nuclei multiply at first by simple division, and that ultimately they give off portions of their substance, which become distributed through the protoplasm in the form of irregular deeply staining strands. The ultimate fate of the microspheric form was not traced in *Polystomella*.

The megalospheric form, whose central chamber is generally about 70 μ in diameter, has, in the usual condition, a single large nucleus which grows in size with the growth of the protoplasm, and passes from chamber to chamber, moving towards the centre of the protoplasm contained in the series of chambers. There is evidence to show that in this form, also, the nucleus parts with portions of its substance. Ultimately the nucleus disappears, and in its place hosts of minute nuclei (1–2 μ in diameter) are found, which eventually become evenly distributed and divide by karyokinesis, the entire protoplasm being aggregated about the dividing nuclei in spherical masses. Resulting apparently from this division, flagellated swarm cells, having a diameter of 3–4 μ, are produced, which escape, leaving an empty shell.

In *Orbitolites complanata* (*Lamck.*), in which species the microspheric form attains the larger size, specimens of this form, with young in their peripheral annuli (brood chambers) were examined. It was found that the protoplasm was withdrawn from the central chambers, being represented by the megalospheric young massed in the brood chambers. The young contain a nucleus in their primordial chamber, which maintains this position during a large part of the period of growth of this form. While the production of megalospheric young by a microspheric parent, which was recorded by Brady, was thus confirmed, the production of megalospheric young by a megalospheric parent was also observed in three cases.

The relation of nuclear characters to the two forms was analogous to that found in *Polystomella*, and a similar relation was found in *Rotalia beccarii* (*Linn.*) and *Calcarina hispida*, Brady.

In conclusion, the question of the relationship of the two forms, under which the Foraminifera present themselves, is discussed, and reasons are urged for regarding them as distinct from their origin.

The hypothesis that they represent the two sexes is negatived by the case of *Orbitolites* in which both forms have been found producing the young of the megalospheric form, a condition incompatible with the view that either is male.

It is suggested that the two forms are members of a recurring cycle of generations, and on this view it must be supposed, from the condition presented by *Orbitolites*, that the megalospheric form may, at least in this genus, be repeated for one or more generations before the microspheric form recurs.

June 7.—"Niagara Falls as a Chronometer of Geological Time." By Prof. J. W. Spencer.

Various estimates of the age of Niagara Falls already have been published, the maximum being 55,000 years, the minimum 6000. The author, after describing the topography and geology of the district, calls attention to the fact that the Niagara river in pre-glacial times had no existence. The peculiar extension of the chasm at the Whirlpool and the buried valley at St. David's belong to a separate and shallower buried valley,

through which the Niagara cañon has been cut. The drainage of the tableland in ancient times was across the direction of the Niagara river, and was strongly marked by bold limestone ridges, which have only been penetrated by the Falls in modern times. Even the Erie basin emptied by a route several miles west of the Niagara.

The basement of the present river channel is described, and the discharge estimated. Attention also is called to the fact that during a considerable portion of the life of the river, only the waters of the Erie basin, or 3/11 of the whole drainage of the great lakes, passed over the Falls.

From four surveys, extending over a period of forty-eight years, the mean modern rate of recession of the Falls is found to be 4·175 ft. a year. Its rate is variable with secular episodes of rapid medial recession, followed by its cessation along the axis, but with increased lateral retreat. This cycle appears to take about fifty years. This rate is, however, excessive, on account of the geological conditions favouring the rapid modern recession, but the rate taken for the mean recession under the conditions of the modern descent of the river with the present discharge is 3·75 ft. a year.

At one time a great proportion of the lake region was covered by a single sheet, or the Warren water. Upon its dismemberment—in part, at least, by the rise of the land—one large lake was formed occupying the basins of Huron, Michigan, and Superior; and another a portion of the Erie extending into the Ontario basin. The waters in these two basins were subsequently lowered, so that they fell to their rocky eastern rims; the three upper lakes discharged by way of Lake Nipissing and the Ottawa river, and the Niagara had its birth, draining only the Erie basin. Then the Niagara river descended 200 ft. In course of time the waters subsided 220 ft. more, but eventually they were raised again 80 ft. at the mouth of the Niagara, thus reducing the descent of the river from the head of the rapids above the falls to the foot of the last rapids in its course to the lake to 320 ft. During the lowest stage, Ontario lake receded twelve miles from the end of Niagara gorge, where the falls had been located at their nativity.

After a discussion of the laws of erosion, the author sketches as follows the history of the Niagara Gorge and Falls:—

First episode: Water falling 200 ft., in volume, 3/11 of modern discharge; gorge, 11,000 ft. long; duration, 17,200 years. Second episode: river descending 420 ft., in three cascades; first stage, only the discharge of the Erie waters; length of chasm, 3000 ft.; duration, 6000 years; second stage, drainage of all the upper lake; length of chasm, 7000 ft.; duration, 4000 years. Third episode: same volume and descent as in last, but the three falls united into one fall; length of chasm, 4000 ft.; duration, 800 years. Fourth episode: volume of water as at present, the level of lower lake as to-day; first stage, a local rapid making the descent of 365 ft.; work particularly hard; length of gorge, 5500 ft.; duration, about 1500 years; the second stage as at present; work easy; length of canon, 6000 ft.; descent of water, 320 ft.; rate of recession here taken as the full measured amount of 4175 ft. a year; duration, 1500 years. Thus the age of the Falls is computed to be 31,000 years, with another 1000 years as the age of the river before the nativity of the Falls. The turning of the Huron waters into the Niagara was about 8000 years ago. A difficult question was the amount of work done in each episode. This was in part determined by the position of the remaining terraces corresponding to different stages of the river, and by the changing effects of erosion.

These terraces in the lake region have been deformed by unequal terrestrial elevation, to which the changing conditions of the river are largely due. The deformation affecting the Niagara district, since the commencement of the river epoch, amounts to 2·5 ft. per mile; east of Lake Huron, 4 ft. per mile; and at the outlet of Lake Ontario, 5 ft. per mile; all in a northeastward direction. Taking the amount of movement in each district as representing also the proportional measure of time, then calculations can be made upon several of the beaches, and in terms of the age of Niagara their antiquity can be inferred. In the application of these results it appears that the rate of terrestrial uplift in the Niagara district is about 1·25 ft. a century; 2 ft. east of Lake Huron, and 2·5 ft. at the outlet of Lake Ontario.

These beaches lead to the conclusion that the beginning of the lake age was about 64,000, or possibly 80,000 years ago; assuming that its waters were not held up by ice-dams. If that were so, the date would be much less remote. If the present rate of uplift continues, the Falls will be brought to an end, before they have reached Lake Erie, by the diversion of the waters of the upper lakes, by way of Chicago, to the Mississippi, which change might be expected 7000-8000 years hence.

June 14.—"Flame Spectra at High Temperatures. Part II. The Spectrum of Metallic Manganese, of Alloys of Manganese, and of Compounds containing that Element." By W. N. Hartley, F.R.S.

The spectrum of manganese has been the subject of much investigation; the spark spectrum was examined by Huggins, Thalén, and Lecoq de Boisbaudran; the arc spectrum was studied by Ångström, Thalén, Cornu, Lockyer, also Liveing and Dewar; the flame spectra obtained from compounds of manganese were investigated by Simmler, Von Lichtenfels, Lecoq de Boisbaudran, and Lockyer, while Marshall Watts has given us accurate measurements of the wave-lengths of lines and bands observed in the spark and oxyhydrogen flame-spectra of spiegel-eisen, manganese dioxide, and other compounds of this metal.

Photographs of the spectra of metallic manganese and of manganic oxide were taken and compared. They were also compared with the spectra of the alloys of manganese. The periods of exposure varied from a mere flash in the case of spiegel-eisen when being poured into a Bessemer converter, to 30 minutes and even as much as 80 minutes with manganic oxide.

The leading features of the spectra of manganese and manganese oxide are the same, but they differ in detail, as may be observed by comparing the wave-lengths of the lines and bands in their respective spectra.

A striking group of lines, the most persistent in the whole of these spectra, is situated in the violet. The following measurements were made:—

4036·5	4034·9	Ångström, also Cornu.
4032·0	{4032·9 / 4031·8}	Ångström.
4029·5	4029·4	Ångström.

June 21.—"A Contribution to the Study of (i.) some of the Decussating Tracts of the Mid- and Interbrain, and (ii.) of the Pyramidal System in the Mesencephalon and Bulb." By Prof. Rubert Boyce.

Chemical Society, June 7.—Dr. Armstrong, President, in the chair.—The following papers were read:—The crystallography of the normal sulphates of potassium, rubidium, and cæsium, by A. E. Tutton. The author shows that the whole of the crystallographical properties of the strictly isomorphous rhombic normal sulphates of potassium, rubidium, and cæsium are functions of the atomic weight of the metal which they contain.—Observations on the nature of phosphorescence, by H. Jackson. The phenomena of fluorescence, of phosphorescence in air on exposure to light, and of phosphorescence of substances in a vacuum under the influence of the electric discharge, seem to be of the same order, and consist in a response on the part of the substances to the operation of radiant energy propagated after the manner of light in undulations of short length.—Note on the viscosity of solids, by J. Dewar. The author has investigated the viscosity of solid substances by forcing them through a narrow orifice by means of a hydraulic press; many substances, such as crystalline sodium sulphate, ammonium chloride, graphite, urea, &c., easily flow under a pressure of 30-40 tons pressure on the square inch. A number of substances, such as starch, sodium chloride, &c., could not be made to flow into wire under a pressure of 60 tons on the square inch.—Boiling points of homologous compounds; part ii., by J. Walker. The formula $T = a M^b$ which the author has previously used to represent the boiling points of members of homologous series is now applied to a number of other such series.—The action of methyl iodide on hydroxylamine, by W. R. Dunstan and E. Goulding. Attempts to prepare β-methylhydroxylamine hydriodide by the action of methyl iodide on hydroxylamine, as described by L. de Bruyn, were unsuccessful; the main product of the reaction is a trimethylhydroxylamine salt.—The reduction products of nitro-compounds, by W. R. Dunstan and T. S. Dymond. The action of various weak reducing agents on aliphatic nitro-compounds is being

examined.—Notes on meta-azo-compounds, by R. Meldola and E. S. Hanes. The authors have prepared metanitrobenzene-azo-β-naphthol and several allied compounds.—Conversion of ortho- into para-, and of para- into ortho-quinone derivatives. III. The hydroximes of the lapachol group, by S. C. Hooker and E. Wilson. The action of mineral acids on the hydroximes of lapachol and hydroxyhydrolapachol yields the same hydroxime as is obtained by the interaction of hydroxylamine hydrochloride and β-lapachone; the authors are able to deduce from these facts the structural formulæ of the substances mentioned.—The behaviour of alloys in a voltaic circuit, by A. P. Laurie. If an alloy of several metals is merely a mixture in which no actual chemical combination exists between the constituents, then the E.M.F. generated by the alloy should change gradually as the composition of the alloy changes; the existence of chemical combination should be indicated by discontinuities in the curve connecting E.M.F. and composition. The author has already shown that compounds exist in the series of Cu : Sn, Cu : Zn and Au : Sn alloys, and is applying the method indicated above to other cases.

Zoological Society, June 19.—Dr. A Günther, F.R.S., Vice-President, in the chair.—Mr. Sclater exhibited the skin of a monkey of the genus *Cercopithecus*, and pointed out that it unquestionably belonged to the local form which he had spoken of in his recent paper on the *Cercopitheci* as *Cercopithecus diana ignitus*. Mr. Sclater also exhibited the typical specimen of *Cercopithecus grayi*, Fraser, formerly in the Knowsley collection, and stated that it was the same as *C. erxlebeni*, Pucheran.—Mr. H. Scherren exhibited a bottle in which an amphipodus crustacean (*Amphithoe littorina*) had built a nest and a series of runs of sand and pieces of weed.—Prof. Ray Lankester, F.R.S., read a paper on the external characters which distinguish the two Dipnoid fishes *Lepidosiren* and *Protopterus*, and pointed out that there could be no doubt that these two forms should be referred to distinct genera.—Dr. Fowler exhibited a specimen of antlers of the fallow deer, belonging to Mr. J. A. R. Wallace, of Loch Ryan, which showed the effect of the removal of one testis on the development of antlers; and made remarks on the effect of different degrees of castration upon antlers, as shown by specimens in the museum of the College of Surgeons. The continuity of variation displayed in the total length, and lengths of brow- and tray-tines, in abnormal antlers in the Natural History Museum was also commented upon.—Mr. P. Chalmers Mitchell gave an account of his observations on the perforated flexor muscles in certain birds recently dissected in the laboratory in the Society's Gardens.—A communication was read from Messrs. R. R. Mole and F. W. Urich containing biological notes upon some of the snakes of Trinidad, B.W.I. To these notes was added a preliminary list of the species of Ophidians recorded from that island.—A communication was read from M. E. Simon containing the second portion of a memoir on the spiders of the Island of St. Vincent, based on specimens obtained through the agency of the Committee for the exploration of the Natural History of the West Indies.—A communication was read from Mr. W. E. Collinge, containing the description of a new species of slug of the genus *Janella* from New Zealand, and giving a detailed account of its anatomy.—A communication was read from Mr. R. J. Lechmere Guppy, containing an account of some Foraminifera from the Microzoic deposits of Trinidad.—Mr. Arthur E. Shipley read notes on some nematode parasites obtained from animals formerly living in the Society's Gardens.—Messrs. F. E. Beddard, F.R.S., and P. Chalmers Mitchell gave an account of the anatomy of *Palamedea cornuta* as compared with that of its allies.—A communication was read from Dr. A. G. Butler, giving an account of a collection of Lepidopterous insects made by Dr. J. W. Gregory during his recent expedition to Mount Kenia. The specimens were referred to 215 species, of which ten were stated to be new to science.

Mineralogical Society, June 19.—Prof. N. S. Maskelyne, F.R.S., President, in the chair. The following papers were read:—A chemical study of some native arseniates and phosphates, by Prof. A. H. Church, F.R.S. This paper dealt with the composition of clinoclase, linoconite, berzeliite, tyrolite, and other minerals, especially as regards the water which they contain, and the amount which is lost on drying or on heating to various temperatures. The author finds calcium and carbon dioxide to be an essential constituent of tyrolite, but in berzeliite to be due in all probability to intermixed calcite.—The occurrence of mispickel in the stewartry of Kirkcudbright, by P. Dudgeon.—A goniometer for demonstrating the relation between the faces of a crystal and points representing them upon a sphere was exhibited by Miss M. Walter. In this instrument the crystal can be turned about two rectangular axes, and each face is adjusted in the usual way by telescope and collimator; a brass sphere turns rigidly with the crystal, and by an ingenious contrivance a small mark is stamped upon the sphere corresponding to each face. The angles between the faces are then ascertained by applying a graduated great circle to the sphere.—At the invitation of the President, Dr. J. E. Talmage, of Salt Lake City, gave an account of the occurrence of gigantic crystals of selenite in Wayne County, Utah, and also described a phosphate of aluminium, so-called turquoise, recently found in Utah.

Linnean Society, June 21.—Mr. C. B. Clarke, F.R.S., President, in the chair. Mr. G. Brebner exhibited and made remarks upon specimens of *Scaphospora speciosa*, Kjellm. describing with the aid of lantern-slides the structure and mode of fructification in this and other allied algæ.—Mr. J. R. Jackson exhibited the cone of a stone pine, *Pinus Pinea*, Linn., picked up by the Comte de Paris in the Coto del Rey, Seville, which had sprouted and continued to grow for a month afterwards. This peculiarity, which had been often noticed in the larch, was said to be of rare occurrence in the pine.—Mr. Thomas Christy exhibited and made remarks on a small-berried coffee-plant from Inhambane, East Africa, somewhat similar to a variety from Sierra Leone and other parts of the West Coast. It was said to be valued for its fine aromatic bitter taste, which made it useful for flavouring beans and other material ground up and sold as coffee.—Mr. A. B. Rendle gave an abstract of a paper upon a collection of plants from East Equatorial Africa, brought home by Dr. J. W. Gregory and Rev. W. Taylor, amongst which were several new species.—A paper by the President followed, on "Tabulation Areas," in which the views of Dr. A. R. Wallace and others on geographical distribution were discussed, and the best mode of tabulating results considered. The Society adjourned to November 1.

NEW SOUTH WALES.

Linnean Society, April 25.—The President, Prof. David, in the chair.—A contribution to a further knowledge of the cystic cestodes, by James P. Hill.—Notes on Australian Coleoptera, with descriptions of new species, part xv., by the Rev. T. Blackburn. One genus and twenty-nine species from various parts of Australia and Tasmania are described as new.—On an aboriginal implement believed to be undescribed, supposed to be a hoe, by R. Etheridge. The implement described was obtained from an aboriginal tribe living on the headwaters of the Endeavour River, N.Q., about 150 miles from the coast. It consists of the columellar portion of the body-whorl of the large melon shell ground to a cutting-edge and wedged into a hole in a stick fashioned by an iron tool. The implement is probably not of local manufacture, but was obtained by barter from one of the Torres Straits Islands.—On the life-history of Australian coleoptera, part ii., by W. W. Froggatt. An account of the life-histories of beetles bred during the season 1892-3, with a notice of their food-plants.—On some naked Australian marine mollusca, part i., by C. Hedley. Under this heading a description and drawings were presented of the external appearance of *Oscanius hilli*, n.sp., a huge sea slug from Sydney Harbour and Broken Bay, of a genus not known before from the South Seas.—Observations upon the anatomy and relations of the "dumb-bell-shaped bone" in *Ornithorhynchus*, with a new theory of its homology; and upon a hitherto undescribed character of the nasal septum in the genera *Ornithorhynchus* and *Echidna*, by Prof. J. T. Wilson. The full text of the paper, a preliminary note to which was communicated at last meeting (*vide* Abstract, March 28, 1894, p. vii.).—Description of a new *Isopogon* of New South Wales, by Baron Ferd. von Mueller, K.C.M.G., F.R.S. A rare plant with always entire leaves, from the margin of the Grose Valley in the more elevated part of the Blue Mountains. With the aspect of the S.W. Australian *I. longifolius*, it is most nearly allied to *I. anemonifolius*, R.Br., which occasionally produces undivided leaves (Fragmenta, vi. 238).—Description of some new species of *Araneidæ* from New South Wales, No. iv., by W. J. Rainbow.—Two new Sydney spiders are described and figured—*Drassus perelegans* and *Cyrtarachne caliginosa*, g. et sp.n.—Australian plants illustrated, No. vii.—Genus *Notothixos*, by R. T. Baker. Two forms of *Notothixos* were

recorded whose characters do not agree with those of the three species recognised by Oliver and Bentham (but united by Baron von Mueller); and the whole five are figured.—List of mollusca collected at Green Point, Watson's Bay, by A. U. Henn, with descriptions of new species, by John Brazier. The specimens on which this list is based (in number 1365, representing 154 species) were contained in a discarded bottle found in a rock pool accessible only at very low tides. A genus new to Australia and several new species were recorded.—On a new *Patella* said to have been found at the Kermadec Islands, by John Brazier.—On a new Australian *Croton* and on a supposed new species of *Acacia*, by J. H. Maiden and R. T. Baker.—Under the name of *C. affinis*, a species allied to *C. acronychioides*, from near Tintenbar, was described. It differs from the latter species in the number and length of the stamens, the marked occurrence of petals, the persistent calyx under the fruit, the shape of the capsule (broader than long), which is both furrowed and deeply lobed, and the thin texture of the leaves.

AMSTERDAM.

Royal Academy of Sciences, May 26.—Prof. van de Sande Bakhuyzen in the chair.—Some observations on oxygen, by J. H. van't Hoff.—The remarkable fact that gaseous oxygen sometimes exhibits more energetic chemical activity in the dilute than in the more concentrated condition, has been investigated in van't Hoff's laboratory by Dr. Ewan, the course of the slow oxidation of sulphur and of phosphorus being selected for study. With phosphorus and oxygen (saturated with aqueous vapour at 20°) it was observed that for pressures of oxygen greater than 700 mm. the velocity of oxidation is excessively small or nothing at all. Below 700 mm. it increases very rapidly. This limit corresponds to that found by Joubert, below which phosphorescence begins. After reaching its maximum velocity a very simple relation exists between the rate of oxidation and the pressure of the oxygen, provided that the change in the rate of evaporation of the phosphorus, which, according to Stefan, is produced by the change in pressure, is taken into account. The rate of oxidation is then directly proportional to the pressure of the oxygen. In absence of water the oxidation also begins suddenly, but at a lower pressure (about 200 mm.). Taking into account the change in the rate of evaporation, the velocity of oxidation then reaches a maximum at a pressure which is approximately the same as that which van't Hoff formerly found to be the most favourable for the explosive combustion of phosphine. After the maximum the relation between the velocity of the reaction and the pressure could not be made out with certainty, because in dry oxygen the coating of oxide which forms on the surface of the phosphorus disturbs the regular course of the reaction. With sulphur and dry oxygen, where the slow oxidation can be conveniently followed at 160°, this relation has, however, been obtained. It appears, again taking into account the change in the velocity of evaporation, that the velocity of the oxidation is proportional to the square root of the pressure. This would appear to point to the conclusion that in the absence of water, the active part of the oxygen is only that very small part of it which is broken up into atoms. This conclusion is perhaps supported in the case of phosphorus by the composition of one of the products of the oxidation in dry oxygen, viz. P_4O.—Mr. Bakhuis Roozeboom discussed the equilibrium of solutions and solid phases formed of the system: HCl, H_2O and Fe_2Cl_6. In a three-dimensional representation the solutions which may coexist with a hydrate of Fe_2Cl_6 form a vault, whose summit lies in the melting point of the hydrate; the isotherms are not unlike half a circle. With a compound of the three components, solutions may coexist, whose compositions are represented for each temperature by a closed curve, surrounding the point which indicates the composition of the solid compound. Two of these were discovered: $Fe_2Cl_6 . 2HCl . 8H_2O$ and $Fe_2Cl_6 . 2HCl, 12H_2O$; melting points:—3° and −6°. The different ways in which the vaults for all the existing solid phases may encounter are discussed.—By diagrams and models Dr. Schoute showed that the natural connection between the homogeneous divisions of space by means of cubes and of orthic tetraikaidekahedra (*see* Lord Kelvin's paper in NATURE, March 8 and 15, 1894) is given by the known theorem, that the plane, orthogonally bisecting a central diagonal of the cube, cuts it in a regular hexagon. Every cube of a given homogeneous division in cubes, we divide into eight equal minor cubes by means of three planes, parallel to the faces. In each of these eight minor cubes we draw the central diagonal ending in the centre O of the original cube, and we divide these into two equal parts by means of planes orthogonally bisecting the diagonals. In this manner every original cube is divided into sixteen equal parts. The eight parts that surround the centre O of the original cube form a tetrakaidekahedron. The remaining "intercellular" parts form equal tetrakaidekahedra, the centres of which are the vertices of the original cubes.—Mr. Kamerlingh Onnes communicated the results of further experiments made by Dr. Kuenen in the Leiden Laboratory, "on the abnormal phenomena near the critical point." Dr. Kuenen has explained the abnormalities observed by Zambiasi, de Heen, and others, by impurities of the matter used. He has now repeated with the utmost care the experiments, from which Galitzine drew the startling conclusion, that ether above the critical temperature has very different densities according to its having been before entirely fluid or partly vapour. The differences found by Dr. Kuenen in the duly corrected densities at some degrees above the critical temperature are only slight, and probably due to the admixture of not more than a two-hundredth of a milligram of a non-coercible gas. This gas, if not air, perhaps originates by the decomposition of some ether during the sealing of the tube before the blowpipe.

BOOKS AND PAMPHLETS RECEIVED.

BOOKS.—Alembic Club Reprints, No. 6 (Clay, Edinburgh).—Nature's Method in the Evolution of Life, 1894 (Unwin).—Climbing in the British Isles: W. R. H. Smith (Longmans, 1894).—Tourist Guide to the Continent.: N.E., 1894 (30 Fleet Street).—Elektro-chemie Erste und Zweite Liefg: Dr. W. Ostwald (Leipzig, Veit).—A Selection of Photographs of Stars, Star Clusters and Nebulæ: Dr. J. Roberts (Universal Press).—The Country Month by Month, July, 1894: J. A. Owen and Prof. Boulger (Bliss).—Elementary Treatise on Natural Philosophy, 13th edition; Prof. J. D. Everett, 1894 (Blackie).—Repartition de la Pression Atmospherique sur l'Ocean Atlantique Septentrional d'Après les Observations de 1870 a 1889: par le Capitaine G. Rung, 1894.—Returns of the Agricultural Statistics of British India and Native State of Mysore, 1892-3 (Calcutta, 1894).—Malaysian Spiders, Parts 1, 2, and 3: T. and M. E. Workman (Belfast, 1894).

PAMPHLETS.—Ebbe und Fluth in Luftmeer der Erde: Prof. Dr. J. Hann (Paetel, Berlin).—Journal of the Royal Agricultural Society of England, Vol. 5, Part 2 (1894. Murray).—Proceedings of the Bath Natural History Antiquarian Field Club. Vol. 8. No. 1 (Bath, 1894).—Transactions of the Institute of Brewing, Nos. 7-8 (J. S. Phillips).

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